THE UNIVERSITY OF ZAMBIA

EFFECT OF FEEDING *Aloe vera* AND PROPOLIS ON EGG PRODUCTION AND EGG SIZE IN COMMERCIAL LAYERS

BY

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A RESEARCH PROJECT REPORT SUBMITTED TO THE SCHOOL OF AGRICULTURAL SCIENCES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF SCIENCE (AGRICULTURE)

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DECLARATION

This research report has been compiled by myself and has not been accepted in any previous application for a degree. The work recorded in this report has been done by me and all sources of information have been acknowledged by means of references.

MPANDAMWIKE MULENGA MARTHA

June, 2012
DEDICATION

I would like to dedicate this work to my Sisters; Chansa Mpandamwike, Mwansa Mpandamwike and Kalemba Mpandamwike.
ACKNOWLEDGEMENTS

It is with immense gratitude that I acknowledge the help, support and guidance of my supervisor Dr K.E.S Yambayamba, whose enthusiasm and unlimited zeal kept me going, instilling in me the qualities of being a good scientist. This project would have remained a dream had it not been for the priests, sisters and staff of MPIMA seminary farm, who offered their facilities willingly, allowing me the room to work in my own way. I am indebted to Dr M.T Daura, Mr D. Zulu and the PAZ Executive Director Mr M. Ngosa who took time to advise where necessary. My special thanks to Mr J. Enright who made me believe all things are possible. Finally I wish to thank my GOD, family and friends whose love and support is always inestimable.
ABSTRACT

Two studies involving Goldline/ Bovine Nera layers were conducted to investigate the effect of Propolis and *Aloe vera* on egg size and production. In the first study 144 layers (36 weeks old) were randomly allotted in equal numbers to four treatments in a completely randomized design (CRD), which involved feeding commercial layers marsh in combination with Propolis and *Aloe vera* administered in drinking water as follows: 1- layers fed commercial layer’s feed only (CONT1); 2- layers fed commercial layer’s feed + *Aloe vera* (ALOE1); 3- layers fed commercial layer’s feed + Propolis (PROP) and 4- layers fed commercial layer’s feed + *Aloe vera* + Propolis (ALOEPROP). Both Propolis and *Aloe vera* were administered at 2 mg/kg body weight, and 100 g of feed was given per bird on a daily basis. The study lasted three weeks. The second study involved 144 Goldline/ Bovine Nera commercial layers (40 weeks old) allotted to two treatments as follows: 1-layers fed commercial layer’s feed only (CONT2) and 2-layers fed commercial layer’s feed + *Aloe vera* (ALOE2). The same dosage of *Aloe vera* and quantity of feed were given as in the first study. The study lasted for six weeks. In both studies eggs were collected on a daily basis, counted and weighed. Two way Analysis of variance (ANOVA) and T-test were respectively applied to determine the effects of different treatments in study 1 and study 2 using Genstat. Separation of means was analyzed using Duncan’s Multiple Range test. Study 1 showed that the ALOEPROP layers laid more eggs (P<0.001) than the CONT1, ALOE1 and PROP layers. Egg production was also highest in the ALOEPROP layers (P<0.001). However no significant differences were observed in relation to egg weight (P=0.730) in all the treatments. In study 2 results showed significant differences (P=0.75) between the CONT2 and ALOE2 layers in the number of eggs collected and production. At (P<0.001) differences were also observed in the egg weight between the CONT2 and ALOE2. It can be concluded that *Aloe vera* influenced the increase in the number of eggs collected and egg production and little if any influence came from Propolis. Study 2 recorded an increase in egg weight when the control was compared to the *Aloe vera* group which was not so in the first study. This could have been because the second study was done over a long period of time to see effects.
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ACRONYMS

ALOE  \textit{Aloe vera}

ALOEPROP  \textit{Aloe vera} and Propolis

CONT  Control

ECOSOC  United Nations Economic and Social Council

FAO  Food and Agricultural Organization

PAZ  Poultry Association of Zambia

PROP  Propolis
CHAPTER ONE

1.0 INTRODUCTION

1.1 Poultry production in Zambia

The poultry industry provides formal employment to over 50,000 people and supports the livelihoods of over 23,000 small scale and backyard producers in Zambia. The performance of the industry has been a strong 20% growth per year for the past five years with the broiler industry production reaching 43 million while the layer industry recorded 2 million (PAZ, 2011). Apart from providing employment, poultry production plays an important role in providing food and cash income for the rural people as well as the national economy (FAO, 2000).

The United Nations Social and Economic Council (2011) stipulates production challenges particularly facing small scale farmers in developing countries as being lack of access to knowledge, skills, inputs, credit, markets and infrastructure. In Zambia today, small scale farmers rearing commercial layers are faced with many challenges of which feed prices and disease have been the greatest challenges. Feed consumption and its efficient utilization is one of the major concerns in commercial table egg production as feed cost is one of the major components of total cost of production. Feed alone may contribute from 60 to 70% of the total cost of production in egg type layers (Qunaibet et al., 1992; Mian, 1994). Better utilization of feed and avoiding unnecessary feed wastage could be the leading factors in minimizing total cost of production (Elwardany, 1998). A layer requires 2.5 kg of feed for 1 kg eggs produced (Ascard et al., 1995). The Poultry Association of Zambia (PAZ, 2010) reported that layer feed prices in Zambia maintained an upward momentum in 2009 on the back of rising maize and soybean prices. While production declined by 40%, feed prices went up by 45%. This has led to the massive dropping out of the small scale farmers due to increases in production costs that were beyond their reach. Other challenges being faced by small scale farmers as reported by PAZ (2010) include output of pullet chicks that affect output of point of lay and in the long run affect the rebuilding of flock stocks negatively. Problems such as packaging, product prices and input supplies still remain a challenge even when production costs seem to recover.
Of the products that come from poultry, eggs are of interest to most farmers because they are a cheap source of protein. Eggs are a common food and one of the most versatile ingredients used in cooking. In general, chicken egg laying starts at 20-22 weeks of age and an individual bird is expected to lay 320 eggs by the age of 75 weeks with consumption of 1.8 kg of feed for each dozen of eggs (Parkhurst et al., 2004). About 25% of commercial eggs in Zambia are provided by small scale farmers (PAZ, 2010). However, it is common knowledge that these farmers are faced with challenges that hamper egg production as well as egg size. In 2009, egg production in Zambia was at 1 million and went down to 715,000 eggs per day (PAZ, 2010). Egg size for most heavy laying birds in Zambia is between 46-60g (Ngosa, Personal communication). Increasing the level of production beyond 715,000 eggs per day and egg size beyond 60g would greatly benefit the farmers with regard to income.

1.2 Efforts to increase production

Scientists in different countries have been trying different products in an effort to increase poultry production. Among the natural products that have been tried are Aloe vera (barbadensis) and Propolis. Propolis has important pharmacological properties that can be used for a wide range of purposes such as anti-inflammatory and hypotensive agent, immune system stimulant, and bacteriostatic and bactericidal agent, among many other uses (Ghisalberti, 1979). All such applications have increased its pharmaceutical demand and have rendered it an interesting subject of study. Aloe vera gel on the other hand contains wound healing, anti-parasitic, anti-viral, anti-fungal and anti-bacterial properties (Reynolds and Dweck, 1999; Boudreau and Beland, 2006).

Antibiotic growth promoters have been helpful in improvement of growth performance and feed conversion ratio in poultry (Izat et al., 1990; Dibner and Buttin, 2002; Miles et al., 2006). Many studies have been carried out on using additives, including herbs, as alternatives to antibiotics, with direct or indirect effects on intestinal microflora, in poultry products (Taylor, 2001). Several studies have shown antimicrobial properties of herb extracts (Cowan, 1999; Hammer et al., 1999) which can improve intestinal microflora population and enhance health in birds' digestive systems through reduction in number of disease-making bacteria (Mitsch et al., 2004).
In Zimbabwe *Aloe vera* and *Aloe spicata* have been used to determine the extent of the usage in the health management of chickens (Mwale *et al.*, 2005). In Somalia, diarrhoea cases were treated with *Aloe vera* juice (Moreki, 2006). Yongolo, (1996) also reported the use of *Aloe vera* in Tanzania to treat Newcastle in village chicken. Other studies have been done on effects of *Aloe vera* gel mixed with broilers’ feed and on performance and morphological changes in intestines and to find out whether *Aloe vera* gel can be a suitable alternative to antibiotic growth promoters (Darabighane *et al.*, 2011). Frenkel *et al.* (2011) studied the effects of Propolis on antibody production in laying hens. Pochop *et al.* (2011) studied the effects of Propolis extracts in chicken diet against *Salmonella Typhimurium* detected by Real-Time Polymerase chain reaction. These and many more studies have been done on Propolis and *Aloe vera* in relation to the poultry industry.

In Zambia *Aloe vera* and Propolis are available although Propolis may be scarce at certain times of the year. No work has been done to ascertain the effects of these products under Zambian conditions particularly under small scale management hence the need to explore its efficacy.

### 1.3 Objectives

The overall objective was to evaluate the effect of feeding *Aloe vera* and Propolis on the productivity of commercial layers.

The specific objectives were to investigate the effects of feeding:

i. *Aloe vera* alone on egg production and egg size.

ii. Propolis alone on egg production and egg size.

iii. Combination of *Aloe vera* and Propolis on egg production and egg size.
CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 General

Agriculture accounts for 20–60% of Gross National Product in most developing countries and provides a livelihood for approximately 2.6 billion people representing 40% of the global population, including 370 million small scale farmers and up to 65% of the labour force in developing countries (ECOSOC, 2011). Access to quality services enhances the productivity and health of the animals and thus the income and welfare of individual producer households and the livestock sector as a whole. Production for small scale farmers is affected by many factors that include expensive feeds, housing, skills, environmental factors and diseases epidemiology just to mention a few. A number of infectious and parasitic diseases pose hindrances to the production and productivity of the livestock industry. Kekeocha (1978) and Dafwang (1987) reported that age and disease among others, are factors that affect the productivity of laying hens. Farmers are handicapped in disease control particularly with the infectious diseases such as Newcastle disease, which is most devastating (Bell et al., 1990; Chrysostome et al., 1995; Yongolo, 1996). Various local concoctions are used by farmers to treat diseases but not much research has been done to test the efficacy of the local treatments. Natural products such as Aloe vera and Propolis have been used mainly as ethnoveterinary medicines to treat certain ailments in poultry. Less work has however been done from a nutritional point of view for example to increase egg production and egg size.

2.2 Aloe vera

Aloe vera has been examined to have numerous properties and is among the most well-known herbs. This member of Liliaceae is similar to cactus in appearance and mostly grows in arid regions of Asia and Africa (Boudreau and Beland, 2006). Aloe vera is a stemless or very short stemmed succulent plant growing to 60-100 cm tall, spreading by offsets. The leaves are thick and fleshy, green to grey-green, with some varieties showing white flecks on upper and lower stem surfaces (Yates, 2002).
There are numerous types of Aloe plants in the world. *Aloe vera* is only one type, although it is, to be sure, the best known of the aloes. However, for the scientific name, numerous at this point favor the designation of Philip Miller, a Scottish botanist: *Aloe barbadensis*. Miller’s varieties name, barbadensis means "of Barbados". There are more than 250 varieties (some resources mentioning about 450) of Aloes in the entire world and many hybrids, mainly native to the African continent and Mediterranean. All Aloes are semi tropical succulent plants, and may only be cultivated outside in locations where there is no possibility of freezing (Akinyele and Odiyi, 2007).

Today *Aloe vera* gel is an active ingredient in hundreds of skin lotions, sun blocks and cosmetics. The gel’s use in cosmetics has been boosted by claims that it has similar anti-aging effects as vitamin A derivatives (Moghaddashi, 2011). The author also reports the use of *Aloe vera* in humans to treat cancer sores, stomach ulcers and even AIDS. *Aloe vera* consists of water, protein, polysaccharides (pectin, hemicellulose, glucomannans, acemann and mannose derivatives of which mannose-6-phosphate are a major component (Waller et al., 2000).

*Aloe extract* has been used as a local therapy in village chickens in countries like Gambia, Zimbabwe and Tanzania (Kitalyi, 1998). Much of the work that has been done on the use of *Aloe vera* in chicken has been centered on the medicinal aspect. Mwale et al. (2006) stated that *Aloe vera* leaf and juice may be used in animals internally or externally for disease and parasite control. McCorlke (1986) also stated the use of *Aloe vera* in controlling coccidiosis. The juice is put in drinking water and used in situations where birds look unhealthy, went off feed or blood is seen in droppings. Aloe extract concentration has an effect on sporulation of coccidian oocysts by killing or inhibiting growth and development of oocysts. Stress is yet another confounding factor that will affect the quality and size of an egg because exposure to stressful situations can affect the health of a flock. Stressors such as rehousing (Hughes et al., 1989), thermal extremes (Thaxton et al., 1974), transport (Rigby and Pettit, 1980), initiation of egg lay (Jones and Ambali, 1987), and molting (Holt, 2003) have all been shown to exacerbate infection susceptibility in poultry. Different housing conditions may elicit stress responses in a flock, depending on the particular breed used. Campo et al. (2008) demonstrated that hen breeds exhibit significantly higher stress responses when raised in
deep litter versus free-range housing conditions, compared with other breeds. This stress may subsequently manifest itself in increased Salmonella in the flock.

2.3 Propolis

Propolis is a natural brownish-green resinous product collected by honey bees. The word is derived from the Greek pro (before) and polis (city). Propolis is a resinous substance collected by worker bees (*Apis mellifera*) from the bark of trees and leaves of plants. It has a pleasant flavor of poplar buds, honey, wax and vanilla but it can also have a bitter taste. When burnt, it exhibits a smell of aromatic resins of great value (Nikolaev, 1978). However the color of Propolis differs depending on its source and age (Ghisalberti, 1979). It can be likened to aromatic glue. It is hard and brittle when cold, but becomes soft and very sticky when warm. This salivary and enzymatic secretion enriched material is used by bees to cover hive walls to ensure a hospital clean environment. As a natural honeybee hive product, Propolis extracts have been used both internally and externally for thousands of years as a healing agent in traditional medicine. The use of Propolis can be dated as far back as the times of the famous Aristotle where it was used in humans to heal sores and ulcers and boost the immune system. Propolis shows a complex chemical composition and its biological properties may vary according to different plant sources. In Brazil, there are many plants that could be visited by bees as sources of Propolis, whose chemical composition may differ depending on the geographic location. Brazil produces the best Propolis in the world due to its tropic and sub tropic climates and through its largest primitive forest (Trusheva *et al.*, 2006).

Chemically, propolis is complex and contains a rich variety of potent terpenes, benzoic, caffeic, cinnamic and phenolic acids. Biologically propolis has efficient activity against Gram-positive bacteria and limited action against Gram-negative bacteria (Parket *et al.*, 2005). Different researchers (Sforcin *et al.*, 2000; Trusheva *et al.*, 2006; katircio and Nazime, 2006; Yaghoubi *et al.*, 2007) have reported that Propolis antibacterial activity is attributed to a number of phenolic compounds, mainly flavonoids, phenolic acids and their esters. Flavonoids have been proven to account for many of the health giving benefits (Joseph, 2010). Flavonoids, or bioflavonoids, are a group of polyphenolic substances which are present in most plants, concentrating in seeds, fruit skin or peel, bark, and flowers. A
great number of plant medicines contain flavonoids. Propolis has important pharmacological properties and it can be used for a wide range of purposes as anti-bacterial (Ghisalberti, 1979; Mochinda et al., 1985; Pepeljnjak et al., 1985; Velikova et al., 2000), antifungal (Schneidewind et al., 1979; Dimov et al., 1991; Murad et al., 2002), antiviral (Amoros et al., 1992; Amoros et al., 1994), local anaesthetic (Paintz and Metzner, 1979), anti-inflammatory (Strehl et al., 1993; Miyataka et al., 1997), antioxidant (Sun et al., 2000; Isla et al., 2001), hepatoprotective (Gonzales et al., 1995), immune stimulating (Dimov et al., 1991), and cytostatic (Frenkel et al., 1993; Banskota et al., 2001). Lunda (quoted by Elkins, 2011) reported that propolis contains nineteen substances which belong to the flavonoid family.

Bonomi et al. (1976) conducted a study on the use of propolis in 4000 hubbard Golden hens aged 5.5 months and weighing 1.85 kg. The birds were given a mixture without and with Propolis (10, 20, 30 mg/kg). Propolis in the diet significantly increased egg production, egg weight, feed utilization and weight gain by 6.07, 1.27, 5.46 and 6 % respectively compared with the controls. The authors concluded that increase in feed intake in Propolis groups might have been due to improved bird health and higher palatability of Propolis diets. In another experiment, Hegazi et al. (1995) observed reduced mortality rate in Propolis treated birds infected with virulent new castle virus compared with untreated birds. Ghisalberti (1979) reported that inclusion of 500ppm Propolis in broilers diet improved body weight by 20 % in comparison with the control. The authors concluded that the improved effects were partially due to flavonoids and increased feed intake of Propolis diets than the control. In their experimental findings, Buhatel et al. (1983) noted that supplementation of Propolis to the ration of pullets improved feed conversion.

Propolis has different pharmacological activities; Giurgea et al. (1981) reported that daily administration of 20 mg/100 g body weight standard Propolis extract (SPE) to chicken for 15 days increased plasma total protein and gamma-globulin content. The authors also suggested that Propolis has an anabolic effect that stimulated the immunologic processes. They also reported that daily administration of 20 mg Propolis extract to chickens for 15 days changed the blood concentration of cholesterol, transaminase, total proteins and amino acids. It also stimulated the immune system. In another study, Giurgea et al. (1982) reported that chicken fed on Propolis extract showed a significant increase in serum total protein and a slight
reduction in the glycogen level of lymphatic organs. The effect of Egyptian Propolis on chicken body weight and lymphoid organs revealed an increase in body weight after one week post injection and increase thymus weight after 14 days post injection up to the end of the experiment.

Evidence from these scientific works strongly suggests that Propolis can be used from a nutritional point of view. However, given that the quality of Propolis differs according to plant sources and geographical location, scientific evaluation under local environment is important.
CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Location of Study

The study was conducted at MPIMA seminary farms in Kabwe, Central Province 14°26' S and 28°27' E. The farm is located about 140 km from Lusaka, the capital city of Zambia.

3.2 Experimental Design

Two studies were done, in the first study a randomized block design involving four treatments with a total of 144 Goldline/ Bovine Nera commercial Layers (36 weeks old), was set up. Thirty-six birds were allocated to each treatment as shown in Table 1.

Table 1: Experimental treatments for study 1

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<th>TREATMENT</th>
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<tr>
<td>Control (CONT1)</td>
<td>Layer’s marsh only</td>
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<tr>
<td>Aloe vera (ALOE1)</td>
<td>Layer’s marsh + <em>Aloe vera</em></td>
</tr>
<tr>
<td>Propolis (PROP)</td>
<td>Layer’s marsh + Propolis</td>
</tr>
<tr>
<td><em>Aloe vera</em> + Propolis (ALOEPROP)</td>
<td>Layer’s marsh + <em>Aloe vera</em> + Propolis</td>
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In the second study, 144 Goldline/ Bovine Nera commercial layers (40 weeks old) were allotted to two treatments as shown in Table 1b.

Table 2: Experimental treatments for study 2

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<th>TREATMENT</th>
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<td>Control (CONT2)</td>
<td>Layer’s marsh only</td>
</tr>
<tr>
<td><em>Aloe vera</em> (ALOE2)</td>
<td>Layer’s marsh + <em>Aloe vera</em></td>
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3.2.1 Housing and lighting

The birds were reared in deep litter system with maize bran as litter at a stocking density of 10 birds per m² to allow free movement in the house and avoid stress as a result of crowding. The house was demarcated into different treatments using wire gauze. The birds were given 16 hours of light per day, to enable them consume more feed.

3.2.2 Feeding and Water supply

Commercial layers feed bought from a commercial feed company was fed to the birds. The nutrient content of feed was as follows: Crude protein 16.51 %, Calcium 4.41 %, Phosphorus 0.47 %, Metabolisable energy 3502 cal/g. The birds were fed manually each bird consuming 0.1 kg of feed per day. Feed and water were given twice in a day, at 07:50 hrs and 14:00 hrs.

3.2.3 Preparation of Propolis Extract

About 500 g of Propolis was collected from bee hives at a bee farm in Kapiri Mposhi about 50 km north of Kabwe. The Propolis was cut into small pieces of about 4 cm³ with hands and cleaned from wood, wax and all forms of dirt debris. To make a 30 % tincture, 700 g of 96 % ethanol was added to 300 g Propolis in a 2 litre plastic container and sealed tightly with a plastic lid. The container was wrapped in a black plastic and stored in a warm dark room to avoid any light reactions. The container was shaken daily and returned to the warm dark for 2 weeks. The liquid was then filtered through a 2 mm kitchen sieve into another plastic container, the cover was set off and the extract was left to evaporate until a quarter of the content had escaped.
Figure 1. Extraction and storage of Propolis; (a) Appearance of the extract soon after extraction; (b) Appearance of the extract after 14 days

3.2.4 Preparation of Aloe vera

A 50 kg bag of *Aloe vera* barbadensis leaves was collected from Rivendell farms along Ndola road 20 km from Kitwe town centre. Using a knife, the Latex of the *Aloe vera* leaf was removed to expose the clear gooey jelly like tissue. The tissue or gel was placed in a kitchen blender for grinding. From a 50 kg sack of *Aloe vera* leaves, 4000 mls of *Aloe vera* gel was obtained and 4000 mls of water was added (1:1 ratio). The solution was put into an air tight container and refrigerated.
3.2.5 Administration of ethnopropolis and Aloe vera

The birds were weighed and an average weight was taken. Based on this, ethnopropolis and Aloe vera were added to the drinking water every morning at a rate of 2 mls/ kg of body weight. The additives were given in the morning only so as to ensure that they were consumed completely by the end of the day.
CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Study 1

Results in the first study showed that the average daily number of eggs was higher (P<0.001) in the ALOE1 and ALOEPROP layers than in the CONT1 and PROP layers (figure 3). The average number of eggs in the ALOE1 and ALOEPROP was about 32; while the average number of eggs was about 29 in the CONT1 and PROP. Similarly the calculated egg production levels were higher (P<0.001) in the ALOE1 and ALOEPROP layers than in the CONT1 and PROP layers (figure 4). The average production level in the ALOE1 and ALOEPROP layers was around 90 % while the average for the CONT1 and PROP was 80 %. However, there were no differences (P=0.73) among the treatments in terms of egg weight (figure 5) although a few eggs in the ALOEPROP and PROP tended to be heavier. These differences observed in a few of these eggs were not statistically significant and could have been by chance or indeed the effect of the Propolis which could have been manifested by a few birds due to different individual performances displayed by the birds because similar results of increased egg weight were observed by Bonomi et al. (1976) who conducted a study on the use of propolis in 4000 hubbard Golden hens aged 5.5 months and weighing 1.85 kg. The birds were given a mixture without and with Propolis (10, 20, 30 mg/kg). Propolis in the diet significantly increased egg production, egg weight, feed utilization and weight gain by 6.07, 1.27, 5.46 and 6 % respectively compared with the controls. Significant differences in egg weight might have been observed if the study had run for a few more weeks. In the present study egg production increased from 70 % to 90 %. The increase in egg production could be attributed to the presence of flavonoids found in the Propolis. Bonomi et al. 1976 concluded that the improved effects in Propolis fed birds were partially due to the presence of flavonoids and increased feed intake of Propolis diets than the control. However Buhatel et al. (1983) in their experimental findings noted that supplementation of Propolis to the ration of pullets also improved feed conversion.

Furthermore increase in production could be attributed to the presence of Aloe vera because production in the PROP and CONT1 was lower than in the ALOE1 and ALOEPROP,
showing that this positive effect could have been due to *Aloe vera* and not Propolis. The other reason for similarities between the CONT1 and PROP could be because the study was conducted over a short period of time in which the effect of Propolis could not be fully exploited, however if the change in production was due to *Aloe vera* could mean that *Aloe vera* manifests its effects quickly or is fast acting.
Figure 3. Average daily number of eggs collected from layers fed commercial layer’s feed in combination with Propolis and *Aloe vera* (CONT1 = commercial layer’s feed; PROP = commercial layer’s feed + Propolis, ALOE1 = commercial layer’s feed + *Aloe vera*, ALOEPROP = commercial layer’s feed + *Aloe vera* + Propolis)
Figure 4. Average production levels (%) for layers fed commercial layer’s feed in combination with Propolis and *Aloe vera* ((CONT1 = commercial layer’s feed; PROP = commercial layer’s feed + Propolis; ALOE1 = commercial layer’s feed + *Aloe vera*; ALOEPROP = commercial layer’s feed + *Aloe vera* + Propolis))
Figure 5. Average egg weight (g) for layers fed commercial layer's feed in combination with Propolis and Aloe vera (CONT1 = commercial layer’s feed; PROP = commercial layer’s feed + Propolis; ALOE1 = commercial layer’s feed + Aloe vera; ALOEPROP = commercial layer’s feed + Aloe vera + Propolis)
4.2 Study 2

Comparisons between the CONT2 and the ALOE2 using a T-test showed a higher average number of eggs in the ALOE2 at P=0.75 (figure 6), a higher calculated production level at P=0.75 (figure 7) in the ALOE2 as well as a higher average egg weight at (P<0.001) as depicted in figure 8. This improved performance in the birds was also observed by Durrani et al. (2011). In their study one hundred and sixty, day old chicks were randomly allotted to four different groups, designated as A, B, C and D in an open sided house. Group A, B and C received aqueous extract of aloe gel at 5, 10 and 15 ml/liter of water. Significantly higher body weight gain, dressed weight and lower feed conversion ratio was observed for broilers in group B. Olupona et al., (2010) also reported increased feed intake in groups that were treated by Aloe vera gel dissolved in water (20, 25 and 30 cm$^3$ /dm$^3$) as body weight gain. Montagne et al., 2003 concluded that Aloe vera’s effect on the intestinal health improves performance and reduces feed conversion ratio. Most of the studies done on Aloe vera have been centered on disease control (Mwale et al., 2006) and in so being the improved health of birds have had good effect on performance.

However the positive effects of Aloe vera cannot be attributed to one material found in Aloe vera as there is no direct reason to why Aloe vera gives positive results in chicken (Durrani et al., 2011). Davis et al. (1994) reported that no adverse effects have been reported in over 20 years of usage of Aloe species. Most studies were Aloe vera was used showed increased feed intake but was not the case in the present study. This increased feed intake can be attributed to changes in feed taste and stimulated appetite (Windisch et al., 2008).

However the properties of Aloe vera that makes its use beneficial in the poultry industry may stem from acemannan (Chinnah et al., 1992; Mascolo et al., 2004; Valle-paraso et al., 2005; Lin et al., 2005) and according to Reynolds and Dweck (1999) acemannans have received attention from researchers.
Figure 6. Average number of eggs collected from layers fed commercial layer’s feed in combination with Aloe vera (CONT2 = commercial layer’s feed; ALOE2 = commercial layer’s feed + Aloe vera)
Figure 7. Average egg production levels (%) for commercial layers fed commercial layer’s feed in combination with *Aloe vera* (CONT2 = commercial layer’s feed; ALOE2 = commercial layer’s feed + *Aloe vera*)
Figure 8. Average egg weight (g) for layers fed commercial layer’s feed in combination with Aloe vera (CONT2 = commercial layer’s feed; ALOE2 = commercial layer’s feed + Aloe vera)
CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

In the first study Aloe vera showed positive effects on egg production only and not egg size, however Propolis did not show any effects. Propolis groups recorded a few big eggs and this might have been due to differences in individual performance of the birds. Another reason to why Propolis could have not shown any effects would have been because the study was only ran for a few weeks due to the scarcity of Propolis at the time the study was conducted. It is however important to know the chemical constitution of the Propolis used if conclusions have to be made.

In the second study Aloe vera increased egg production and size when compared to the control. Significant differences in average egg size were seen in the second study owing to the fact that the second study was ran over a longer period of time.

5.2 Recommendations

Further studies should be done on the effect of Propolis in chickens on egg size and production under Zambian conditions for a sufficient time enough to draw conclusions.
REFERENCES


The United Nations Economic and Social council., 2011. Technologies to address challenges in areas such as agriculture and water. Geneva. May 23-27.


APPENDIX

Propolis tincture concentration procedure

1. To get the desired percent Propolis (30% tincture) in column 2, follow across to column 3 to find the amount of extract to evaporate.

<table>
<thead>
<tr>
<th>Start extract</th>
<th>Desired extract</th>
<th>% volume to reduce</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>66.7</td>
</tr>
<tr>
<td>10</td>
<td>40</td>
<td>75</td>
</tr>
<tr>
<td>20</td>
<td>30</td>
<td>33.4</td>
</tr>
<tr>
<td>20</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>30</td>
<td>40</td>
<td>25</td>
</tr>
</tbody>
</table>

If you have 30% extract and you want to have 40% you would have to let 25% of the alcohol evaporate. If you started with 1 cup, you would let it evaporate until you have 3/4 cup remaining.

2. Let the container set with the cover off until the correct amount is evaporated off. You can hurry it along by warming it up. Be careful because alcohol is flammable.
### Study 1

**Table 1. Number of Eggs**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>d.f</th>
<th>s.s</th>
<th>m.s</th>
<th>v.r</th>
<th>Fpr</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRT</td>
<td>3</td>
<td>313.685</td>
<td>104.562</td>
<td>16.69</td>
<td>0.001</td>
</tr>
<tr>
<td>Residual</td>
<td>88</td>
<td>551.304</td>
<td>6.265</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>864.989</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Production level (%)

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>d.f</th>
<th>s.s</th>
<th>m.s</th>
<th>v.r</th>
<th>Fpr</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRT</td>
<td>3</td>
<td>2420.41</td>
<td>806.80</td>
<td>16.69</td>
<td>0.001</td>
</tr>
<tr>
<td>Residual</td>
<td>88</td>
<td>4253.89</td>
<td>43.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>6674.30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3. **Average Egg weight**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>d.f</th>
<th>s.s</th>
<th>m.s</th>
<th>v.r</th>
<th>Fpr</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRT</td>
<td>3</td>
<td>71.49</td>
<td>23.83</td>
<td>0.43</td>
<td>0.73</td>
</tr>
<tr>
<td>Residual</td>
<td>88</td>
<td>4843.24</td>
<td>55.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>91</td>
<td>4914.73</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Study 2

#### Table 4. Number of eggs

<table>
<thead>
<tr>
<th>Sample</th>
<th>Size</th>
<th>Mean</th>
<th>Variance</th>
<th>Standard deviation</th>
<th>Standard error of mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Eggs for Aloe vera</td>
<td>42</td>
<td>27.40</td>
<td>18.93</td>
<td>4.351</td>
<td>0.6713</td>
</tr>
<tr>
<td>Number of Eggs for Control</td>
<td>42</td>
<td>22.67</td>
<td>20.96</td>
<td>4.578</td>
<td>0.7064</td>
</tr>
</tbody>
</table>

Difference of means: 4.738

Standard error of difference: 0.975

95% confidence interval for difference in means: (2.799, 6.677)

Test statistic $t = 4.86$ on 82 d.f.

Probability $< 0.001$
Table 5. Production level (%)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Size</th>
<th>Mean</th>
<th>Variance</th>
<th>Standard deviation</th>
<th>Standard error of mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production level of Aloe vera</td>
<td>42</td>
<td>76.12</td>
<td>146.1</td>
<td>12.09</td>
<td>1.865</td>
</tr>
<tr>
<td>Production level of Control</td>
<td>42</td>
<td>62.96</td>
<td>161.7</td>
<td>12.72</td>
<td>1.962</td>
</tr>
</tbody>
</table>

Difference of means: 13.161
Standard error of difference: 2.707
95% confidence interval for difference in means: (7.776, 18.55)
Test statistic $t = 4.86$ on 82 d.f
Probability < 0.001
Table 6. Average egg weight

<table>
<thead>
<tr>
<th>Sample</th>
<th>Size</th>
<th>Mean</th>
<th>Variance</th>
<th>Standard deviation</th>
<th>Standard error of mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average egg weight for Aloe vera</td>
<td>42</td>
<td>64.75</td>
<td>22.00</td>
<td>4.691</td>
<td>0.7238</td>
</tr>
<tr>
<td>Average egg weight for Control</td>
<td>42</td>
<td>60.20</td>
<td>0.05</td>
<td>0.226</td>
<td>0.0349</td>
</tr>
</tbody>
</table>

Difference of means: 4.550

Standard error of difference: 0.725

95% confidence interval for difference in means: (3.087, 6.013)

Test statistic $t = 6.28$ on approximately 41.19 d.f.

Probability < 0.001