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Evaluation Of Termite (*Macrotermes Subhyalinus)* Meal As An Alternative Protein On The Performance Of Broiler Chickens.

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APPROVAL FORM

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The undersigned certify that they have read the dissertation and it is suitable for submission to the Faculty of Science and checked for conformity with the Faculty.

Supervisor: **Date…23/09.2024...**

Chairperson: **Date: 3/10/24**

DECLARATION

I, Clara Panashe Chirwa ,declare that this research herein is my work and has not been plagiarized from another source(s) without the acknowledgement of the concerned author(s), electronically or otherwise.

Signature ……. Date………. **05/06/ 2024**

DEDICATION

This research project is dedicated to my family.

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LIST OF ACRONYMS

LMAC-Livestock and Meat Advisory Council

FCR- Feed conversion ratio

TM-Termite meal

AWG- Average weekly gain

AWFI- Average weekly feed intake

ANOVA- Analysis of variance

ABSTRACT

The rising cost of conventional feed ingredients has prompted the need to look for alternative feed resources in order to reduce the cost of poultry feeds. The termite (*Macrotermes subhyalinus)* meal as an alternative protein feedstuff in the broiler diet was investigated in this research. The growth performance, meat quality of broiler chicks and the factors influencing the use of termites as a protein supplement were assessed. Twenty-four 1-day old broiler chicks, twelve males and twelve females were assigned to four dietary treatments, commercial conventional feed,75% termite meal,50%termite meal and 25% termite meal. For each treatment, there were six chicks with equal number of male to female ratio. The amino acid profile of the termite meal was analyzed using the Kjeldahl method,with 44.5% crude protein ,26.6% fat content and 8.3% moisture content.After four weeks the chickens were weighed and the food conversion ratio on the proposed diets were also calculated. An ANOVA test was done to compare the means of the four groups in four weeks and the p value was ,p=0.00 for FCR in relation to time and p=0.043 for FCR in relation to the proposed diets(proposed treatments. A normal distribution test was done on the treatments and all the p values analyzed were >0.05 . Based on the proximate profile of termites, it was found that there is need to carry out extensive research on their nutritional value in order to enable their use in smallholder poultry production. The termite meal did not significantly affect meat quality. Overall, the termite meal inclusion in broiler diet is acceptable as a protein feed meal as well as an important step towards the improvement of poultry production in Zimbabwe.

LIST OF TABLES

LIST OF APPENDICES

TABLE OF CONTENTS

CHAPTER ONE: INTRODUCTION

1.1 Background to the study

Zimbabwe's economy is mainly supported by agricultural activities, contributing over 40% of income through exports (Mapiye, *et al.* 2008). One of the fast-growing agricultural activities in Zimbabwe is poultry farming, especially the broiler chickens. However making profits from this business has become problematic because of the rising production costs that are influenced by the highly inflationary macroeconomic environment (Phiri, Ruzhani, Madzokere, Madududu , 2023). Broiler chickens have assumed an important role in the livelihoods of urban, peri-urban and rural households in Zimbabwe (Gororo and Kashangura, 2016). The Livestock and Meat Advisory Council (LMAC), (2013) reported that 70% of all commercial day-old chicks produced in Zimbabwe are broilers, and emerging, relatively small-scale informal producers account for the bulk (65%) of production. Change in climate is affecting feed raw materials availability and as such the need for more research on how to sustain the poultry section (FAO 2017). The recent innovation in poultry industry is to identify and utilize alternative cheap animal origin protein sources in poultry feed (Laudadio et al., 2012). In any kind of poultry production, feed is the major cost because same feed materials are shared by both human and birds (Dhama et al., 2015). As the major expenditure on poultry industry is towards the feed constituting approximately 60–70 per cent of the total recurring expenditure, one of the major approaches of research in poultry nutrition should involve in producing both economical and quality rations (Khan et al., 2010). This may be based on the substitution of locally available feed ingredients both conventional as well as non-conventional (Chand et al., 2014; Khan et al., 2014; Dhama et al., 2015).

1.2 Problem Statement

Feed ingredients are needed in chicken production which do not only have good nutritive value but must also be cheaper than the other conventional protein sources such as soya bean (Tufarelli et al., 2012). Soya bean (*Glycine max*), for example, is a valuable source of protein to meet dietary requirements of broiler chickens. However, the domestic production of soya bean in Zimbabwe has been grossly inadequate for local utilization. Zimbabwe's the soya bean production has declined over the years due to El Nino induced droughts lead (Livestock and Meat Advisory Council (LMAC) (2013). Feed is the biggest expense in any type of chicken production (Dhama et al., 2015). Therefore, finding and using cheaper alternative sources of animal origin protein in chicken feed is a new invention in the poultry business (Laudadio et al., 2012). Since feed accounts for between 60 and 70 percent of the industry's overall recurrent costs, one of the main focuses of research on chicken nutrition should be on creating diets that are both affordable and high-quality (Khan et al., 2010). This means therefore substituting conventional and non-conventional feed components that are readily available locally (Chand et Dhama et al., 2015). Recently, different species of insects have emerged as a new alternative protein source in animal feed (Martínez-Sánchez, Et al. 2014).This study focused on the use of the termite *M.subhyalinus* as a supplement for proteins in chicken feed in Zimbabwe.

1.3 Aim of the study

To investigate the impact of incorporating *M.subhyalinus* meal as an alternative protein source in broiler chicken diets on growth performance, feed efficiency, nutrient utilization, and meat quality parameters.

1.4 Objectives

- To determine the proximate composition of amino acids in *Macrotermes subhyalinus* meal.
- To determine the feed conversion efficiency of broiler chicken fed on *M.subhyalinus* supplemented feed.
- To determine the meat quality of broiler chickens fed on *M.subhyalinus* supplemented feed in terms of the texture, taste, aroma, appearance ,pH and the water holding capacity of the meat.

1.5 Research questions

- What is the proximate composition of amino acids in the termite meal?
- What s the feed conversion ratio of broiler chickens fed of the termite meal?
- Is the meat derived from broiler chickens fed of termite meal of good quality in relation to its texture,appearance,aroma, taste, pH and water holding capacity?

1.6 Research Hypothesis

H_0: There is no significant difference between the feed conversion ratio(feed conversion efficiency) on termite (*M.subhyalinus*) meal and the feed conversion ratio on commercial poultry feed on broiler chickens.

H_1: There is significant difference between the feed conversion ratio on termite (M. *subhyalinus*) meal and the feed conversion ratio on commercial poultry feed on broiler chickens.

1.7 Significance of the study

Conventional chicken feed is relatively expensive for small scale poultry farmers. Therefore, there is need to develop or use alternative protein supplements that are cheaper and easily accessible to the farmers. Identification of such cheap protein alternatives such as *M. subhyalinus* meal would help resource poor farmers not only to cut down their production costs, but also to improve the efficiency of their production.

1.8 Limitations of study

Due to financial constrains the researcher had to use a small number of chickens as a way to reduce the expenses that would be incurred during this research.

1.9 Delimitation

The results from this investigation cannot be generalized for all breeds of chickens .Termites used were obtained from one part of the country and may not have the same characteristics as other termites from other parts of the country.

1.10 Definition of terms

Broiler chicken - a hybrid of chickens designed to grow rapidly ,which is specifically raised for meat.

Termite - small insects that live in colonies,consuming wood as their primary food source.

Food conversion efficiency - a measure of how much feed is required to produce a certain amount of a desired output in this instance the weight of the chickens was the output accessed.

Proximate composition- it is the composition of the biomass regarding the moisture content, volatile matters, ash content, and fixed carbon in a sample.

CHAPTER TWO

LITERATURE REVIEW

2.1 Chicken protein supplements in diet

Chickens, like all animals, have the biological machinery to produce proteins within their bodies. However, chicken cannot synthesize all the necessary amino acids required for their growth, health, and overall functioning. Just like humans, they can only produce some of these amino acids independently. The remaining essential amino acids must be obtained through their diet. These essential amino acids play critical roles in processes such as muscle development, feather growth, immune function, and the production of enzymes and hormones (Al - Hayani and Waleed,2017). Therefore, to ensure that chickens receive a complete and balanced diet, it is important to provide them with feed that contains a proper balance of all essential amino acids. By supplementing the chickens' diet with protein sources that contain a full spectrum of amino acids, farmers can ensure that their chickens receive all the necessary building blocks for healthy growth and development.

In broiler chicken diets, lysine and threonine are amino acids which have a crucial role in growth and overall performance. Lysine is an essential amino acid that is greatly employed for body protein synthesis in broiler chickens (Qaisrani, Ahmed, Azam, Bibi, Saima, Pasha and Azam, 2018).It is the second limiting amino acid in broiler chicken diets based on corn-soybean.Threonine is the third limiting essential amino acid after methionine and lysine in corn-soybean-based diets for broilers. Dietary imbalance of threonine can result in poor growth performance inbroilers(Ishii, Shibata, Kai, Noguchi, Hendawy, Fujimura and Sato,2019). Interestingly, increased threonine levels in broiler diets have been associated with improved growth and productive performance (Al - Hayani and Waleed, 2017).The nutritional value of insects is extremely versatile due to different factors like the environment where the terimtes are in and the diet they are exposed. There has been research where other insect species shown to be rich in lysine, threonine and tryptophan while other species do not contain these amino acids in adequate quantity.For example the termite *Macrotermes bellicoccus* has been found to be a good source of lysine and tryptophan while some other species of termites are not (Sogbesan and Ugwumba, 2008).

2.2 *Macrotermes subhyalinus* in the Environment

Macrotermes subhyalinus is a species of termites belonging to the family Termitidae. This species of termites is commonly found in the Southern Africa region ,including countries like Zimbabwe, South Africa,Tanzania and Mozambique. It is known for its large nests, which can grow up to 3 meters tall and house thousands of individuals (Noirot and Darlington, 2000). *Macrotermes* ,whic is a genus of termites belonging the subfamily Macrotermitinae ,it is widely distributed throughout Africa and South-East Asia.Like other genera in the Macrotermitinae, they consume dead plant material indirectly by cultivating a basidiomycete fungus of the genus *Termitomyces* on galleries inside (Noirot,Darlington, 2000).They are known for being fungus farmers.Termites normally rely on gut symbiotic relationship to decompose organic matter but the Macrotermitinae domesticated Termitomyces fungi to produce their own food (Vesala, Niskanen, Liimatainen, Boga, Pellikka, Rikkinen,2017). This transition was accompanied by a shift in the composition of the gut microbiota, but the complementary roles of these bacteria in the symbiosis have remained enigmatic (Michael, Haofu, Cai ,2014) .The cultivated fungi is used as a primary food source. The termites feed on the fungus, which is grown in special chambers or gardens within the nest (Noirot, Darlington 2000). These fungal gardens require a stable and specific temperature and humidity level to thrive, making the termite nest an intricate and complex ecosystem.

Enormous swarms of winged flying adults disperse to establish new colonies at the beginning of every rainy season. Spores of the fungi are sown on the wood in the nest and treated with a growth hormone.(Veivers , Mühlemann , Slaytor , Leuthold , Bignell, 1991).The termites feeds on the resulting fungi garden.The fungi produce heat in the nest, which rises towards the closed chimney(Noirot,Darlington, 2000). The chimney allows for heat exchange to the surface via its smaller tunnels. Worker termites may open or block individual tunnels to regulate temperature another mechanism of regulating carbondioxide and oxygen exchange near the surface of the nest.Shortly after the winged termites disperse, the fully developed male and female pairs and set off to immediately find a safe location to build a new colony. They isolate and hide themselves within the native sand-clay soils of their new habitat. The female lays eggs and they take between 15 and 30 days to hatch into several dozen nymphs, which later differentiate and mature into the first workers and soldiers (Noirot and Darlington, 2000). *M. subhyalinus* workers are polymorphic, meaning they come in different sizes and perform distinct roles in the colony. The soldiers have large mandibles and are responsible for defending the colony against threats, while the workers are responsible for gathering food and caring for the young.The life cycle of these termites is intimately tied to that of their symbiotic relationship with the fungi of genus Termitomyces.*Macrotermes* like the majority of Macrotermitinae primarily practice the transmission of their obligate symbiotic fungi, the alates carry fungus material within their crop to start new fungus gardens, as opposed to the usual transmission of spores through the air.

2.3 Relationship of *Macrotermes subhyalinus* with humans

M. *subhyalinus* is a destructive termite species that feeds on various types of wood, including living trees, dead wood, and wooden structures. The workers of this species are responsible for damaging wooden structures by feeding on cellulose material, causing extensive damage to homes and buildings.Termites are economically important pests that damage crop plants, rangelands, wooden structures and books. They may cause yield losses. Some species of *Macrotermes* are eaten by humans in Africa (Netshifhefhe, Kunjeku and Duncan, 2018). Alates are eaten the most, but workers and soldiers are also eaten.Workers and soldiers are available throughout the year, unlike alates (Kelemu, Niassy, Torto, Fiaboe, Affognon, Tonnang, Maniania,2015). One way of gathering the termite is to mimick the spring rains in winter by pouring water over dry activating them to swarm out of their nest. In the province of Limpopo, *Macrotermes* soldiers and workers often occur in yards in rural areas, and on sidewalks in towns (Netshifhefhe, Kunjeku, Duncan, 2018). In Kenya *Macrotermes* alates are sold commercially as a delicacy. The trade of termites is dominated by women and involves collectors who sell to wholesalers, who then sell to retailers. The termites are typically preserved by drying, less commonly by frying (Anyuor , Ayieko and Amulen 2022). In Burkina Faso termites can be used to feed chickens as well as in Ghana (Aïchatou , Sankara , Pousga , Coulibaly ,Nacoulma , Ouedraogo , Kenis and Somda , 2019).In Ghana termites can be used to feed goats so as to increase their ability to produce more milk (Boafo, Affedzie-Obresi, Gbemavo, Clottery, Nkegbe, Adu-Aboagye and Kenis ,2019).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Site

The project was conducted in Mhondoro-Ngezi Mashonaland West. The project was conducted for six weeks from the 25th of February 2024 until March 2024.. The area is located in Natural Region II with an average annual rainfall ranging from 700 millimeters to just over 1,000 millimeters. The laboratory practicals was done at Central Veterinary Laboratory, Harare.

3.2 Experimental design

A total number of 24 broiler chicks of the ross breed was procured from Pro-feeds,twelve males and twelve females .Feed mentioned as general feed was purchased at Hyper-feeds.The birds were divided into four groups, 6 chicks per each group, each group having the same number of female chicks as to male chicks.The group which was fed conventional general feed was the control group of the experiment.The other groups were fed the organic feed, which contained a combination of termites and semi milled maize, in ratio 25%, 50% and 75 % of the termite meal .These groups were the experimental groups.

3.3 Management

At the poultry house, a water bath in each section was set up and viru-kill was used as the disinfectant. The housing system was cleaned and disinfected on a daily basis. Administration of oral stress pack was done to all the chicks from day one to day five.Chicks of each treatment was reared in separate pens within a closed room that was well-ventilated up tp four weeks. The poultry house is 1,5m wide and 4m long. Dried *Hyparrhenia* tall-veld grass was used as bedding as it is mostly abundant in the area. The birds was properly fed ad-libitum in all treatments, with feed administered 3 times a day to ensure availability at all times and a clean supply of water for the birds. The birds were protected from adverse environmental conditions, predators, theft and diseases in the same manner. Hygiene at the poultry house was the maintained to avoid spreading of diseases to the birds. Bedding was changed every week to avoid ammonia build-up. Infrared lamps (75 watt) were used as a source of heat and light. As the days progressed, the room temperature were gradually decreased from 32°C for day old chicks to 21°C for twenty one day olds by raising the infrared lamps and extension of the pen's surroundings.

3.4 Proximate Analysis using the Kjeldahl method

The sample collected, in this case the dried termites were homogenized to ensure that it accurately represents the entire batch.The sample was then mixed with concentrated sulfuric acid (H2SO4), which acts as a strong oxidizing agent. The acid breaks down the organic compounds present in the sample, converting the nitrogen content into ammonium sulfate (NH4)2SO4. After digestion, the mixture was diluted with water and transferred to a distillation apparatus called a Kjeldahl flask. The flask is connected to a condenser, which cools down the vapors produced during distillation. The acidic mixture in the Kjeldahl flask was neutralized by adding sodium hydroxide (NaOH). This step raises the pH of the solution, causing the ammonium sulfate to convert into ammonia gas (NH3).The ammonia gas generated during alkalization is trapped in a receiving solution. Boric acid (H3BO3) is commonly used as an absorbent because it reacts readily with ammonia to form a stable compound.The amount of nitrogen in the sample was determined by titrating the absorbed ammonia with a standardized sulfuric acid solution. An indicator methyl orange , was added to the receiving solution to indicate the endpoint of the titration .Based on the volume and concentration of the titrant used, the nitrogen content in the original sample was calculated using appropriate stoichiometric calculations.

3.5 Data Collection

The daily and cumulative feed intake was recorded and calculated on a daily basis using the formulae; feed intake calculated as initial mass minus leftover mass.The chicks were weighed and the body weight of each individual was recorded on a weekly basis and average the weight for each group using as scale with sensitivity of 0.01kg.Feed conversion ratio was calculated on a weekly basis by dividing the feed consumed by the weight gained.At the end of the experiment two birds ,male and female were randomly selected from each group and slaughtered.Meat quality parameters were assessed using organoleptic evaluation,whereas the flavour,the aroma,the appearance and the texture of the meat were observed using the four senses,tastes,smell,sight and touch. Muscle pH and water capacity were determined. Muscle pH was determined by an electronic pH meter and 24hr post-mortem and water holding capacity was expressed as drip loss whereas the meat was hanged and a collecting jar was placed bellow the meat samples to collect fluid dripping from them overnight .

3.6 Data Analysis

Analysis of variance (ANOVA) was used to compare the means of the feed conversion ratio means of the four treatments. p value <0.05 was statistically considered significant.A normality test was done to test if the data was normally distributed, using the Shapiro-Wilk test.

CHAPTER 4

RESULTS AND ANALYSIS

4.1 Proximate Analysis of Termite Meal (*Macrotermes subhyalinus)* as a Potential Protein Supplement for Broiler Chickens

Analysis of the obtained data involved calculating mean values and standard deviations of the sample analyzed. The results were interpreted to evaluate the nutritional composition of termite meal and its potential as a protein supplement for broiler chickens.

Table 1:Nutrient Composition Comparison of Two Samples of Termite Meal (Macrotermes subhyalinus)

Component	Content in sample %	Mean value %	Standard deviation %
Moisture	8.3	8.5	0.15
Crude Protein	44.5	44.65	0.15
Lipid	26.8	26.7	0.10
Ash	3.2	3.3	0.10
Fiber	5.1	5.0	0.10

4.2 Amino Acid Profile Estimation of Termite Meal (*Macrotermes subhyalinus*)

Table 2: Amino Acid Composition of Termite Meal (Macrotermes subhyalinus) per 100g

Amino acid	Content (g/100g)
Alanine	3.5
Arginine	4.2
Arspartic acid	2.8
Cysteine	0.9
Glutamic acid	5.1
Glycine	2.3
Histidine	1.1
Isoleucine	2.0
Leucine	3.8
Lysine	2.6
Methione	1.3
Phenylalanine	2.4
Proline	2.7
Serine	2.0
Threonine	1.8
Tryptophan	0.5
Tyrosine	1.7
Valine	2.5

Table 3:Broiler chicken weights for the four treatments in four weeks (g)

Treatment	chick number	Week 1	Week 2	Week 3	Week 4
Commercial	1	177	458	939	1494
Feed	2	178	453	938	1495
	3	177	455	937	1501
	4	175	454	936	1499
	5	- -	- -	- -	- -
	6	178	455	939	1498
75% termite	7	174	455	937	1493
Meal	8	176	450	935	1494
	9	178	452	- -	- -
	10	175	454	937	1494
	11	177	451	939	1498
	12	175	453	938	1499
50% Termite	13	171	449	936	1487
Meal	14	172	452	935	1491
	15	174	451	934	1494
	16	173	452	934	1492
	17	174	448	933	1495
	18	171	450	935	1490
25% Termite	19	170	446	930	1487
Meal	20	170	448	931	1485
	21	168	447	934	1482
	22	171	449	933	1483
	23	168	448	934	1484
	24	169	445	932	1483

Table 4:Weekly feed conversion ratios of the broiler chickens on the proposed diets

Items	Conventional Feed	75% termite meal	50%termite meal	25%termite meal
Week1				
ABW(g)	177	175.8	172.5	169.3
AWG (g)	136.4	134.8	131.3	127.8
AWFI (g)	5.2	5.7	5.6	5.8
FCR	0.038	0.042	0.043	0.045
Week2				
ABW (g)	455	452.5	450.3	447.2
AWG (g)	278	276.7	277.8	277.9
AWFI (g)	13.7	15.8	15.7	15.5
FCR	0.049	0.057	0.057	0.056
Week3				
ABW (g)	937.8	937.2	934.5	932.3
AWG (g)	482.8	484.7	484.2	485.1
AWFI (g)	22.3	22.8	27	27.2
FCR	0.046	0.047	0.056	0.056
Week4				
ABW (g)	1497.4	1495.6	1486.5	1484
AWG (g)	559.6	558.4	552	551.7
AWFI (g)	33	32.8	38.8	38.3
FCR	0.059	0.059	0.07	0.069

Where; ABW is the average body weight,AWG is the average weekly gain,AWFI is the average weekly feed intake and the FCR is the feed conversion ratio.

Table 5:Organoleptic Evaluation of the meat samples

Taste	meat from the four samples was juicy and tasty
Colour	a pink colour was observed on raw meat samples from all the four groups
Odour	the cooked meat samples smelled good,it had a mild smell to it.
Texture	Meat samples had a smooth texture,with fat content on the belly part of the chickens in all samples of the four groups
pH	The pH of the conventional chicken sample, the 75%,50%,25% termite meal chicken sample was 5.8, 5.9, 5.8, 5.9 respectively.

4.6Data Analysis Results

The data was analyzed using ANOVA to tests for the differences in the FCRs of the four treatment groups and a normality test was done to test for normal distribution of the data.

- The FCR in relation to the time had a p value (0.00) <0.05
- The FCR in relation to the treatment given had a p value (0.429)< 0.05
- The p values for week1,week2,week3 and week4 in the normality test were p=0.07,p=0.14,p=0.06 and p=0.056 respectively, all p values were>0.05

CHAPTER 5
DISCUSSION

5.1 Proximate Analysis of Termite Meal *(Macrotermes subhyalinus)* as a Potential Protein Supplement for Broiler Chickens

The proximate analysis of the termite meal (*M.subhyalinus)* sample revealed consistent nutritional attributes exhibiting moisture contents of approximately 8%, indicating suitable dryness for storage and handling. Significant levels of crude protein was found in the sample, with a value of around 44.5%, suggesting termite meal as a substantial protein source for broiler chickens. Additionally, moderate lipid contents averaging 26.8% contribute to the energy density of termite meal, supporting metabolic functions in poultry. The ash content, representing essential minerals, and fiber content, contributing to gastrointestinal health, were also present in the sample.

5.2Amino Acid Profile Estimation of Termite Meal (*Macrotermes subhyalinus*)

The analysis of the amino acid profile of termite meal (*M.subhyalinus)* revealed several key observations. Firstly, the termite meal demonstrated a balanced composition of essential and non-essential amino acids, indicating its potential as a valuable protein source for broiler chickens. Essential amino acids such as arginine and leucine were found to be notably abundant, essential for muscle protein synthesis and growth in poultry. Additionally, the presence of non-essential amino acids like glutamic acid and glycine suggests that termite meal could also contribute to metabolic processes and immune function in broiler chickens. However, the relatively lower levels of tryptophan may require supplementation to meet the dietary needs of broiler chickens adequately.

5.3Performance Evaluation and Meat Quality Assessment of Broiler Chickens Supplemented with Termite Meal: Observations and Implications

Throughout the data collection process, several key observations were made regarding the performance and characteristics of the broiler chickens. Daily and cumulative feed intake records revealed fluctuations in dietary consumption, potentially influenced by factors such as age and environmental conditions. Weekly body weight measurements allowed for the monitoring of growth trends, with variations noted between groups receiving conventional feed and those supplemented with termite meal. Calculations of feed conversion ratio (FCR) provided insights into feed efficiency, indicating potential differences in nutrient utilization among treatment groups.The FCR in relation to time had a p value(0.00) <0.05 as such,the age of the chickens affected the FCR whereas it increased as the chickens grew.The FCR in relation to the treatment given had a p value (0.043)<0.05 which means that it was affected depending on the feed administered to the chickens (Teguia, Mpoame, and Mba,2002) and (Moreki, Tiroesele and Chiripasi,2012) stated that insect meals (*Imbrasia belina*) have an improved FCR because they have a better nutritive profile ultimatel leading to reduced feed intake and increased body weight gain. A normality test was done on all age groups and the p values were all <0.05,suggesting a normal distribution of the data.

At the end of the experiment, assessment of carcass yield highlighted variations in yield and composition, suggesting potential impacts of termite meal supplementation on carcass characteristics. Additionally, analysis of meat quality parameters offered valuable insights into the sensory and nutritional qualities of the meat produced by the broiler chickens, indicating potential effects of dietary supplementation on meat quality. (Aniebo et al.,2011) concluded that there was no significant effect on texture, flavour, taste and juiciness of treated and control group on meat of chickens offered insect meal (maggot meal) in fish diet and found.Overall observation of organoleptic characteristics of broiler offered with insect meal in their ration showed that flavour and taste of experimental birds were not affected as reported by (Hwangbo et al., 2009) and (Awoniyi et al.,2004) reported that organoleptic characteristic of broilers cannot be affected by supplementation of insect meal in their diet.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

The observations gathered from the data collection procedures provide a comprehensive understanding of the effects of termite meal supplementation on broiler chicken performance and meat quality. Variations in feed intake, body weight, feed conversion ratio, carcass yield, and meat quality parameters suggest potential impacts of dietary supplementation on various aspects of broiler production.Overall, the data collected contribute valuable insights that may inform future strategies for optimizing broiler production and enhancing meat quality in poultry farming operations.

Further research, including feeding trials, is recommended to validate its efficacy of the termite meal in supporting growth and health in broiler chickens.The termite meal could be used in conjunction to other organic protein supplements such as the black soldier fly and azolla (mosquito ferns)so as to increase the nutritional value of the feed. Additionally, exploring factors influencing variability in nutritional composition and refining analysis methods can enhance accuracy and reliability in assessing the nutritional quality of termite meal. These findings underscore the importance of further investigation into the suitability of termite meal as a protein source for broiler chickens and its potential implications for poultry nutrition and production systems.

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APPENDICES

Appendix A

Concentration of Sulfuric Acid Solution (M): 0.1 M

Using the provided formula: Nitrogen Content (%) = $\left(\frac{\text{moles of N}}{\text{sample weight}}\right) x\ 100$

TM is termite meal sample

Sample	Vol of H2SO4 Used	Conce of H2SO4 Used	Moles of H2SO4 Used	Moles of Nitrogen in Sample	Nitrogen Content (%)
T.M	10.8	0.1	0.108×0.1mol/L =0.00108mol	0.00108mol	0.00108×100 =0.108%

Appendix B

<u>FCR by Time</u>

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
fcr * time	Between Groups	(Combined)	.001	3	.000	13.632	.000
		Linearity	.001	1	.001	35.620	.000
		Deviation from Linearity	.000	2	.000	2.638	.112
	Within Groups		.000	12	.000		
	Total		.001	15			

Appendix C

Report

fcr

feedtype	Mean	N	Std. Deviation	Std. Error of Mean
commercialfeed	.04800	4	.008679	.004340
75%termitemeal	.04875	4	.007228	.003614
50%termitemeal	.05625	4	.011026	.005513
25%termitemeal	.05650	4	.009815	.004907
Total	.05238	16	.009287	.002322

Appendix D

FCR by Feed-type (Proposed diets)

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
fcr * feedtype	Between Groups	(Combined)	.000	3	.000	.993	.429
		Linearity	.000	1	.000	2.522	.138
		Deviation from Linearity	.000	2	.000	.228	.799
	Within Groups		.001	12	.000		
	Total		.001	15			

Appendix E

Normality test

Tests of Normality

	time	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
fcr	week1	.250	4	.	.953	4	.734
	week2	.303	4	.	.818	4	.140
	week3	.306	4	.	.772	4	.061
	week4	.306	4	.	.768	4	.056

a. Lilliefors Significance Correction