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AKENTEN APPIAH-MENKA UNIVERSITY OF SKILL TRAINING AND ENTREPRENEURIAL DEVELOPMENT

COLLEGE OF AGRICULTURE EDUCATION

DEPARTMENT OF ANIMAL SCIENCE EDUCATION

MAMPONG ASHANTI

THE EFFECT OF SHADE-DRIED *MORINGA OLEIFERA* LEAF MEAL AT DIFFERENT INCLUSION LEVELS ON THE GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF QUAIL BROILERS

BY

STEPHEN ASAASIBA ASANYIRE

NOVEMBER, 2022

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STEPHEN ASAASIBA ASANYIRE

(7191910035)

A DISSERTATION SUBMITTED TO THE SCHOOL OF GRADUATESTUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF EDUCATION IN AGRICULTURE (ANIMAL SCIENCE) IN THE AKENTEN APPIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMENT

NOVEMBER, 2022

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DECLARATION

STUDENT'S DECLARATION

I, STEPHEN ASAASIBAASANYIRE declare that this thesis, except for quotations and references contained in published works which have been identified and duly acknowledged, it is entirely my own original work and it has not been submitted, either in part or whole for another degree elsewhere.

SIGNATURE:....................................

DATE: ....

SUPERVISOR'S DECLARATION

I hereby declare that, the preparation and presentation of this work were supervised in accordance with the guidelines for supervision of thesis as laid down by the AkentenAppiah-Menkah University of Skills Training and Entrepreneurial Development

NAME: DR. WILLIAM K. J. KWENIN

SIGNATURE: ....

DATE: ....

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With all my heart I will say to the Lord, there is no one like you. In line with the Psalmist, I say to you alone, O Lord, to you alone and not us, must glory be given because of your constant love and faithfulness.

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Extension of my gratitude goes finally to my family for the moral support and love they gave me. May the oil in your lamps never run dry.

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DEDICATION

I dedicate this work to My parents (Mr. and Mrs. Robert Asaasiba),My wife Belinda, my children(Glory, Grace and Giana), My siblings,(Erastus, Valentine, Perpetual, Victoria, charity, Felicia and Rebecca).

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LIST OF ABBREVIATIONS

ABBREVATION	**MEANING**
AAMUSTED:	Akenten Appiah-Menkah University of Skills Training and Entrepreneurial Development
FAO:	Food and Agricultural Organization
FCR:	Feed Conversion Ratio
INTORGWGT:	Internal Organ Weight
LSD:	Least Significant Difference
MOFA:	Ministry of Food and Agriculture
MOLM:	*Moringa oliefera* Leaf Meal

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ABSTRACT

The use of readily available feed resources in the rearing of quail has the potential of improving animal protein needs in resource-poor communities in Ghana. The leaf meal of *Moringa oleifera is* one such feed resource. However, its utility has not been assessed by quail farmers. This study was, therefore, conducted to determine the effect of *M. oleifera* leaf meal (MOLM) on growth performance and carcass characteristics of Japanese quails. Freshly harvested *M.oleifera* leaves were shade-dried for one week, milled using a hammer mill, sieved into meal and used in the formulation of the feed for the birds. A total of 120 unsexed Japanese quails were randomly allotted to four treatments with three replications each. There were ten (10) birds per replicate giving a total of 30 birds in each treatment. Completely Randomized Design was used for the experiment. Four levels of MOLM consisting 0 %, 5 %, 10 % and 15 % treatments (T1, T2, T3 and T4) were fed during the research period which lasted for 12 weeks. All the experimental diets were formulated to meet the nutrient requirements of breeder chicks according to the NRC (1994). The experimental diets were formulated at Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED) Teaching and Research Farm of the Department of Animal Science Education. The MOLM was used to mix with a commercial started and finisher diet at a rate of 0, 5, 10 and 15 g/kg (CON, MOLM5, MOLM10 and MOLM15, respectively) producing four dietary treatments. During the feeding trial feed intake and body weight gain were measured and used to calculate feed conversion ratio (FCR). The results showed that dietary treatments of MOLM had a statically significant effect ($P < 0.05$) on overall body weight gain, feed intake, FCR and dressed weight of birds. However, there were no statically significant difference ($P > 0.05$) between the varied levels of MOLM diets on live weight, bled

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weight, defeathered weight, head weight, Leg pair, intestine weight and giblet weights. The study concluded that birds' development efficiency and carcass characteristics appeared to be unaffected, Japanese quail nutrition may include *Moringa oleifera* leaf meal to enhance their growth performance and their carcass characteristics.

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TABLE OF CONTENT

CONTENT PAGE

University of Education,Winneba http://ir.uew.edu.gh

University of Education,Winneba http://ir.uew.edu.gh

CHAPTER SIX

University of Education,Winneba http://ir.uew.edu.gh

LIST OF TABLES

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the study

Nutritional problems persist in most developing nations, despite favourable economic gains and a variety of poverty-reduction efforts. The growing human population in developing countries demands the urgent need to seek out alternative protein sources to meet the population's protein requirement. (El-Katcha *et al*., 2015). A best alternative in addressing malnutritional issues is by boosting up the poultry industry and alleviating poverty and animal protein deficiencies by introducing species of birds such as quails which have a short generation interval, easy to rear with minimum capital and offer better income within a very short period.

Quail farming is said to be a short generation industry with a potential of meeting the economic and nutritional needs of developing countries (Ojo *et al*., 2014). The main purpose for the production of quails is for their meat, eggs and also is very useful for research work. There are many quail breeds under domestication but the most common breed of quails is the Japanese quail (*Coturnix japonica*) an avian belonging to the same Pheasant family as the indigenous domestic chicken (Priti and Satish, 2014). Quail carcasses are made up of 76 % of meat, 14 % of skin, and 10 % of bone, and have the highest amount of meat and the least bone ratio among the other poultry products (Gecgel *et al*., 2015).

According to a survey conducted by Mohammed and Gharib (2017) Kenya, Nigeria, Zambia and as well as Zimbabwe is few among some African countries that have introduced quail farming in their poultry industry. Thus, quail production is becoming

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a species of interest to farmers in some parts of Africa. Although quail production is growing steadily of late in Ghana since its official introduction into the Ghanaian poultry industry, its potential has not been fully exploited because most poultry farmers have limited their rearing to chicken production (Ofori, 2017). In spite of intensive research, much still remains to be discovered and verified with regard to why there is slow uptake of quail production by most farmers.

1.2 Problem statement

Despite the fact that quail farming is still in its infancy in Ghana, it has contributed in closing the gap between the population's protein deficit. Commercial poultry meat production is expanding day by day in Ghana and there is tremendous opportunity for the poultry industry to make profit (Omane *et al*., 2020). Quail farming has gotten less attention in Ghana than the most prevalent indigenous chickens and Guinea fowl due to lack of understanding about the bird and its production procedures. Despite its great commercial, nutritional, and therapeutic importance, quail and its products were apparently in short supply in Ghana (Ayim, 2019), compared to other African countries such as Kenya, Zambia, and Nigeria (Bakoji *et al*., 2013). These phenomena could be linked to a lack of scientific information and public awareness of quail farming, its potentials and advantages (Bakoji *et al*., 2013). In terms of development and egg production, quails are more profitable than native chickens. This is because the former matures quickly and begins egg laying within six weeks, whilst typical layer chickens take six months (Bakoji *et al.,* 2013). Despite the fact that quail raising appears to be attracting some farmers, its production performance remains limited in both urban and rural areas of the country, particularly in the middle zones where chicken production predominates. This may be as a result of its production standards or potentials not mastered in our environment. However, according to a study

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conducted in Ghana to examine quail growth performance, reproduction, and survival qualities, the climatic and environmental circumstances in Ghana were quite favorable for commercial quail production (Aikins *et al*., 2019). The recent increase in the price of conventional feed materials like maize in Ghana, as well as the frequent and intermittent outbreaks of chicken diseases like bird flu from neighbour countries, are key factors affecting net return from the poultry sector. The use of antibiotics as growth promoters in poultry production has been banned due to chicken products intended for human consumption.

According to Tsiko (2016), some farmers are also resorting to feeding quail broilers feed that may not be conducive to their proper or optimum performance due to high feed costs and scarcity. Feed cost reduction through the use of less expensive and an unusual feed source is an important part of commercial livestock production. *M. oleifera* leaves are high in proteins, minerals, vitamins, and amino acids such as arginine, lysine, and methionine, which are needed in poultry (David *et al.*, 2012). Their inclusion in the diets would not only assist cut feed costs, but would also minimize competition for available conventional feedstuff between humans and livestock (David *et al.*, 2012).

1.3 Objective of the study

The main objective of the study was to evaluate the growth performance of quails fed with different levels of MOLM.

1.4 Specific objectives of the study

The specific objectives of the stud+y were to determine;

1. Growth performance of quails

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2. Carcass characteristics of quails

1.5 Significance of the study

This research work will be very useful in providing ample information to both research and academic studies. This work would be very beneficial to farmers, MOFA, and researchers as well as consumers of quails and their products. Additionally, information on the growth performance, carcass characteristics of broiler quails fed with MOLM will enable quail and poultry farmers, FOA and other interested individuals make informed decisions about feed security and sustainable management as well as the economisation of feed in the poultry industry.

Furthermore, this work would be very useful in assessing the type and recommended level of feed to be fed on to quails to attain positive outcome. Also, this study can equally give clue to quail farmers as to when to gain profit from their farms.

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CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Poultry

Chicken, ducks, guinea fowls, turkeys, pigeons, quails, and ostriches are the most common poultry species kept, with chicken leading the business. According to El-Katcha *et al.* (2015), the human population in developing countries is steadily expanding, necessitating the urgent need to expand food sources, particularly animal protein. According to a survey conducted by the FAO meat protein consumption is significantly below the daily minimum of 200 grams. The majority of people in underdeveloped nations struggle on a daily basis to put a decent meal on the table, let alone get enough protein in their diet. This circumstance necessitates smallholder projects to ensure that people with little resources have access to animal protein in their diet at reasonable prices. Poultry production has grown in popularity in recent years, and it now takes pride of place among animal operations due to its high monetary turnover. Poultry is widely regarded as the poor's livestock, offering a source of income as well as a tool for poverty reduction. According to the Food and Agriculture Organization of the United Nations (FAO), 85 percent of rural households in Sub-Saharan Africa raise hens or other species of poultry (FAO, 2016). Chicken is the most important and common poultry specie in the world and its meat and eggs make a significant contribution to human nutrition.

According to an FAO data from 2016, the global meat output in 2007 was 269 million tons, with 88 million tons of chicken meat accounting for nearly 33 % of total meat production. There is, therefore, a need to introduce additional poultry species with a shorter life cycle to increase animal protein supply by complementing the

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existing poultry species. A possible species for the expansion of the poultry industry reared for both meat and egg production are the *Coturnix coturnix japonica*, commonly known as the Japanese quail. Quail production is an agricultural activity that has been seen to contribute much to food security and reduction of poverty (FAO, 2016). The demand for high-quality protein source for human consumption is remarkably increasing, hence other alternatives such as quails rearing.

2.2 Origin and Distribution of Quails

Quail, like domestic chickens, pheasants, and partridges, are tiny birds that belong to the order Galliformes and family Phasianidae (Priti and Satish, 2014). Quail's origins as a wild meat can be traced back to the Bible, which mentions God's provision for the tribe of Israel throughout their trek through the desert from Egypt to the promised land (Numbers 11:31-32). The domestication of quails is believed to have started in China when a particular subspecies that commonly migrates between Europe and Asia were raised as pets and singing birds. The domesticated Coturnix was brought to Japan from China across the Korean bridge where it was purposefully raised as a farm animal to produce eggs and meat (Onyewuchi *et al*., 2013).

Quails has not been fairly dispersed throughout the world since its introduction from Asiatic countries to the United States, Canada, Kenya, Zimbabwe, Zambia, Nigeria, Benin, and Ghana. This is due to the fact that, despite the fact that 1.4 billion quails are expected to be produced annually for meat and eggs, China accounts for approximately 80% of this total (Quail Facts & Worksheets: https://kidskonnect.com). China, Spain, France, and the United States of America are among the world's top quail meat producers, while China, Japan, Brazil, and France are among the world's top quail egg producers (Berthechini, 2012).

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Despite the fact that quail farming is still relatively new in Africa, having been introduced into the poultry sub-sector only recently, it is gaining traction in several African countries. Despite the fact that public awareness, acceptability, and patronage of quail and quail products remain low, farmers in various parts of the country have undertaken quail farming as a business since then (Ayim, 2019).

2.3 Quail farming

According to (Gomwe, 2015), quail farming is the commercial rearing of quails and other bird species for the goal of producing marketable eggs and meat. Quail is a pheasant-like poultry species (Mishra & Shukla, 2014). A male quail's behavioural behaviour is usually the production of a melodic tone sound, which might be bothersome to some individuals. Quails, unlike Guinea fowl, which are mostly raised by farmers in Ghana's northern regions, have a limited population. A lack of sufficient information on quail husbandry in local settings, for example, is one of the challenges that quail farming faces. Japanese quail have great and tastier flesh, rapid growth, high reproductive capacity, and a low feed consumption rate when compared to other avian species (Omane *et al.,* 2020). Despite the smaller sizes of quail, the nutritional value of their egg is three to four times greater than chicken eggs (Tunsaringkarn, *et al.,* 2013). Quail is a great food, as it is approved in the Holy Bible and the Holy Koran and has no religious taboos. Quails have been around for a long time and have been used as food in the Bible. According to the Old Testament record, quails appeared twice in Israel's history: once in Exodus 16.13 and again in Numbers 11:31-34. Psalms 78:26-30 and 105:39-42 both reference quails.

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2.4 Housing System in Quail Farming

Quail farming is a new type of poultry production that focuses on the intensive growing and breeding of small birds known as quails as a farming operation for egg and meat production, as well as other purposes (Aliyu, 2016). The poultry industry's overall success is thought to be influenced by the housing scheme (Redoy *et al.,* 2017). Despite the fact that quail can adapt to practically any type of weather, their housing structure must be conducive to quail farming. Under the intensive system of quail production, there are two basic housing systems: deep litter systems (concrete floor pens) and battery cage systems. Both the deep litter and battery cage systems can be utilized to raise quails without compromising their welfare, productivity, or reproductive success, as long as all biosecurity and growth standards are met (Ojedapo, 2013; Olawumi, 2015).

2.5 Challenges in Quail Farming

Despite the fact that quail farming is a simpler company to run than any other small livestock or poultry operation, the quail industry faces a number of obstacles worldwide, notably in Africa. Production management, transportation, and marketing, to name a few areas, all have these limitations. The high expense of feeding, a lack of understanding of the bird's nutritional needs, climatic circumstances, and high chick death rates due to low-quality day-old chicks and sensitivity to cold temperatures are all major production difficulties for quail farmers (Adeoti and Baruwa, 2019).

Male crowing noise, high ammonia content in their droppings, which causes an unpleasant stench, and male pecking, which can result in severe injuries and death, are some of the other production management issues. Quail cannibalism can be caused by a variety of factors including lack of feeding or drinking space, malnutrition, insufficient nesting space, overstocking, high maize levels in the diet, frequent feeding of compressed or pelleted feeds, high artificial light intensity, high environmental temperatures, and ectoparasite irritation (Redoy *et al.,* 2017).

2.6 Nutritional requirements of quails

Nutrition is one of the most important aspects that impact an animal's growth and development, including the quail. Quail nutrient requirements, like those of other animals, vary depending on their age, stage of development, and purpose of production. Mineral and vitamin supplements in female breeder feed should be offered to prevent this problem (Priti and Satish, 2014). As a result, dietary necessary nutrient requirements are critical for the birds to obtain the intended results. Despite the importance of nutrients in an animal's life, water is a necessity that cannot be overlooked. Quails should always have access to clean, fresh drinking water, as a lack of water for long periods of time can cause death in birds. Water is necessary for the movement of other nutrients such as lipids, and protein, as well as the regulation of body temperature.

2.7 Nutritive and medicinal benefits of quail meat

Quail meat is rich in health and nutritive qualities as it is packed with essential nutrients. It is delicate and white, with extremely low subcutaneous fat and cholesterol, a low-calorie value, and a high value protein of significant biological importance, making it the meat of choice for persons with high blood pressure (Tuleun *et al*., 2011). Essential amino acids like lysine, valine, and leucine, as well as non-essential amino acids like alanine and aspartic acid, are present in appropriate proportions quail meat (Genchev, 2012). Quail meat is also said to be leaner and healthier than chicken meat. Quail meat is preferred for eating by patients with cardiovascular diseases, such as hypertension and high cholesterol levels, due to these properties, particularly the low-fat content. Quail meat is also known to help children grow their bodies and minds (Monika *et al*., 2018).

2.8 Quail egg nutritional value

Both the human and animal bodies are affected by good nutrition. Human health can be improved by eating a well-balanced diet, according to nutritional composition study. Many organizations, including the Food and Agriculture Organization (FAO), are becoming increasingly concerned about alternative food security, particularly dietary sources better suited to addressing global malnutrition challenges as a result of the world's growing population, which is expected to reach nine billion by 2050 (FAO, 2017).

According to a paper on the benefits of quail eggs by Kamba (2012), quail eggs have a nutritious content four to five times more than chicken eggs, while being 5 to 6 times smaller. Quail's eggs are substantially higher in vitamins and minerals than hen's eggs, according to British medical researchers for Health; they are especially rich in vital amino acids and lack complex carbohydrates and dietary fibre (Williams, 2013). According to the same study, Chinese, Japanese, and Russian experts determined that the eggs and flesh of the Japanese quail had medical benefit in addition to their nutritional value. Regardless of age, a quail egg rejuvenates the body. Quail eggs are one of the most well-known natural therapeutic products, according to the researchers. Chinese doctors have been utilizing quail eggs as a cure for hundreds of years, according to (Kamba, 2012), with excellent results. Quail goods should be used to help patients who are currently taking medication to recover quickly,

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according to the paper. This research therefore aims at studying the effect of *M. oleifera* leaf meal on the growth performance in quail birds.

2.2.1 *Moringa oleifera*

With the current trend of rising prices for both fish and soya bean meals, other protein sources are needed. Moringa is one of the tropical leguminous plants that have the potential to replace soybean meal. The consumption of moringa (*M. oleifera*) as a protein source for poultry farming has been recently of high interest (Akangbe, 2014; Ologhobo, 2014). *M. oleifera* is one of the elevated nourishing browse plants with all parts been of food importance and medicinal properties which could help cut down on antibiotic use in poultry keeping. (Patel, 2011; Gadzirayi, 2012). Antibiotics are commonly used in poultry diets to boost production or prevent disease (Ologhobo *et al.,* 2014). Antibiotics are man-made or semi-artificial antibacterial compounds that can be given orally and are used in veterinary and human medicine to prevent illnesses, as well as for other purposes such as enhancing performance or growth in meat livestock. Because of antibiotic resistance, the use of contemporary antibiotics as growth promoters, as well as for disease prevention and treatment, is becoming inappropriate and unaffordable in underdeveloped nations (Ogbe, 2012). Antibiotics, which are non-nutritive feed additives, have a negative impact on human health. *M. oleifera* is a pan-tropical tree that has been used in human nutrition for its nutritional and therapeutic characteristics.

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2.2.2 Growth performance of birds fed with shade-dried *Moringa oleifera* leaf meal (MOLM)

Studies on growth performance of broilers fed Moringa leaf meal had a better weight gain when compared to birds fed control diet. Hassan *et al.*, 2016; Nkukwana *et al.*, 2014; reported in an experiment that birds fed diets supplemented with Moringa leaf meal at 0 %, 0.1 %, 0.2 % and 0.3 %. The result revealed that body weight gain increased significantly (P < 0.05) as the level of Moringa increased; also, the feed intake followed the same trend. Feed conversion ratio recorded better values as the level of Moringa leaf meal increased. According to Zanu *et al.* (2012), with inclusion levels of 5 %, 10 %, 15 %, and 20 % MOLM, mean body weight gain, final body weight (FBW), and feed conversion efficiency all decreased considerably (P < 0.05). Gadzirayi *et al.* (2012) recommends that the inclusion of Moringa leaf meal as protein supplement in broiler diets at 25 % inclusion levels produces broilers of similar weight and growth rate compared to those fed under conventional commercial feeds. Similarly, (Gakuya *et al.*, 2014; David *et al.*, 2012) reported that broilers fed 20 % MOLM showed better weight gain and feed conversion ratio than in control group. According to KoutElkloub *et al.* (2015). The inclusion of *Moringa oleifera* leaves meal with 0.2, 0.4 and 0.6 % levels in the diet of growing Japanese quails significantly (P<0.05) enhanced their final body weight and body weight gain compared with control group**.** In their study, Ebenebe *et al.* (2012) reported that, chicks fed on Moringa based diets performed significantly better than the birds on control group regarding Feed Conversion Ratio (FCR).

2.2.3 Carcass quality of birds fed with *M. oleifera* leaf meal (MOLM)

Meat quality is determined not only by its composition, but also by its aesthetic and sensory qualities, as well as the carcass ratio. The market value of chicken products is

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determined by their quality, as well as their safety for human consumption. The color of the skin, bones, and meat is especially important in the broiler sector. The leaves of the Moringa plant contain natural colorants called xanthophylls and carotenoids, which are important in poultry nutrition (Nkukwana *et al*., 2014). Meat quality is determined by its capacity to supply a wide range of nutrients to the consumer. Tenderness and color are two elements that influence meat quality, while color is frequently used to attract buyers. Aderinola *et al*. (2013), conducted an experiment on the utilization of *Moringa oleifera* leaf as feed supplement in broiler diet. They observed the effect of *Moringa oleifera* on the carcass characteristics of the birds. Their results indicated that live weights, breast, thigh, drumstick and shank were highest at the inclusion levels of 2.0 % MOLM. Zanu *et al*. (2012), observed yellow coloration of the bird's body parts such as beak and shanks when moringa leaf meal was fed to broilers. This could be credited to the presence of carotenoid and xanthophylls pigments in MOLM. Muscle composition changes as an animal gets older, regardless of sex, breed, or species. Quail meat has been increasingly popular among customers in recent years. Consumer reactions to poultry meat are heavily influenced by its quality.

2.2.4 Growth limit and profitability of quails

Profitability is the most important aspect in determining the industry's long-term existence as well as the farmers that produce broilers. Etuah *et al*. (2013) showed that broiler production was lucrative in Ghana, with a return on investment of 27 percent, and that the key production bottlenecks identified were high feed costs, lack of access to credit, competition from cheap chicken imports, and lack of government support. Quail farming is a financially beneficial enterprise due to its prolific egg production

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and excellent meat productivity (Zambia AgriBusiness Society, 2019). A study in Bangladesh (Rana *et al*, 2012) identified that broiler production was highly profitable and that the major factors affecting production were feed cost, cost of day-old chick, labour cost and litter cost.

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CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Location and duration of the research study

The study was conducted at the Teaching and Research Farm of the Department of Animal Science, Faculty of Agriculture Science, Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (Asante Mampong campus).

3.2 Climatic conditions

The area has a bimodal rainfall pattern, with a mean annual rainfall of roughly 1224mm. The rainy season lasts from March to July, with June being the wettest month. The minor raining season lasts between August to November. From December through March, there is a dry season (meteorological service department, 2020). Temperatures range from 22.3 ºC to 30.5ºC, with an average temperature of 26.5 ºC.

3.3 Experimental Treatment and Design

One hundred and twenty (120) unsexed Japanese quail chicks were placed into four treatment groups, replicated thrice, each with ten birds per replicate. The treatments were coded as T1, T2, T3, and T4. All of the chicks were raised in battery cage system with raised wire floors under the same climatic, management, and veterinary circumstances. During the twelve-week experiment, the birds were given unlimited amounts of feed and water. The experimental diets were prepared by mixing MOLM at 0 %, 5 %, 10 % and 15 % and designated as T1, T2, T3 and T4 respectively (Table 3.1 and Table 3.2).

3.4 Preparation of *Moringa oleifera* Leave meal (MOLM)

The plant samples used throughout this study were taken from healthy and mature naturally growing *M. oleifera*. Their collection in the same area was to avoid any soil micronutrient content variations. *M. oleifera* trees were identified by a reputable botanist and authenticated by a taxonomist. After that, fresh and green leaves were harvested using a cutlass and transported to the University campus and shade-dried for 5-7days. Following that, the branches were carefully threshed to separate the leaves from the stock in order to reduce the chaff in the feed. Later, the MOLM was milled with a hammer mill and sieved with 3mm mesh to obtain a product herein referred to as moringa leaf meal (MOLM) before being stored in air-tight bags to avoid contamination from foreign materials.

3.5 Experimental Diets

The experimental diets were formulated by mixing the moringa leaf meal (MOLM) with a broiler starter and finisher diets. The diets were formulated at four different levels with MOLM inclusions per the guideline of the NRC (1994) as presented in Table 3.1 and Table 3.2 as starter and finisher diets respectively.

Table 3.1: Proportions of feed ingredient in starter diet

Feed ingredients (kg)	T1 (0 % MOLM)	T2 (5 % MOLM)	T3 (10 % MOLM	T4 (15 % MOLM)
Moringa Leaf meal	0.00	5.00	10.00	15.00
Maize	57.5	54.0	52.5	52.0
Wheat bran	11.0	10.50	9.50	6.50
Soya bean meal	8.50	9.00	7.50	7.00
Tuna fish meal	8.00	7.50	6.50	6.00
Anchovy fish meal	12.0	11.00	11.0	11.0
Oyster shell	1.50	1.50	1.50	1.50
Vitamin premix	0.50	0.50	0.50	0.50
Dicalcium phosphate	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50
Total	**100**	**100**	**100**	**100**

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Table 3.2: Proportions of feed ingredients in finisher diet

Feed ingredients (kg)	T1 (0 % MOLM)	T2 (5 % MOLM)	T3 (10 % MOLM	T4 (15 % MOLM)
Moringa leaf meal	0.00	5.00	10.00	15.00
Maize	55.0	50.0	50.0	50.0
Wheat bran	19.5	18.5	16.5	14.5
Soya bean meal	9.00	3.50	4.50	2.00
Tuna fish meal	5.50	4.50	4.00	3.00
Anchovy fish meal	8.00	7.00	6.00	6.50
Oyster shell	1.50	7.50	7.50	7.50
Dicalcium phosphate	0.50	0.50	0.50	0.50
Vitamin premix	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50
Total	**100**	**100**	**100**	**100**

3.6 Daily feed intake

Dietary treatments and clean water were provided *ad libitum* during feeding trial. The weight of the amount of feed consumed including the remnants was recorded daily so as to determine daily and weekly feed intake. Feed served to birds was weighed into a feed trough using a sensitive electronic balance with initial values recorded. Each morning debris in feed were removed and additional feed was weighed and added to those that were getting empty. Left-over feed was measured on weekly basis and feed intake/bird/day was determined as follows:

$$\text{Feed intake/bird/week (g)} = \frac{\textbf{Amount of feed given} - \textbf{Remaining feed (g)}}{\textbf{Number of birds x 7}}$$

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3.7 Water intake

A given volume of water was given to birds by measuring it using a graduated measuring cylinder. After 24 hours the water remaining in the measuring cylinder is measured and its volume recorded. The volume of remaining water was subtracted from the initial volume to get the quantity of water consumed per day.

Water consumption was determined every morning as:

Water Consumed (l) = Water Served (l) – Left-over Water (l).

$$\text{Water consumed per bird} = \frac{\text{Volume of water consumed}}{\text{Number of birds}}$$

3.8 Weight gain

Weight gain is the total weight an animal has gained for a given period of time. The weight of the birds was taken weekly to determine their weight gain. Weight gain after every week was deducted from their initial weight before the commencement of the research. These records were gotten using a digital weighing scale and they were used to compute average weight gain of the experimental birds. The weight gain in a week was calculated as:

Weight gain = Ending weight – Starting weight

$$\text{Also, Weight gain per bird per week} = \frac{\text{Overall weight gain (Kg)}}{\text{Number of birds}}$$

3.9 Dressing Percentage

The dressed carcass is an eviscerated and beheaded bird with shanks removed, as well as the gizzard and neck. The dressing percentage was computed using the relationship shown below.

$$\text{Dressing percentage} = \frac{\text{Weight of dressed carcass}}{\text{Live Weight of bird}} \times 100$$

3.10 Feed Conversion Ratio (FCR)

It is the amount of feed used to produce one kilogram of body weight. It was calculated by dividing the amount of feed consumed from 0 to 10 weeks by the average weight gain of the birds over the same time period. The feed conversion ratio (FCR) was calculated as the ratio of feed intake to total body weight gain.

FCR = Total feed intake (g) x Total body weight (g)

Arithmetically, FCR = $\frac{\text{Total feed intake (g)}}{\text{Total body weight (g)}}$

3.11 Carcass Characteristics

At the conclusion of the trial, two chicks were selected at random from each cage whose bodyweights were closest to the mean body weight of their respective groups. The birds were fasted for 24 hours to allow the stomach to empty and reduce the impact of digesta on live body weight at slaughter. The chosen chicks were weighed and kill instantly by making an incision to cut the jugular veins. The slain chicks were left to bleed and were manually defeathered. The giblet as well as the head and other visceral organs, were weighed and their values recorded using a digital balance scale.

The dressing percentage was calculated as:

Dressing percentage = $\frac{\text{Dressed carcass weight}}{\text{Slaughter weihgt}} \text{x } 100$

3.12 Statistical Analysis

Experimental data was analyzed using STATISTIX 9.0 (2008) and the means separated by LDS at 5 %.

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CHAPTER FOUR

4.0 RESULTS

4.1 Effect of MOLM (*Moringa oleifera* leaf meal) on the Growth Performance of Quail Broilers

The effect of MOLM on Growth performance of quail Broilers is presented in Table 4.1

Table 4.1; Effect of MOLM on Growth Performance of Quail Broilers

‘	**Treatments (inclusion levels of MOLM)**					
Parameters	**T1 (0 %)**	**T2 (5 %)**	**T3 (10 %)**	**T4 (15 %)**	**LSD**	**Sig**
Live weights (g)						
Day old weight	6.8333	6.7333	6.8100	7.0000	0.9329	ns
3 wks weight	39.753^{a}	34.400^{b}	39.063^{a}	38.270^{a}	1.9339	***
6 wks weight	82.463^{d}	85.713^{c}	88.250^{b}	90.000^{a}	1.4882	***
9 wks weight	15 8.18^{c}	163.34^{b}	163.89^{ab}	165.80^{a}	2.0441	***
12 wks weight	202.17^{b}	210.00^{a}	210.00^{a}	207.67^{ab}	5.6811	***
Feed intake (g)						
wk 1-3	4.2167^{a}	3.4667^{b}	3.4300^{b}	3.2967^{b}	0.3327	***
Wk 4-6	6.1567^{a}	5.9267^{b}	5.9300^{b}	5.8267^{b}	0.2147	*
Wk 7-9	8.9633^{a}	8.7200^{b}	8.5867^{c}	8.5100^{c}	0.1279	***
Wk 10-12	9.7933	9.7867	9.6967	9.7300	0.3570	ns
Weight gain(g)						
1-3 wks	1.5800^{a}	1.3133^{c}	1.5333^{ab}	1.4900^{b}	0.0791	***
4-6 wks	2.0333^{b}	2.4433^{a}	2.3467^{a}	2.4600^{a}	0.1252	***
7-9 wks	3.6067	3.6933	3.6033	3.6133	0.1123	ns
10-12 wks	2.0933	2.2200	2.1967	1.9967	0.2561	ns
FCR						
Wk 1-3	2.6633^{a}	2.6400^{a}	2.2367^{b}	2.2167^{b}	0.2535	**
Wk 4-6	3.0267^{a}	2.4333^{b}	2.5300^{b}	2.3633^{b}	0.1859	***
Wk 7-9	2.4867^{a}	2.3633^{b}	2.3833^{b}	2.3567^{b}	0.0828	*
Wk 10-12	4.6833	4.4200	4.4167	4.8800	0.4921	ns

^{abc}Means in the same row with different superscripts are significantly different (P<0.05), LSD = Least significant difference, MOLM= *Moringa oleifera* leaf meal, Significance: ns=no significant, *= P<0.05, ** =P<0.01, *** = P<0.001

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From table 4.1 varied MOLM regimes had no significant ($P > 0.05$) effect on Day old weight of the birds. The results indicated that, there was significant ($P < 0.05$) effect of MOLM on body weight at 3wks, 6wks, 9wks and 12wks. Also, MOLM had a significant ($P < 0.00$) effect on feed intake at 1-3weeks, 4-6weeks and 7-9weeks in the experiment except in 10-12 weeks which showed no significant difference ($P > 0.05$) for feed intake in the experiment. It was observed that, birds on the 0 % MOLM had the highest feed intake as compared to those on the treatment diet.

From Table 4.1 it was observed that, varied levels of MOLM had a significant ($P < 0.05$) influence on the daily weight gain of birds at 1-3weeks and 4-6weeks in the study. For weeks 1-3, birds on T1 recorded significantly ($P < 0.05$) the highest weight similar to T3 birds, followed by T4 and the least by T2 birds. However, T1 birds recorded significantly ($P < 0.05$) lower weight gains than birds on MOLM diets (T2, T3 and T4 birds). The result from Table 4.1 also, indicated that varied levels of MOLM had a significant ($P < 0.05$) effect on the feed conversion ratio (FCR) of quails at 1-3weeks, 4-6weeks and 7-9weeks. Generally, quails on control diets (T1) recorded significantly ($P < 0.05$) higher FCRs than quails on MOLM diets. There was no significant difference ($P > 0.05$) of MOLM inclusion in the diet at 10-12 weeks in the experiment.

4.2 Effect of MOLM (*Moringa oleifera* leaf meal) on Carcass Characteristics of Quail Boilers

Table 4.2 represents the effect of MOLM in Carcass Characteristics of Quail Broilers

Table 4.2; Effect of MOLM on Carcass Characteristics of Quail Broilers

	Treatments (inclusion levels of MOLM)					
Parameters	**T1 (0 %)**	**T2 (5 %)**	**T3 (10 %)**	**T4 (15 %)**	**LSD**	**Sig**
Live weight (g)	217.02	215.25	214.78	216.22		ns
Bled weight (g)	189.17	190.79	192.12	192.21	21.09	ns
Defeathered weight (g)	179.12	180.74	184.23	184.20	24.29	ns
Dressed weight (g)	164.59^{ab}	164.69^{ab}	162.31^{b}	165.26^{a}	2.41	**
Dressing percentage (%)	75.84	76.51	75.57	76.43	14.70	ns
Head weight	6.97	6.87	7.06	7.40	0.86	ns
Leg pair (g)	3.18	3.25	3.16	3.00	0.26	ns
Intestine weight (g)	11.05	13.72	12.66	13.33	2.69	ns
Giblet weight (g)	11.75	11.34	11.80	11.49	2.00	ns

^{ab} Means in the same row with different superscripts are significantly different (P < 0.05), LSD = Least significant difference, MOLM= *Moringa oleifera* leaf meal, Giblet = dressed liver, heart and gizzard, Significance: ns=no significant, *=P<0.05, ***=P<0.00

The result from Table 4.2 showed that there was a significant difference (P < 0.05) in dressed weight of quails fed different levels of MOLM in diets. Quails fed 0 % MOLM (T1) did not differ significantly (P > 0.05) from those on T2 and T3 for dressed weight. T1, T2 and T4 did not also differ significantly (P > 0.05) but differences existed between T4 and T3 (P < 0.05). However, other carcass parameters

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such as bled weight, defeathered weight, dressing percentage, head weight, leg pair weight, intestine weight and giblet (dressed liver, heart and gizzard) weight did not record any significant differences ($P > 0.05$).

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CHAPTER FIVE

5.0 DISCUSSIONS

5.1 Effect of MOLM (*Moringa oleifera* leaf meal) on the Growth Performance of Quail Broilers

Growth performance as affected by dietary treatments is explained in Table 4.1. The significant differences in body weight at 3, 6, 9 and 12 weeks recorded in this study confirms previous findings by Nkukwana *et al.* (2014) who worked with diets containing moringa levels ranging from 1 to 5 percent who observed that the mean final body weights of growing Japanese quails recorded no statistically significant difference between the four treatments. The literature is highly controversial with respect to the use of Moringa in poultry feeding. These results were similar to those found in this study, in which no differences were observed at the inclusion levels tested for live weight. This study however contradicts previous findings by other authors who indicated moringa leaf meal promoted good growth and productivity in poultry is attributed to its nutrients and phytochemicals.

Also, Portugaliza and Fernandez (2012) observed that adding *Moringa oleifera* aqueous leaf extracts in drinking water significantly decreased feed intake of broilers as the concentration increased. In this study, adding moringa beyond 15 % compromised growth performance of the quails, which can be due to higher levels of antinutritional factors (tannins, oxalate, saponins, phytates and fibre) that makes moringa leaves to have a bitter-taste rendering the diets-containing moringa unpalatable and poorly digested at higher inclusion levels (Tesfaye *et al.,* 2012).

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Body weight gain at all ages (1-3 weeks and 4-6 weeks) is in line with the findings of Nwogor and Ifeyinwa (2017) who concluded in their study, that the inclusion of MOLM is concentration dependent, with moderate concentration (10 % MOLM) showing better weight gain than higher ones (20 % MOLM). The birds on the T2 (5 % MOLM) had the highest weight gain than the control group and others that received diet with 10 % and 15 % (MOLM). This study confirms previous findings by Walaa *et al*. (2018) who indicated moringa leaf meal promoting good growth and productivity in poultry is attributed to its nutrients and phytochemicals. Also, Ebenebe *et al.* (2012) reported high performance of livestock fed on moringa based diet.

The significant differences in feed conversion ratio (FCR) at 1-3 weeks, 4-6 weeks and 7-10 weeks recorded in this experiment is in agreement with the findings of (Walaa *et al.,* 2018) who reported that feed conversion ratio (FCR) was significantly ($P < 0.05$) affected by adding moringa to the diets. The birds fed 0 % (MOLM) had the highest FCR followed by 5 % MOLM, 10 % MOLM and 15 % MOLM having the least FCR in the study. Feed conversion ratio decreased with increasing level of MOLM in the diet. This can be explained by the decrease in feed intake and high weight gain associated with increasing level of MOLM in the diet. This result agrees with the conclusion of Ayssiwede *et al*. (2012) and Houndonougbo *et al*. (2012). This result is nearly similar to those of Ashong and Brown (2011) who reported that birds fed with control diet had higher feed intake compared to other groups of chickens fed *Moringa oleifera* leaf meals.

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5.2 Effect of MOLM (*Moringa oleifera* leaf meal) on Carcass Characteristics of Quail Boilers

The effects of different dietary treatments on carcass parameters are shown in Table 4.2. Even though numerical differences were recorded in the present findings, the results revealed that MOLM inclusion levels in the diets had no statically significant difference (P > 0.05) on live weight, head weight and leg pair weights of the birds. The birds fed (0 % MOLM) recorded the highest mean value for live weight, followed by T4 (15 % MOLM) then T2 (5 % MOLM) while T3 (10 % MOLM) recording the least mean value. However, the head weight increases with increasing MOLM inclusion levels with T1 (0 % MOLM) recording least mean value and T4 (15 % MOLM) recording highest mean value. The lowest average value for the leg pair was obtained for T4 (15 % MOLM), followed by T3 (10 % MOLM). The largest value was obtained by T2 (5 % MOLM), followed by T1 (0 % MOLM). Although there were observable differences in their numerical values, there were no statistical difference (P > 0.05) in the various treatments.

The present results are in agreement to the findings of Safa and Tazi (2012), who indicated that none of the parameters measured for carcass characteristics in birds fed with *M. Oleifera* leaf meal were significantly affected. These findings are congruent to that of Nwogor and Ifeyinwa (2017), who concluded in their study that, the inclusion of MOLM is concentration dependent, with moderate concentration (10 %) showing better head weight than (0 %). Although, there were obvious differences in the treatment values for bled and defeathered weights, they were found not to be statistically significant (P > 0.05). The lowest average value for both bled and defeathered weight were obtained for T1, T2 followed by T4 and the highest by T3, there were no statistically significant difference (P > 0.05) in the various treatments.

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Hence, it implies that all the treatments have the same effect on both bled and defeathered weights.

As shown in Table 4.2, the dressing weight trended similarly to other investigations by (David *et al*., 2012; Nkukwana *et al.,* 2014; Safa *et al.,* 2014). According to the study's findings, feeding MOLM to quail broiler chicks could increase their dressed weight. On the other hand, the current findings differ from those of Zanu and Asiedu (2012), who claimed that adding MOLM to broiler diets at various amounts (5, 10, and 15 %) had no impact on dressed weight. The therapy T3 (10 % MOLM) worked badly when the dressed weight was taken into account, whereas the treatments T4 (0 % MOLM), T2 (5 % MOLM), and T1 (0 % MOLM) were all successful. Furthermore, the addition of MOLM had no impact on the dress percentage.

Expressed in Table 4.2, the inclusion of MOLM in diets of quails did not result in significant difference ($P > 0.05$) in dressing percentage. This finding is consistent with the findings of Cui *et al*. (2018), who reported no significant responses on carcass traits in broilers which were fed a basal diet supplemented with 0, 1, 2, 5, 10, and 15 % MOLM, respectively. The current study is however not similar to findings by Karthivashan *et al*. (2015) who reported that broiler feed 0 %, 0.5 %, 1.0 %, and 1.5 % of MOLM extracts supplementation, had significantly ($P < 0.05$) higher dressing percentage compared to control group, while 1.0 % MOLM showed the highest dressing rate.

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Considering the intestine weight, it was clearly seen that T2 (5 % MOLM) had the highest average value, followed by T4 (15 % MOLM) and then T3 (10 % MOLM), while T1 (0 % MOLM) had the lowest average value. There was no significant difference ($P > 0.05$) in the average intestine weights of the various treatments. Results in current study confirm findings in previous studies by Shaba *et al*. (2016) who reported no differences on viscera macromorphometry.

The giblets (dressed liver, heart and gizzard) weight were taken into consideration and the results as clearly presented in Table 4.2 indicated that, T4 (15 % MOLM) obtained the highest average value followed by T3 (10 % MOLM), then and T1 (0 % MOLM) in that order. However, T2 (5 % MOLM) obtained the lowest average value. Despite records in numerical differences, there were no significant difference ($P > 0.05$) in the average value for the various treatments under consideration. The non-significant difference found in giblets weight of quail broiler chicks in all treatments are similar to the finding of Zanu *et al*. (2012) and Safa and Tazi (2012) who confirmed that, none of the parameters measured for carcass characteristics in birds fed with diets containing *Moringa oleifera* leaf meal were significantly affected by inclusion of Moringa leaf meal.

Conclusion can therefore be made to the fact that the T1 (0 % MOLM) and T2 (5 % MOLM) performed equally with regards to their effect on internal organ weight and they were both better than T3 (10 % MOLM) and T4 (15 % MOLM) treatments.

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CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Based on the findings of this experiment, the following conclusions were made:

- In the experiment, the quails' feed intake, weight gain, FCR, live weight and dressed weight were significantly affected by the different levels of MOLM inclusion.
- Different levels of MOLM inclusion had no significant effect on head weight, internal organ weight, and leg pair weight of the birds in the experiment.
- Because the experimental birds' development efficiency and carcass characteristics appeared to be unaffected, Japanese quail nutrition may include *Moringa oleifera* leaf meal to enhance their growth performance and their carcass characteristics.

6.2 Recommendations

This study makes the following recommendations:

1. It is recommended that up to 15 % MOLM inclusion is ideal for weight gain in quail farming.
2. Further studies should be conducted to investigate the effect of MOLM inclusion on the haemato-biochemical indices and sensory attributes of quails.

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