EFFECT OF *Parkia biglobosa* LEAF MEAL AS A PARTIAL REPLACEMENT FOR SOYBEAN MEAL IN BROILER CHICKEN DIET

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DECLARATION

I, Chinenye Ngozi NNONYELU, a ***PGD*** student of Animal Production and Health in the ***Department of Animal Science***, Landmark University, Omu-Aran, hereby declare that this project entitled **"*Effect of Parkia biglobosa Leaf Meal as A Partial Replacement for Soybean Meal in Broiler Chicken Diet''*** submitted by me is based on my original work. Any material(s) obtained from other sources or work done by any other persons or institutions have been duly acknowledged.

Chinenye Ngozi NNONYELU: 19PGAC000037

Signature & Date

CERTIFICATION

This is to certify that this project has been read and approved as meeting the requirements of the Department of Animal Science, Landmark University, Omu-Aran, Nigeria, for the Award of PGD Degree in Animal Production and Health.

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ABSTRACT

The purpose of carrying out this research was mainly to determine the main effect of *Parkia biglobosa* leaf meal (PBLM) as a partial replacement for soybean meal in the broiler chicken diet. Five different diets were being formulated, with PBLM included at 0% (control), 5%, 10%, 15% and 20% designated to diet 1, 2, 3, 4 and 5 respectively. 150 day old broiler chicks were assigned randomly, on the basis of weight equalization, to the five dietary treatments with 30 broiler chicks for each treatment and 10 broiler chicks in each replicate. The experimental design used was completely randomized design (CRD). The experiment was conducted for a six weeks period. Three feeding phases were used in the experiment: which are starter phase (first 2 weeks), grower phase (third week) and finisher's phase (the last three weeks). The proximate analysis of the PBLM, the effect of inclusion of PBLM on growth performance, carcass traits, haematological indices, serum-biochemical indices of the birds and the feed cost benefit of inclusion of PBLM in the experimental diets were determined. There was no significant (P0.05) effect on growth performance in broiler chickens fed up to 10% inclusion level of PBLM during the starter and grower feeding phases. The results for the growth performance at the finisher phase showed that the control diet and diet 2 are statistically similar for feed conversion ratio. This study also found that PBLM inclusion had no negative effects on the birds' viscera organs. The haematological and serum biochemical analyses of the broilers revealed no significant ($P>0.05$) effect on the birds. The study showed that the use of PBLM will reduce the cost of feed for broiler production. These findings indicated that *Parkia biglobosa* leaf meal could replace up to 5% of soybean meal in broiler diets without affecting animal health or carcass quality or blood parameters.

Keywords: *Parkia biglobosa*, Carcass, Haematology and serum-biochemical, Growth Performance, Cost Benefit

DEDICATION

It is my intention to dedicate this research to God Almighty, the creator of Heaven and Earth, in gratitude for the divine wisdom, knowledge, and grace that have been showered upon me during the course of this project's execution. Mr and Mrs Michael Nnonyelu, my loving parents, are also acknowledged in this project for their unwavering love and support throughout my academic career.

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TABLE OF CONTENTS

TITLE PAGE ……………………………………………………………………………..i

DECLARATION ii

CERTIFICATION iii

ABSTRACT.. iv

DEDICATION.. v

ACKNOWLEDGEMENTS vi

TABLE OF CONTENTS.. vii

LIST OF TABLES AND FIGURES.. xii

CHAPTER ONE 1

1.0. INTRODUCTION 1

1.1. Background of the study 1

1.2. Justification of the study 3

1.3. Objectives of the study... 4

1.3.1. General objectives 4

1.3.2. Specific objectives... 4

CHAPTER TWO 5

2.0. LITERATURE REVIEW 5

2.1. Poultry Production.. 5

2.1.1. Types of Poultry Production in Nigeria.. 6

2.1.2. Cost of Poultry Production in Nigeria 6

2.1.3. Constraints of Poultry Production in Nigeria 7

2.2. Broiler Chicken 8

2.2.1. Breeds of Broiler Chicken 9

2.3. Dietary Nutrient Sources and Requirement for Chickens 10

2.3.1. Energy 10

2.3.2. Protein 13

2.3.3. Vitamins 17

2.3.4. Minerals 19

2.4. Significance of the Haematology and Serum Biochemical Analysis in Poultry 19

2.5. Importance of Carcass Analysis 22

2.6. Alternative feed resource available for poultry 22

2.7. Potential of Plant Leaf Proteins in Livestock Production 25

2.8. *Parkia biglobosa* 27

2.8.1. Geographical Distribution 27

2.8.2. Taxonomy 27

2.8.3. Botanical Description 28

2.8.4. Medicinal uses of *Parkia biglobosa* 34

2.8.5. Toxicity of *Parkia biglobosa* 36

CHAPTER 3 37

3.0. MATERIALS AND METHODS 37
3.1. Experimental site and duration of the study 37
3.2. Experimental design 37
3.3. Collection and processing of Experimental feed 37
3.4. Experimental birds and Management 37
3.5. Experimental diets 38
3.6. Chemical Analysis of the *Parkia biglobosa* leaf meal 43
3.6.1. The Proximate analysis: 43
3.7. Growth performance indices determination 46
3.8. Carcass and organ indices 46
3.9. Haematological and Serum-Biochemical Indices Determination: 47
3.10. Feed cost benefit 48
3.11. Statistical analysis 48
CHAPTER 4 49
4.0 RESULTS AND DISCUSSIONS OF FINDINGS 49
4.1. Results 49
4.1.1. Chemical composition of the leaves 49
4.1.2. Growth performance 51
4.1.2.1. Starter feeding phase 51
4.1.2.2. Grower feeding phase 53

4.1.2.3. Finisher Feeding Phase ... 55

4.1.2.4. Overall Performance Characteristics ... 57

4.1.3. Carcass analysis ... 59

4.1.3.1. Relative organ weight ... 61

4.1.4. Haematological and Serum-biochemical analysis ... 63

4.1.4.1. Haematological result ... 63

4.1.4.2. Serum-biochemical result ... 65

4.1.5. Feed cost benefit of broiler chickens fed diet containing *P. biglobosa* leaf meal67

4.2. Discussion ... 70

4.2.1. Proximate Analysis of *P. biglobosa* Leaf Meal ... 70

4.2.2 Growth Performance at Different Feeding Phase for Broiler Chickens Fed Diets Containing *P. biglobosa* Leaf Meal (PBLM) ... 71

4.2.2.1. Growth Performance at Starter Feeding Phase ... 71

4.2.2.2. Growth Performance at the Grower Feeding Phase ... 71

4.2.2.3. Growth Performance at the Finisher Feeding Phase ... 72

4.2.2.4. Overall Performance Characteristics ... 73

4.2.3. Carcass and organ quality of broilers fed *Parkia biglobosa* leaves ... 74

4.2.3.1. Organ Quality of Broilers Chickens Fed Diets containing PBLM ... 75

4.2.4. Haematological and Serum-Biochemical Analysis ... 75

4.2.4.1. Serum-Biochemical Analysis ... 76

4.2.5. Feed Cost Benefit Analysis 78

CHAPTER 5 79

5.0. SUMMARY, CONCLUSIONS AND RECOMMENDATION 79

5.1. Summary 79

5.2. Conclusion 80

5.3. Recommendation 81

REFERENCES 82

LIST OF TABLES AND FIGURES

Table 2.1: Sources of Protein

Table 2.2: Vitamin Deficiencies

Table 2.3: Normal ranges of Haematological Parameters of Chicken

Table 2.4: Alternative feed sources and their uses in Poultry

Table 2.5: The use of various leaf meals in Poultry Production

Table 2.6 Uses of *Parkia biglobosa* in Traditional medicine

Table 3.1: Experimental diet composition for Starter

Table 3.2: Experimental diet composition for Grower

Table 3.3: Experimental diet composition for Finisher

Table 3.4: Vaccination and Medication Schedule

Table 4.1: Proximate result for PBLM

Table 4.2: Growth Performance result for starter

Table 4.3: Growth Performance result for grower

Table 4.4: Growth Performance result for finisher

Table 4.5: Growth Performance result for overall performance characteristics

Table 4.6: Carcass analysis result of broilers fed diet containing PBLM

Table 4.7 Relative organ analysis result of broilers fed diet containing PBLM

Table 4.8: Haematological analysis result of broilers fed diet containing PBLM

Table 4.9: Serum-biochemical analysis result of broilers fed diet containing PBLM

Table 4.10: Feed cost benefit result of broilers fed diet containing PBLM

Figure 1: *Parkia biglobosa* pending flower head

Figure 2: *Parkia biglobosa* tree

Figure 3: *Parkia biglobosa* leaf

Figure 4: *Parkia biglobosa* pod and yellow mealy pulp

Figure 5: *Parkia biglobosa* seed

Figure 6: Bar chart showing feed cost reduction

CHAPTER ONE

1.0. INTRODUCTION

1.1. Background of the study

Demand for meat across underdeveloped nations is increasing, and it is expected that this trend will continue in the coming years. It is impossible to overstate the importance of poultry in addressing the expanding need for animal protein in developing nations. However, costly conventional feed ingredients, particularly these common feed meals such as groundnut, fish, soybean and maize, which is in fierce competition with man's nutritional requirements, stands out as the most significant impediment to the efficient and effective utilization of poultry (Ogbuewu, Emenalom, & Okoli, 2017). In order to run a profitable poultry operation, feed is the most important production input. It accounts for seventy to eighty percent of the total manufacturing expense (Kehinde, Babatunde, Ayoola & Temowo, 2006). However, even under the most optimistic of scenarios, it is evident that demand for traditional feed ingredients will not be available, despite hopeful predictions. Moreover, it is anticipated that the gap between local demand and supply for these conventional feedstuff will increase over the next several years, giving a strong argument for investigating the potential importance of indigenous unconventional feedstuffs in feed formulations (Ogbuewu et al., 2017). Among other things, unconventional feedstuffs include agro-industrial waste and leaf meals from a few readily available exotic plant species. Unconventional feed ingredients have been extensively studied in the literature, and their application in chicken feed compositions to lower feed costs has been well-documented. (Abeke, 2008; Duru, 2010). Unconventional feedstuffs are the most cost-effective options available in our environment for lowering feed costs while also lowering the prices of meat and animal products and they are also environmentally friendly. Several peels of various crops (Cassava, potato, yam and plantain), seeds (jack bean and *Luffa aegyptica*), and processed poultry litter and leaf meals (*Moringa oleifera*, *Gliricidia sepium* and neem leaf) are just a few of the alternative feedstuffs that have been identified in developing countries (Ogbuewu et al., 2017). In spite of the fact that they are good food sources, their use in animal production continues to be in short supply due to restrictions imposed by these factors, which include socio-economic and nutritional constraints. According to research, the leaves contain the majority of the essential amino acids and are extremely high in protein, minerals, and vitamins. (Edelman and Colt, 2016). Research has also revealed that the leaves are safe for consumption by monogastric animals, which is a positive development. For instance, Tesfaye et al. (2013) reported that, in broiler diets up to 5% of the total ration, moringa leaves can be replaced for soybean meal without impacting the biological performance of the birds. Fasuyi, Dairo, & Adeniji (2008) additionally reported in their study that the results of the proximate composition, gross energy, amino acids content and mineral composition all indicated that a tropical vegetable known as *Amaranthus cruentus* is an extraordinarily rich nutritional source in monogastric feed composition. Additionally, they reported that sun drying significantly reduced anti-nutritional factors (ANFs) to levels that promoted tolerance in experimental animals and that using 5% of the leaf in broiler diets was found to be the optimal level for supporting improved overall performance characteristics. According to Amata (2010), haematological measures, as well as carcass characteristics, showed no effects of inclusion levels of Gliricidia leaf meal up to 20%. Muhammad, Peter, James & Wosilat (2015) investigated the effects of neem leaf meal on Japanese quail, and the findings revealed that neem (*Azadirachta indica*) leaf meal at up to 5% of dietary levels can be used as growth promoters in Japanese quail diets without having any significant negative effects.

Because of the success that has been recorded in the use of other plant materials as substitute feed stuff. It is necessary to begin testing how other untapped plant materials can be used as replacement feedstuffs as soon as possible, as this will reduce the competition between man and animals for certain conventional feedstuffs in the future. This research aims at examining the usage of *Parkia biglobosa* leaf meal in the broiler chickens diet as a partial replacement for soybean meal.

1.2. Justification of the study

This study is important because conventional feedstuffs are expensive, and there is constant competition between man and animals for conventional feeds, as opposed to unconventional feedstuffs, which are readily available, less competitive, and inexpensive, as previously stated, and locust been leaves are readily available throughout the year. Furthermore, conventional feed resources are vulnerable to price volatility and seasonal scarcity, and which will become increasingly important as the world's population, particularly in developing countries, continues to expand.

These and other factors have driven many people out of the livestock business and diverted attention away from those who might otherwise have entered this enviable industry. *Parkia biglobosa* leaf with its potentials as shown in the previous study can bridge the gap.

1.3. Objectives of the study

1.3.1. General objective

The general objective of this study is to evaluate the effects of *Parkia biglobosa* leaf meal as a partial replacement for soybean meal in broiler chicken diet.

1.3.2. Specific objectives

The specific objectives of this research are to:

- determine the proximate composition of *Parkia biglobosa* leaf meal;
- evaluate the growth performance, carcass indices as well as haematological and serum-biochemical indices of broiler chickens fed diets containing *Parkia biglobosa* leaf meal;
- calculate the cost implication of adding *Parkia biglobosa* leaf meal in broiler chickens feed

CHAPTER TWO

2.0. LITERATURE REVIEW

2.1. Poultry Production

Poultry are birds that are kept and cared for by humans for their eggs, feathers and meat. A significant proportion of the birds are typically members of the suborder Galloanserae (fowl), and specifically the order Galliformes (which includes chickens, quails, and turkeys), according to the data (Fadimu et al., 2020). In the majority of rural communities, poultry production provides a source of income primarily because it provides ready funds for emergency needs, supplies high-quality protein to a rapidly growing human population, contributes significantly to food security, and promotes poverty reduction and ecological raw material management. (Ayinde, Adejumo, Akintola, Ajibade, & Aina, 2017). Poultry production is different because it delivers the fastest return on investment in livestock enterprise and the greatest sales rate (Sanni and Ogundipe, 2005). When compared to other livestock enterprises, the financial resources invested in poultry production are recovered much more quickly. When compared to ruminant and other monogastric animal production, poultry production grows and develops at the highest rate. Poultry production is also the most affordable, most widely available, and best source of animal protein available (Kalla et al., 2007). This is due to the fact that chicken produce are widely accepted source of animal protein among many persons all over the continent, owing to the fact that they are associated with fewer religious and communal taboos and that the meat has and also low cholesterol content. Nigeria's chicken production industry employs both skilled and unskilled laborers, accounting for around 10% of the country's population (Ahmadu, Erhabor, & Jimoh, 2010). In comparison to other animals, chickens have a short gestation time and hence provide rapid returns on investment; they are also extremely prolific, an efficient converter of feed to meat,, and require little in the way of capital and space for production (Ahmadu and Giroh, 2013).

2.1.1. Types of Poultry Production in Nigeria

Poultry farming is the most commercialized livestock agricultural production in Nigeria, accounting for more than half of the country's livestock agricultural production. Chickens, pigeons, turkeys, guinea fowls, ducks, and, more recently, ostriches are some of the most common types of poultry raised in Nigeria. Pigeons are also raised in large numbers. Chicken and turkey are two of the most valuable poultry species in terms of commercial or economic value, with chickens accounting for the vast majority of production (Ugwu, 2009). In Nigeria, the chicken industry consists of the production of eggs, broilers, hatchery, and poultry equipment, as well as feed manufacture. (Ahmadu, Okoror, & Ehigiator, 2019).

2.1.2. Cost of Poultry Production in Nigeria

Poultry farming is the fastest-growing animal protein source in Nigeria, it accounts for the vast majority of Nigeria’s livestock production. However, poultry farming is also the most expensive to operate in the country. Because feed is the most expensive input, inadequacies and poor quality feed resources can make the development of the poultry industry seem absurdly optimistic (Olayinka, 2013). Medication costs, veterinary bills, labor costs, electricity costs, and other inputs are all examples of additional expenses. The total of all of these expenses is referred to as the farmer's production cost in each of the production cycles. The high cost of poultry production discourages most Nigerians from entering the poultry industry under the pretext that it is both expensive to operate and potentially not very profitable. Recent studies have revealed that poultry farming can generate significant profits, but that this can only be achieved through improved cost management, a low mortality rate, and overall good management (Yusuf, Tiamiyu & Aliu, 2016; Omolayo, 2018; Ezeano and Ohaemesi, 2020).

2.1.3. Constraints of Poultry Production in Nigeria

Nigeria's poultry industry accounts for approximately 58.2% of the country's total animal production (Ogunyemi and Orowole, 2020). As a result, the demand for poultry products has increased as a result of a variety of factors, some of which include an increasing population, urbanization, and rising income (FAO, 2020). But, despite their usefulness, poultry farms are confronted with an array of challenges in the course of their operations. Poultry production constraint refers to any impediment, problem, or difficult situation that requires the farmer to use a higher level of input than necessary in order to create a unit amount of output, incur higher costs than anticipated in order to create a unit amount of output, reduces farmers' capacity utilization, or limits the transformation of input into output, and which the farmer must resolve or deal with in order to maximize his or her output (Ogunyemi and Orowole, 2020).

Researchers have carried out studies on the various constraints that are associated with the production of poultry. The most significant obstacles to poultry production are high feed costs, a lack of financial resources, an increase in disease outbreaks, and rising transportation costs (Osuji, 2019). Anosike et al. (2015) stated in their study that the challenges facing the poultry industry in Ibadan were high rates of mortality, poor quality chicks because the farmers in that area have no idea which farms hatch the chicks they purchase for production and also insufficient access to veterinary services, and excessive cost to veterinary treatments. As reported by Roys Farm (2016), poultry problems include a lack of productive breeds, insufficient housing, inadequate feed and feeding, a lack of access to drugs, ineffective management, inadequate training, insufficient recording of expenses and income, as well as insufficient transportation of poultry products. According to Girel (2020), among the challenges facing poultry production is the lack of production and marketing know-how, together with a dearth of organization among poultry farmers, a lack of genetic facilities, a lack of awareness among farmers through extension services, unfavourable weather conditions (particularly in the northern part of the country), lack of acess to medicine and vaccine and high cost of feed. Specifically focusing on the health-related challenges of poultry farmers in Oyo state, Aderounmu, Oke, and Adeoye (2020) reported that 53.8 percent of the farmers suffered from neck pains, 45 percent from back pains, 41 percent from leg pains, and 35 percent from general body pains, according to their findings. Notably, each of these issues falls into one of four categories: biological, institutional, socio-economical, and technical problems (Ogunyemi and Orowole, 2020), all of which contribute to non-sustainable poultry production in Africa, according to (Sonaiya, 2020). Other studies of problems relating to farm operations, particularly poultry farming, include Alho (2015), Das (2015), Osakwe (2018) and Bola-Badmus (2020).

2.2. Broiler Chicken

Broiler chickens (*Gallus gallus domesticus*) are a type of chicken that is raised primarily for meat. They are a cross between the layers chicken and the red jungle fowl. The term "common broiler" refers to broilers with feathers that are white in color and with a skin yellow in color. Almost all broilers for commercial production achieve market weight around the age of 5-6 weeks after breeding; however the varieties with slow growth rate reach slaughter weight slightly later, at 14 weeks (Jha et al., 2019). The majorities of these birds (94%) is of a quicker developing breed and are killed around 5–6 weeks of age, with the weight of 2.2–2.5 kg. (DEFRA, 2018). They are associated with a slew of welfare concerns, as well as production costs and other underlying concerns.

2.2.1. Breeds of Broiler Chicken in Nigeria

There are many different types of broilers. At the moment, researchers are conducting investigations into broiler chickens from various parts of the nation in order to identify the breeds that lay the most eggs and produce the greatest amount of meat (Nenge, 2019). Farmers in Nigeria have a few favorite breeds, which are listed below.

1. Cornish Cross Broilers (also known as Cornish Crosses): The most popular broiler chicken breed is not an original mix between white rock and Cornish chickens, which explains its popularity. A Cornish male white cross rock weighs roughly 4.5 pounds at six weeks of age. They weigh roughly 9.5 pounds after another five weeks of rearing. Cornish game hens are the female offspring of this mix. They develop slower than males and weigh about 2.5 pounds at 5 weeks of life. Because of the growth of feathers, their carcasses do not have any blemishes on the skin, similar to the carcasses of various other white colored feathered meat birds (Meggitt, 2017).
2. Grinphield Marshall: When it comes to broiler chick development, it typically takes 6-8 weeks for them to reach what is known as "table size." These birds are also quite tall and large in stature (Nenge, 2019).

3. Red Broilers: Red broilers chicken, also known as Red Label chicken, does not grow and develop as quickly as Cornish chicken; it can take up to twice as long as 12 weeks for them to fully develop for sale. Males reach maturity at approximately 7 pounds, while the females reach maturity at approximately 5 pounds. This specific breed is well-suited for outdoor broiler production rather than indoor or housing production dedicated to broiler production. These birds have a range of muted tones of red on their body and tails, with some having black tails, as their name implies. Their hens lay huge brown eggs, but they are not particularly good brooders. This means that if your goal is to breed a new generation of red broilers chickens, you will need to incubate the fertilized eggs first (Meggitt, 2017).
4. Rosambro Broilers: This variety of broiler chickens has a medium growth rate and is raised for meat. Although they mature a little more quickly than red broilers, they are not as tasty. Their meat has a distinct taste and flavor that distinguishes it from the competition (Nenge, 2019).

2.3. Dietary Nutrient Sources and Requirement for Chickens

2.3.1. Energy

The daily maintenance energy requirement of an animal is related to its metabolic physical size and structure, and it is estimated to be approximately 0.35 MJ W (where W is the animal's body weight in kilograms) in resting birds (Priyankarage, Rose & Pirgozliev, 2011). However, the total amount of energy required by the bird is comprised of the amount of energy required for maintenance as well as the amount of energy required for the production of protein and fat in the bird's body. Because different poultry species have different body compositions and growth rates, their daily energy requirements vary from one another as well. It is the second most important nutrient required by chickens after water, and it is commonly expressed as metabolizable energy (ME) or as mega joules per kilogram (MJ/kg) of the animal's body weight. According to Ahiwe, Omede, Abduallh, & Iji (2018) the energy requirements of broilers vary depending on their growth stage and breed. PoultryHub (2021), recommended the energy requirement for broiler starter to be 3010 kcal ME/kg or 12.60 MJ/kg; grower to be 3175 kcal ME/kg or 13.30 MJ/kg and finisher to be 3225 kcal ME/kg or 13.50 MJ/kg. This required energy for broilers is obtained from a variety of sources, including cereal grains, roots and fibers, fats and oils, as well as energy obtained from protein sources.

Cereals grains

Cereals can be defined as plants that produce grains; it has the potential to be used as sources of energy in both human and animal food production. These constitute the majority of energy sources for poultry diets and have the greatest level of inclusion in a typical poultry diet formulation, making them the most important. According to PoultryHub (2017) Corn, wheat, sorghum, barley, rye, oats, triticale, and millet are principal cereal grains utilized as a source of energy in broiler diets, with sorghum being the most frequent. Starch is the primary source of energy in grains, and it is extremely digestible, making it a particularly good choice for poultry. The metabolizable energy composition of rye and corn, which are the most, used grains, ranges from 2734-3300kcal/kg, respectively, depending on their use. The nutrient composition of cereal grains vary depending on the grain type, the method of cultivation, the season, the location, the handling and the harvesting conditions. Despite the fact that they are composed primarily of highly digestible starch, nearly all grains contain anti-nutrients, which have a negative impact on the digestion, absorption, and availability of nutritionally important substances (Ahiwe et al., 2018).

Root and tubers

When it comes to broiler diet formulation, root and tuber are second only to cereals when it comes to nutritional value (Chandrasekara and Kumar, 2016). Despite the fact that thay have high ME content, their application to chicken feed ingredients is restricted due to anti-nutritional elements found in the root and tuber products. These anti-nutrients, on the other hand, are reduced to a bare minimum or completely eliminated through the use of acceptable processing techniques. Cassava, cocoyam, and potato are just a few examples of these crops (Beckford and Bartlett, 2015).

Fats and oils

Lipids are a general term that refers to fats and oils as a group. They provide a large quantity of energy to poultry diets. Their inclusion is generally limited to 4 to 5 percent, which is the optimum percentage (Ahiwe et al., 2018). The most commonly used types of fat in chicken diets are tallow, yellow grease, feed-grade animal fat, and poultry fat, with tallow being the most popular. Animal fats have an average energy density (ME) of 8850 kcal/kg in poultry. Oils also have a high energy level, with the average ME content of various types of vegetable oils ranging from 8300 to 8975 calories per kilogram of weight (Walker, 2011). The most often used oils in broiler chicken diets are soybean oil, canola oil, and palm oil because they improve the physical qualities and palatability of the poultry diet, increase pellet durability, and raise the necessary fatty acid content of the diets, especially linoleic acid. (Ahiwe et al., 2018).

Energy from protein sources

Plant protein sources, such as canola, soybean, cottonseed, sunflower, lupine, and peas, or animal source of protein, such as meal of fish, meat, blood, feather and chicken by-product can provide this energy (PoultryHub, 2017). Despite the fact that proteins have a higher energy density than the energy found in carbohydrates, and they are also not employed as strong energy sources because of the substantial expense and biological load of excreting it out of the body.

2.3.2. Protein

When it comes to poultry, proteins are specific sequences or groups of amino acids that fit together to form a specific protein. Protein is an essential nutrient for poultry as well as for all other types of animals. Protein, through its amino acid contents, is involved in a variety of biological tasks, including growth, egg production, immunity, environmental adaptability, and the creation of feathers, beaks, and toenails, among others. (Esmail, 2016). Proteins serve a variety of activities in the body, including muscle development and cell structure formation, DNA replication, the transportation of other molecules, and the production of enzymes that speed up chemical reactions. **P**roteins are three-dimensional structures made up of amino acid sequences that are specific to each individual protein. Chickens consume proteins, and these amino acids are obtained from the proteins that the chicken produces on its own (Esmail, 2016).

Proteins are broken down into specific amino acids during digestion, which are then transported and utilized throughout the entire body. After being assimilated, these amino acids are restructured into proteins that the chicken will require (Williams, 2019). These amino acids are grouped as either non-essential or essential.

Essential amino acids can be seen as those that the animal cannot produce in sufficient quantities to meet the demands of the various systems in the body on an ongoing basis. It is necessary to obtain the essential amino acids from food. Lysine plays a critical role in updating the quality of the carcass of broiler chickens by promoting the growth of type IIb fibers, where the fat content is low with reduced cooking damage. Type IIa fibers hold larger amounts of a significant metabolic role for threonine is the regulation of gastro-intestinal secretions and endogenous losses, which improves the nutrient digestibility and reduces the likelihood of digestive disorders. In the absence of choline or vitamin B12, other amino acids, such as methionine, may be able to partially compensate for this deficiency by providing the necessary methyl groups.

In the case of broiler, diets are typically designed to contain 22 percent protein in the starter feed and 19 percent protein in the finisher feed (Esmail, 2016). Akinbobola (2018) also recommended that the diets of broilers be designed to contain 21-22 percent for starter diets, 19-20 percent for grower diets, and 18-19 percent for finisher diets.

Sources of protein

Several protein sources are widely used in poultry feed formulation, and each has its own advantages and disadvantages. These protein sources include both plants meals (soybean, alfalfa, cottonseed, and sunflower) and animals (meat, poultry, and eggs). Not only do these various feeds contain protein, but they also contain an abundance of vitamins, minerals, and other vital nutritious food components (Esmail, 2016).

Each of these protein sources should be utilized in a specified quantity within the diet plan and should be combined and blended with other protein sources for the greatest outcomes. This will assist in achieving the desired protein concentration while maintaining a better amino acid profile, as well as alleviating a significant amount of the production and health issues that could arise from utilizing a single protein source above the recommended level of consumption (Esmail, 2016).

Table 2. 1: Sources of Protein

Protein source	The diets level of inclusioin	Outcomes of too much feeding amounts
Soybean meal	Broilers: 25% (starter feed) and 20% (finisher feed). Layers: 12% (Starter feed) and 15% (Finisher feed)	This may result in renal failure as a result of the retention of urates, which obstructs the passage of the droppings. Soybean meal may potentially contribute to the development of goiter.
Alfalfa meal	2-3% for broilers and up to 10% for the layers.	The high concentration of carotenoids results in a strong yellow coloring of the skin, which customers dislike.
Cottonseed meal	50% of the test ingredient can replace soybean meal, but should not be fed in excess of 5% of the layer's diet.	When layers are fed a very high quantity of cottonseed meal, the gossypol found in greenish casts to egg yolks. Cyclopropenoic fatty acids, which are also found in the teat ingredient, cause egg whites to become pink during storage.
Sunflower meal	3-5% for broilers and layers.	Sunflower meal contains anti-nutrients such as pectins and arabinoxylans, which impair protein digestion as well as absorption.
Fishmeal	2-5% for broilers and layers.	Fishy taste is discovered in the meat and eggs when fishmeal is in high amount.
Meat and poultry by-products	Up to 10% for broilers and layers.	*Clostridium perfringens* is found in the gut, resulting in a variety of health concerns when consumed in excess of the appropriate amount.

Source Poultry world (2016)

2.3.3. Vitamins

It is necessary to have a sufficient quantity of vitamins to support poultry nutrition, as it helps to strengthen the bird's defenses against harmful pathogens. This is true for any species, including poultry. During periods of illness or stress, when the immune system is compromised and energy levels are at their lowest, proper nutrition becomes increasingly important to maintain health (Straeten, 2011). In fact, nutrition is an important factor in the prevention, treatment, and recovery from illness or stressful situations. Vitamin nutrition should no longer be regarded as being necessary only for the prevention of deficiency signs, but should also be considered essential for the optimization of animal health, productivity, and product quality as well (McDowell and Ward, 2008). For optimal poultry health, a large number of vitamins must be consumed daily. In poultry, vitamins have a plethora of beneficial effects, including supporting the development of the skeleton, improving health, strengthening immunity, and aiding in the absorption of protein. The following table 2.2 outlines the ramifications of vitamin deficiency in the body.

Table 2. 2: Vitamin deficiencies

Vitamin	Fat Soluble Vitamins
A	Reduced egg production, frailty, and inability to grow
D	Eggs with thin shells, decreased egg output, stunted growth, and rickets
E	Enlarged hocks, encephalomalacia (crazy chick disease)
K	Prolonged clotting of the blood, intra-muscular bleeding
	Water Soluble Vitamins
Thiamine (B1)	Appetite loss and death
Riboflavin (B2)	Paralysis of the curly-toed toes, stunted development, and low egg production
Pantothenic Acid	Dermatitis and wound on the mouth and feet
Niacin	Bowed legs, swelling of tongue and mouth cavity
Choline	Inadequate development, fatty liver, and low egg laying
Vitamin B12	Anaemia, stunted growth, and death of embryo
Folic Acid	Lack of quality growth, anaemia, poor feathering and reduces egg laying
Biotin	Dermatitis on the feet, around the eyes, and on the beak

2.3.4. Minerals

Maintaining optimum nutritional status, 14 inorganic elements are required by the chicken. In addition to those elements; nitrogen, carbon, hydrogen, oxygen and sulfur are the primary constituents of organic chemical compounds found in the body (Scott, Nesheim & Yang, 1982). They are normally classified into two categories according to the quantity demanded by poultry and the amount of each ingredient present in the diet of the poultry. Trace minerals are found in trace levels in animal tissues and are largely involved in the catalysis of enzyme reactions and the regulation of physiological processes (Thompson and Fowler 1990). For chicken, essential macro-minerals are calcium (Ca), phosphorus (P), potassium (K), sodium (Na) and chlorine (Cl). The presence of excessive calcium, on the other hand, may serve as an antagonist, making trace minerals like iron (Fe), copper (Cu), zinc (Zn), as well as other minerals which are magnesium (Mg), sodium (Na), and potassium (K) difficult to absorb (Faria et al., 2020).

2.4. Significance of the Haematology and Serum Biochemical Analysis in Poultry

Oftentimes, determining an animal's present state of health without undergoing a comprehensive blood examination is quite difficult (Amakiri, Owen, & Iboh, 2009). Clinical blood analysis enables veterinarians to conduct clinical investigations into the presence of several metabolites and other bodily elements, and it is critical in determining the animal's biological, nutritional, and pathological health (Etim, Akpabio, Okpongete, & Offiong, 2014).

It is possible to discover changes in health and biological state that are not easily noticed via a physical examination and one approach that can aid in this regard is a blood test that is able to pick up these alterations in health and biological condition (Bamishaiye et al., 2009). The study of the quantities and morphology of the blood's biological parts, such as red cells (erythrocytes), white cells (leukocytes), and platelets (thrombocytes), as well as their application in disease diagnosis and monitoring, is known as haematology (Tijani, Akanji, Agbalaya & Onigemo, 2015). Blood cell formation, storage, and circulation are all investigated in haematology (Tijani et al., 2015). Packed Cell Volume (PCV), Red Blood Cell Count (RBC), and White Blood Cell Count (WBC) are just a few of the blood parameters that can be determined during a haematological analysis. Haematological parameters are excellent indicators of an animal's physiological condition, and changes in these parameters are useful in determining how an animal will respond to a variety of physiological settings and illness conditions (Etim et al., 2014).

The serum is the component that is neither a blood cell nor a factor in the clotting process. It is the fraction of blood that resembles water and includes chemicals (referred to as antibodies) that aid the body in fighting sickness. It is made up of all proteins that are not required for blood coagulation, as well as electrolytes, antibodies, antigens, hormones, and any foreign chemicals not found in blood (Martin, 2007). Some of the serum biochemical parameters include uric acid, albumin, total protein, serum lipid profile, creatinine, and the activities of liver enzymes such as alanine transaminase, aspartate transaminase, and alkaline phosphatase.

Haematological as well as serum biochemical parameters are affected by feed, infections, toxic compounds, medication, sex and age of all of the birds.

Table 2. 3: Normal ranges of haematological parameters of chicken

Hematologic Type	The common ranges for haematological analysis
PCV (%)	35.90-41.0
Haemoglobin (g/dL)	11.60-13.68
RBC (x10-6/mL)	4.21-4.84
WBC (x10-3/mL)	4.07-4.32
MCV (Fl)	81.6-89.1
MCH (Pg)	27.2-28.9
MCHC (%)	32.41-33.37

Retrieved from Wikivet, 2012

2.5. Importance of Carcass Analysis

Broiler breeding's major objective is to boost the economic importance of the broiler meat industry. In the past, practically all poultry were sold as live birds; nevertheless, the number of birds reared for portioning and additional processing has increased significantly in recent years (Zerehdaran, Vereijken, van Arendonk, & van der Waaijt, 2004). In recent years, poultry production and processing technology has become more readily available and is being implemented on a global scale, allowing the meat industry to expand and remain competitive in the long run. However the profitability of chicken meat production was closely linked to enhancement in growth and the carcass output, mainly due to the increase in breast development and a decrease in belly fat. Since 1950, extensive selection for growth is responsible for the growth rate of meat type poultry. It has also been found that fast growth increases fat deposition on the carcass of the chicken. (Zerehdaran et al., 2004). The factors that influence meat quality are numerous and occur at various stages throughout the production cycle. Nutrition, rearing conditions, and pre-slaughter management are all essential details to contemplate when pursuing the objective of high-quality carcasses and these are the practices that must be considered (Esmail, 2016).

2.6. Alternative feed resource available for poultry

To minimize the cost of chicken and other poultry feed, the effectiveness of utilizing locally accessible agro-industrial by-products in chicken feed, a better scientific understanding of their effects is required. (Swain, 2016). In light of the fact that feed accounts for 60-70% of overall production costs, minimizing the feed cost may result in the total production expenses to be reduced significantly. (Thirumalaisamy, Muralidharan, Senthilkumar, Sayee & Priyadharsini, 2016). Crops for human consumption account for the majority of agricultural land use in developing and developing countries and also poultry is viewed as a competitor to humans for grain consumption (Ahammad, 2018). In terms of economics, the use of cereal products as livestock feed is becoming increasingly unjustified (Khajarern and Khajarern, 2007). As a result, it is necessary to take advantage of less expensive energy sources in order to replace expensive cereals used in poultry farming. To the contrary, feeding broilers diets made up of cereal crop by-products and unconventional feedstuffs is an appealing and viable alternative strategy for broiler total production because it would prevent competition between human food and broiler feed (Ahammad, 2018).

Table 2.4: Alternative feed sources and their uses in poultry nutrition

Feed sources	Levels in ration	Effect on poultry	References
Casava leaf meal (CLM)	The chickens were subjected to treatment diets with cassava leaf meal (CLM) included in diets at 0, 100, 200 and 300 g/kg.	The study concluded that the acceptance of meals containing CLM during the chickens' growing-finishing phase was unaffected. However, weight gain was impaired when larger doses of CLM were included in chicken diets	(Bakare et al., , 2020)
Cashew pulp meal (CPM)	Five diets were formulated in which cashew pulp (apple) meal (CPM) replaced 0, 5, 10, 15 and 20% of dietary maize	Inclusion of CPM in the diet of starter broilers depressed performance in terms of weight gain and feed conversion ratio but resulted in a progressive decrease in feed cost, with the best cost of feed/kg gain (N) at 20%. Even at a concentration of 20%, CPM had no significant effect on the health of the birds.	(Oyewole, Rotimi, Anthony & Adewumi, 2017)
Dried brewers' grains (DBG)	The dietary treatments consisted of a basal diet as the control and DBG groups (3%, 6%, 9% and 12%, respectively).	The addition of DBG to broiler diets significantly improved all sensory evaluation indicators except appearance and tenderness.	(Ashour et al., 2019)
Cottonseed meal (CSM)	Five isonitrogenous and isoenergetic diets were formulated to produce diets in which 0%, 25%, 50%, 75%, and 100% of protein from SBM was replaced by protein from CSM.	CSM should not exceed 7.08 percent in gosling diets during the early growth period (day 1 to 28 days), but can be increased to 22.65 percent between days 29 and 63 days. Due to impairments in feed intake, liver metabolism, and antioxidant capacity, a high concentration of CSM may impair growth performance in 1–28 day old goslings.	(Yu et al., 2021)

2.7. Potential of Plant Leaf Proteins in Livestock Production

The leaves of plants are the world's greatest source of protein (Fiorentini and Galoppini, 1983; Ellis, 1979). Around 80% of proteins in leaves is believed to be found in chloroplasts, where approximately half are found in soluble form in the stroma and the other half are found as part of the thylakoid membranes (Fiorentini and Galoppini, 1983; Mejia et al., 2018; Tenorio, Kyriakopoulou, Suarez-Garcia, van den Berg, & van der Goot, 2018).

When you classify leaf proteins according to their ability to dissolve in water, two varieties exist: insoluble and soluble. Proteins that form photosynthetic complexes with lipids and pigments in the chloroplast's thylakoid membranes, as well as other proteins, make up the insoluble protein portion of the chloroplast. (Fiorentini and Galoppini, 1983; Mejia et al., 2018; Tenorio et al., 2018). A limited amount of insoluble protein can also be discovered linked to polysaccharides in the cell wall (Tenorio et al., 2018). While grazing animals commonly consume the protein found in plant leaves, this protein can also be used to supply monogastric animals with nutrients.

Table 2.5: The use of various leaf meals in poultry production

Leaves	Levels in rations	Effects on birds	References
Cassava	Added to the basic ration at levels of 10, 20, and 30%	Addition (all levels) compromised body weight gain and feed efficiency of broilers	Montilla, Vargas &Montaldo (1977)
Papaya	Incorporated at broiler diets at levels of 0, 0.5, 1.5 and 2.0%	The addition of 2% papaya leaf meal to finisher diets increased broiler growth performance.	Onyimonyi and Ernest (2009)
Dried sweet potato	Included at levels of 0, 50, 100, 150, and 200 g/kg DM	The leaf meal can be optimally included in diet at the level of 100 g/kg DM	Tamir and Tsega (2010)
Moringa oleifera	Included at broiler rations at levels of 0, 5, 10, 15 and 20%	5% inclusion Moringa oleifera leaf meal did not have a detrimental influence on growth performance in diets, however its inclusion at 10%-20% lowered broiler growth performance.	Tesfaye, Animut & Dessie (2013)
Bamboo	Included at 5 g/kg in broiler rations	Improved the body weight gain of broilers	Oloruntola, Agbede, Ayodele& Oloruntola (2019)
Pineapple leaf powder	Supplemented to broiler rations at levels of 0, 1, 2 and 3%	Supplementation at all doses increased broiler growth performance and maintained a balanced gut bacteria community	Rahman and Yang (2018)

2.8. *Parkia biglobosa*

2.8.1. Geographical Distribution

A wide distribution of *P. biglobosa* is found throughout the Sudan and Guinea savanna ecological zones, and the species' range extends from the western coast of Africa in Senegal all the way across to Sudan (Keay, 1989). A total of nineteen African countries have been identified as having *P. biglobosa* in their populations: Senegal; Gambia; Guinea-Bissau; Guinea; Sierra Leone; Mali; Côte d'Ivoire; Burkina Faso; Ghana; Togo; Benin; Niger; Nigeria; Cameroon; Chad; Central African Republic; Zaire; Sudan; and Uganda (Keay, 1989) *Parkia biglobosa* can be seen in abundance throughout Nigeria

2.8.2. Taxonomy

- Domain: Eukaryota
- Kingdom: Plantae
- Phylum: Spermatophyta
- Subphylum: Angiospermae
- Class: Dicotyledonae
- Order: Fabales
- Family: Fabaceae
- Subfamily: Mimosoideae
- Genus: Parkia
- Species: *Parkia biglobosa*

2.8.3. Botanical Description

Parkia biglobosa is a plant that belongs to the Fabaceae family. (Alabi, Akinsulire, & Sanyaolu, 2005). The word Parkia was given to it in honor of Mungo Park, a Scottish explorer who died in Niger River in Nigeria in January 1805 while exploring the region (Orwa, Mutua, Kindt, Jamnadass & Simons, 2009). There are several species of this deciduous tree that grows year after year in a belt between 5° N and 15° N 7. It can grow to be up to 20 m tall, and in some cases it can grow to be up to 30 m tall. Indehiscent brown pod 30 to 40 cm long and 2 to 3 cm wide, with up to 20 seeds, the fruit is shaped like a slightly curved, slightly curved, brown pod (Keay, 1989). They are brown, smooth, and oval in shape. Each seed contains 30% testa and 70% green cotyledons, with 30% testa and 70% green cotyledons (Di-Cagno, Filannino & Gobbetti, 2016). The seeds account for 22 percent of the fruit's total weight, with the pod case accounting for 42 percent and the pulp accounting for 36 percent (Di-Cagno et al., 2016). A distinctive longitudinal fissure pattern is present on the bark, which is thick and ash-grey to greyish-brown in color, with a slash that is fibrous and reddish-brown in color and exudes an amber gum; the crown is dense, wide spreading, and umbrella-shaped, with heavy branches forming a dense canopy above the ground (Builders, Isichie, & Aguiyi, 2012). Alternate, dark green, up to 30 cm long, with up to 17 pinnae and 13–60 pairs of leaflets on each of the pinnae, the leaves of this plant are alternate and have 13–60 pairs of leaflets on each pinnae (Orwa et al., 2009).

Parkia biglobosa is a member of the genus Parkia, which is in turn a member of the tribe Parkieae. It is comprised of approximately 35 species with a pan-tropical distribution, with the exception of African locust bean, of which there are five well-known species:

P.filicoidea, P. bicolor, P. roxburghii, P.biglandulosa, and P. madagascariensis (African locust bean). Many Parkia species are found to be high in carbohydrate, protein, and minerals, according to research (Saleh *et al.*, 2021).

Figure 1: ***Parkia biglobosa*** **pending flower head (Heuze, Thiollet, Tran, Edouard, & Lebas, 2019)**

Figure 2: ***Parkia biglobosa*** **tree (Heuzé et al., 2019)**

Figure 3: ***Parkia biglobosa*** **leaves (Heuzé et al., 2019)**

Figure 4: ***Parkia biglobosa*** **pod and yellow mealy pulp (Heuzé et al., 2019)**

Figure 5: ***Parkia biglobosa*** **seed (Heuzé et al., 2019)**

2.8.4. Medicinal uses of *Parkia biglobosa*

For centuries, traditional African medicine has employed *Parkia biglobosa* to treat a variety of ailments, particularly in the Republic of Benin and Nigeria, as well as in Burkina Faso, Ivory Coast, Togo and Mali. The bark, the leaves, and the roots of the plant are particularly useful for this purpose, as are the other components of the plant. The plants are most commonly used to cure digestive problems, wounds, high blood pressure, and infections.

Table 2. 6: Uses of *P. biglobosa* in traditional medicine

Scientific name and Family	Plant part used	Therapeutic indication	Medicinal Preparation (and administration mode)
Parkia biglobosa	Leaves	Liver diseases, hepatic deficiency	Decoction (oral, bath)
Parkia biglobosa	Leaves	Diabetes	Infusion (oral)
Parkia biglobosa	Leaves, pods, stem Bark	Wounds	Powder, decoction (local application)
Parkia biglobosa	Root bark, trunk bark, leaves	Digestive, nervous, cutaneous and pregnancy-birth disorders, infection and infestation, poisoning	Decoction, calcinations, trituration and maceration (oral, bath, (application)
Parkia biglobosa	Bark, fruit pulp	High blood pressure, Yellow fever, Constipation	Bark and fruit are soaked and drunk (oral)
Parkia biglobosa	Stem bark, leaves	Wounds, pain, fungal infection	Bark decoction in water (for bathing and/or drinking) Typically, the powder is dissolved in water (bath and/or drinking) or thrown onto a fire (inhalation)
Parkia biglobosa	Roots	Coal disease	Decoction in salty water (oral)
Parkia biglobosa	Roots,stem bark	Diarrhoea, general weakness, abdominal Pains	Powder, decoction (oral)
Parkia biglobosa	Seeds	Whitlow	Fermentation(local application)
Parkia biglobosa	Seeds, leaves	Hypertension	Decoction (oral)
Parkia biglobosa	Fruits,barks leaves	Constipation, anorexia, rickets, icterus Mumps Haemorrhoid, ascariasis Burns	Fruits flour (oral); gargle, inhalation, fumigation of bark; maceration of fresh leaves, roast the young leaves (local application)
Parkia biglobosa	Stem bark	Wound, antiseptic, disinfectant, cicatrizing	Infusion (oral)
Parkia biglobosa	Bark	Fever, malaria	Maceration in water (oral)

Source (Dedehou et al., 2016)

2.8.5. Toxicity of *Parkia biglobosa*

It is clear from the use of *P. biglobosa* as an herbal remedy in African countries and from reports on the plant's toxicity to humans that the plant is non-toxic to humans when consumed cooked (Angami et al., 2018). The oral median lethal dosage (LD50) for both aqueous and ethanol extracts of P. biglobosa stem bark was higher than 5000 mg/kg in rats, according to an investigation of acute and subacute toxicity profiles (Builders, 2012). However, the LD50 values of the leaves, stems, and roots in an acute toxicity investigation were within the range of 500–5000 mg/kg body weight of fish in another report, indicating that they are only mildly poisonous and thus not potentially dangerous (Abalaka, Fatihu, Ibrahim, & Kazeem, 2010). Apart from the barks of *P. biglobosa*, the pods have piscicidal activity, which can be used to regulate and maintain fishponds by removing predators (Oshimagye, Ayuba & Annume, 2014). *P. biglobosa* seeds have been discovered to contain non-toxic fatty acids and oils, according to studies (Saleh et al., 2021).

CHAPTER 3

3.0. MATERIALS AND METHODS

3.1. Experimental site and duration of the study

The experiment was conducted out at the Poultry Unit of Landmark University Teaching and Research Farm in Omu-Aran, Kwara state, Nigeria. The duration for this study was six weeks.

3.2. Experimental design

This experiment used a completely randomized design for the observation.

3.3. Collection and processing of Experimental feed

Landmark University's Teaching and Research Farm in Omu-Aran, Kwara State, Nigeria, provided the *Parkia biglobosa* leaves used in this experiment. The leaves were dried in the open air to ensure that the nutrients in the leaves were retained. The remaining feed ingredients were purchased from Offa, Kwara State, Nigeria.

3.4. Experimental birds and Management

This research used 150 broiler chicks obtained at a reputable farm. The birds were sectioned of into five treatment groups, with three replicates for each. Thirty broiler chicks were earmarked to each of the five treatments, with 10 chicks per replication. In the poultry house, the light bulbs and the net used for demarcations were properly installed prior to the expected date of brooding. Before brooding, the house, food and beverages were correctly cleansed and disinfected. All experimental feed and clean water were freely available for the three weeks brooding. The chicks were fed experimental diet from day one till the experiment was terminated. The experimental birds were properly vaccinated and routine medication and other management practices were implemented throughout the feeding trial.

3.5. Experimental diets

In this study, three feeding phases/regimes were used: starter diets were given to the birds for the first two weeks, followed by grower diets for one week, and finisher diets for the remaining three weeks. In the first phase, there were five different types of experimental diets; diet 1 served as the control and contained no *Parkia biglobosa* (*P. biglobosa*) leaf meal as a protein source, whereas diets 2 to 5 contained soybean meal (SBM) that had been replaced with graded levels of *P. biglobosa* leaf meal at levels ranging from 5%, 10%, 15%, 20% respectively.

The crude protein of the diets ranged 22.13% to 17.47%, 20.02% to 15.31% and 18.82% to 14.1% for the starter, grower and finisher diets respectively while the calculated metabolizable energy ranged 3137 kcal to 3127 kcal, 3066 kcal to 3055 kcal and 3050 kcal to 3039 kcal for the starter, grower and finisher diets respectively. The diets' compositions for the three feeding regimes are as shown in the tables below

Table 3.1: Experimental diets composition for Starter

Ingredients (%)	**Inclusion level of *P. biglobosa* leaf meal**				
	Control	**5%**	**10%**	**15%**	**20%**
Maize	58.00	58.00	58.00	58.00	58.00
Soybean meal	38.00	36.10	34.20	32.30	30.40
Parkia biglobosa	0.00	1.90	3.80	5.70	7.60
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	0.50	0.50	0.50	0.50	0.50
Premix	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Limestone	1.00	1.00	1.00	1.00	1.00
Toxin binder	0.10	0.10	0.10	0.10	0.10
Calculated analysis					
Crude protein %	22.13	21.04	19.85	18.66	17.47
Metabolizable energy (kcal/kg)	3137	3135	3133	3130	3127

Table 3. 2: Experimental diets composition for Grower

Ingredients (%)	Inclusion level of *P. biglobosa* leaf meal				
	Control	**5%**	**10%**	**15%**	**20%**
Maize	56.50	56.50	56.50	56.50	56.50
Maize Offal	8.00	8.00	8.00	8.00	8.00
Soybean meal	31.50	29.925	28.35	26.775	25.20
Parkia biglobosa	0.00	1.575	3.15	4.725	6.30
Fish meal	1.50	1.50	1.50	1.50	1.50
Bone meal	0.50	0.50	0.50	0.50	0.50
Premix	0.30	0.30	0.30	0.30	0.30
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Limestone	1.00	1.00	1.00	1.00	1.00
Toxin binder	0.10	0.10	0.10	0.10	0.10
Calculated analysis					
Crude protein %	20.02	18.88	17.69	16.50	15.31
Metabolizable energy (kcal/kg)	3066	3063	3060	3058	3055

Table 3. 3: Experimental diets composition for Finisher

Ingredients (%)	Inclusion level of *P. biglobosa* leaf meal				
	Control	**5%**	**10%**	**15%**	**20%**
Maize	58.00	58.00	58.00	58.00	58.00
Maize Offal	9.00	9.00	9.00	9.00	9.00
Soybean meal	29.00	28.05	26.10	24.65	23.20
Parkia biglobosa	0.00	1.45	2.90	4.35	5.80
Fish meal	0.80	0.80	0.80	0.80	0.80
Bone meal	1.00	1.00	1.00	1.00	1.00
Premix	0.25	0.25	0.25	0.25	0.25
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25	0.25
Limestone	1.00	1.00	1.00	1.00	1.00
Toxin binder	0.10	0.10	0.10	0.10	0.10
Calculated analysis					
Crude protein %	18.82	17.63	16.44	15.25	14.10
Metabolizable energy (kcal/kg)	3050	3047	3045	3042	3039

Table 3.4: Vaccination and Medication Schedule

Age (days)	Medication/Vaccination	Root
1	Anti-stress	In the water
2-7	Anti-stress/Antibiotics	In the water
13	Goumboro (First dose)	In the water
13-18	Anti-stress	In the water
20	Lasota (First dose)	In the water
21	Anti-stress	In the water
22-26	Coccidiostat	In the water
27	Gumboro(Second dose)	In the water
27-28	Anti-stress	In the water
33	Lasota (Second dose)	In the water
33-36	Anti-stress	In the water

3.6. Chemical Analysis of the *Parkia biglobosa* leaf meal

3.6.1. The Proximate analysis:

The proximate analysis was done using the procedure of AOAC method (AOAC, 2007).

Moisture determination: The crucibles were disinfected, dried in an oven at 100^oC for 1 hr., and then allowed to cool for 45 minutes in a desiccator. Following that, approximately 2g of the sample was weighed in the dried crucible. The crucible and sample were placed in an oven set to 105^oC for 4 hrs. The crucibles and sample were withdrawn from the oven and chilled for 45 minutes at room temperature in the desiccator before being weighed. This procedure was continued until the weight remained constant.

$$\%Moisture = \frac{(\text{Initial weight of the crucible + sample}) - (\text{Final weight of the crucible + sample})}{\text{Weight of the Sample}} \times 100$$

Determination of Crude Protein (CP): using KJELDAH nitrogen method which is in three stages (digestion, distillation and titration)

Digestion: 1 gram of the sample was weighed into kjeldah flask, 1 kjeldah tablet was added, 10 milliliter of concentrated sulphuric acid, spelt of selenium (catalyst) were added in that order to the sample. The sample was digested at 420^oC until clear solution was obtained.

Distillation: After cooling the digested sample solution, it was distilled with alkali-containing sodium thiosulfate. The resulting ammonia was distilled into a boric acid solution containing methylene blue and methyl red indicators.

$(NH_4)_2SO_4$ +2NaOH+2NH_3 →2 Na_2SO_4 +2H_2O

NH_3 +H_3BO_3 (boric acid) → NH_4^+ +$H_2BO_3^+$ (borate ion)

Titration: Titration of the distillate with standardized 0.1 N hydrochloric acid was carried out until the first appearance of the pink color was observed. Additionally, a blank sample was titrated to account for any residual nitrogen present in the chemicals employed.

Calculation: % Nitrogen = $\frac{(\text{Vs} - \text{Vb x } 0.0014\ )\text{x } (100 \text{ x } 250\ )}{\text{W x } 25}$

Where; Vs = Vol (ml) of acid required to titrate the sample

Vb= Vol (ml) of acid required to titrate the blank

W= weight of sample in grams

Note: 100 % N in protein = conversion factor.

% Crude Protein = % N x F

Ether extract: This was analyzed using Soxhlet method. 1g of the sample was carefully enclosed in Whatman filter paper then inserted into the Soxhlet tube that was 75% filled with petroleum ether for semi continuous solvent extraction. This was boiled until clear solution was observed. The fat content of a sample is determined by its weight loss..

Crude Fiber: Weighing the sample (1g) into a 500 ml flask, 100 ml of tricarboxylic acid (TCA) digestion reagent was added. This was left to boil and reflux for exactly 40 minutes, beginning with the start of the boiling. The flask was withdrawn from the heater, cooled, and filtered using a known-weight No 4 Whatman filter paper. Six times with hot water and once with industrial spirit rinsed the residue. The filter paper was folded and placed in a known-weight porcelain dish. It was dried in the oven overnight at 105oC. This was removed, cooled for 45 minutes in a desiccator, and the weight was measured. The sample and filter paper in the dish were burned for approximately one hour on a hot plate before being transferred to a muffle furnace set to 600oC for five hours. After ashing, the dish was chilled and weighed in a desiccator. The crude fiber was determined using the following equation:

%Crude Fiber = Difference in weight x 100

Ash: The crucibles were dried in an oven for one hour at 100oC before being placed in a desiccator to cool. In the dry weighted crucibles, 1g of samples were weighed. The sample-containing crucible was then placed in the muffle furnace for 4 hours at 550oC. After that, the samples were removed from the furnace, cooled in a desiccator, and weighed. The ash content was determined as follows:

$$\% \text{ Ash} = \frac{(\text{Weight of empty crucible + ash}) - (\text{Weight of empty crucibles})}{\text{Weight of the Sample}} \times 100$$

Nitrogen free extracts (NFE): NFE was calculated from the formula below:

%NFE = 100 – (Moisture + CP + EE + CF + Ash)

3.7. Growth performance indices determination

The birds were given a measured quantity of feed every day and on the following day the left over were removed and measured to evaluate the feed intake by the experimental birds. Feed intake (g) = Quantity of feed given – Quantity of feed not consumed

Feed intake and weight gain were determined on weekly bases. Weekly weight gain (g) =Final weight – Initial weight

Feed conversion ratio = Quantity of feed consumed ÷ Weight gain

Mortality (%) = (Number of dead animals ÷ Total number of animals) × 100

3.8. Carcass and organ indices

As a result of the feeding trail, two birds from each treatment (ten birds in total) were picked, fed for 24 hours, then fasted for 24 hours, weighed, and then had their jugular veins cut to provide them with an even treatment and allow an equal number of birds to be selected. Before being defeathered, they were thoroughly bled and scalded by dipping them in warm water (50-55 degrees Celsius). Weighing the birds allowed us to determine their Live weight, Slaughter weight, Defeathered weight, Eviscerated weight, and Trunk weight. Cut parts evaluation was performed on each dressed carcass that had been divided into pieces. Besides that, the organs were weighed as well: the gastro intestinal tract (GIT), the proventriculus, the gizzard (full), the gizzard (empty), the heart, the lungs, the kidney, the liver, and the abdominal fat.

3.9. Haematological and Serum-Biochemical Indices Determination:

At the end of the trial, two sets of blood were drawn from the brachial veins. Two chickens were chosen at random from each treatment and bled via the brachial vein with sterile needles and syringes. In the first set, 2 ml of blood was collected into EDTA-laden bottles for haematological analysis using an automated Mindray BC 2800, while the erythrocyte indices (mean corpuscular volume, mean corpuscular haemoglobin, and mean corpuscular haemoglobin concentration) were calculated from the packed cell volume (PCV), haemoglobin (Hb), and the mean corpuscular haemoglobin concentration (RBC).

The mean corpuscular volume (MCV) expresses the average red cell volume measured in cubic micron (μ^3).

$$\text{MCV} = \frac{PCV}{RBC}\ X\ 10$$

Mean corpuscular haemoglobin (MCH): This expresses the amount of haemoglobin per cell expressed in pictogram (pg).

$$\text{MCH} = \frac{Hb\ (g/100ml)}{RBC}\ X\ 100$$

Mean corpuscular haemoglobin concentration: This is the concentration of haemoglobin in red cells as a percentage of the concentration of haemoglobin in 100 ml of whole blood.

$$\text{MCHC} = \frac{\text{Hb (g/100ml)}}{\text{PCV}}\ X\ 100$$

To test the serum biochemical indices (such as glucose, cholesterol, total bilirubin, albumin, urea, creatine, total protein, ALT, SGOT, and SGPT), 2.0 ml of blood was collected from the birds without anticoagulant into plain sample bottles and then the blood was tested using the colorimetric method with BIOBASE BK-F96PRO spectrophotometer.

3.10. Feed cost benefit

The feed cost reduction of replacing the soybean meal with *P. biglobosa* leaf meal (PBLM) was calculated. Other treatment expenses were common for all medications, vaccination and litter.

3.11. Statistical analysis

The present study used a Completely Randomized Design (CRD), and the results were subjected to one-way Analysis of Variance (ANOVA). The Duncan Multiple Range Test, which is included in the IBM SPSS Statistics 20 software, was used to find significant differences between treatment means.

CHAPTER 4

4.0 RESULTS AND DISCUSSIONS OF FINDINGS

4.1. Results

4.1.1. Chemical composition of the leaves

Using proximate analysis, the chemical composition of P. biglobosa leaf meal was obtained. The results are shown in Table 4.1. Because the replacement ingredient contains 18.21 percent crude protein, it can be used as a source of protein in chicken feed, according to the results of the proximate analysis.

Table 4.1: Proximate composition analysis of *P. biglobosa* leaf meal

Parameters	**Value (%)**
Moisture	15.45
Dry matter	84.55
Crude protein	18.21
Crude fiber	9.5
Ether Extract	8,13
Ash	7.65
Nitrogen free extract (NFE)	41.06

Values are in means of duplicate

4.1.2. Growth performance

4.1.2.1. Starter feeding phase

The results for growth performance during the starter feeding phase (Table 4.2) revealed that the partial replacement of soybean meal (SBM) with *P. biglobosa* leaf meal had a significant (P 0.05) impact on the growth parameters, with the exception of total and daily feed intakes, but not on the other growth parameters. Generally the values reduced as the replacement level of soybean meal with *P. biglobosa* leaf meal increased. There were statistical ($P > 0.05$) similarities among the control diet, diets 2 and 3 in all the parameters, while values observed in diets 4 and 5 were similar ($P > 0.05$) to each other but differ ($P > 0.05$) to values obtained for diets 1 to 3. Live weight also showed that there was a similarity ($P < 0.05$) among diets 1, 2 and 3. Likewise, the total weight gain and daily weight gain were significantly ($P < 0.05$) influenced by the inclusion of the *P. biglobosa* leaf meal.

Table 4.2: Growth performance result for starter

Parameters (g)	**Diet 1 (0%)**	**Diet 2 (5%)**	**Diet 3 (10%)**	**Diet 4 (15%)**	**Diet 5 (20%)**	**P-value**
Final weight	185.57 ± 1.72^{b}	186.97 ± 7.45^{b}	186.20 ± 6.25^{b}	163.90 ± 6.65^{a}	161.07 ± 2.46^{a}	0.011
Total weight gain	144.83 ± 1.73^{b}	146.40 ± 6.84^{b}	145.40 ± 6.30^{b}	123.57 ± 6.55^{a}	120.77 ± 2.22^{a}	0.01
Daily weight gain	10.33 ± 0.12^{b}	10.47 ± 0.46^{b}	10.37 ± 0.43^{b}	8.83 ± 0.47^{a}	8.63 ± 0.15^{a}	0.008
Total feed intake	188.97±6.66	189.03±6.12	192.10±6.36	178.80±7.50	182.17±0.55	0.525
Daily feed intake	13.50±0.47	13.50±0.42	13.70±0.46	12.77±0.55	13.01±0.06	0.533
Feed conversion ratio	1.30 ± 0.06^{a}	1.30 ± 0.00^{a}	1.30 ± 0.07^{a}	1.40 ± 0.03^{ab}	1.50 ± 0.03^{b}	0.016

Values are in means of triplicate ± standard error

a, b = Means on the same row but with different superscripts are significantly different (P < 0.05)

4.1.2.2. Grower feeding phase

The growth performance results at the grower feeding phase (Table 4.3) showed that *P. biglobosa* leaf meal was significant ($P < 0.05$) and affected the growth parameters across the diets. Like the observation at the starter phase, the values decreased as the level of inclusion of *P. biglobosa* leaf meal increased in the diets. There were statistical ($P > 0.05$) similarities among the control diet, diets 2 and 3 in all the parameters and are better than values obtained in diets 4 and 5. Finally, for feed conversion ratio (FCR) the control diet had the least and best FCR. The FCR obtained in diets 2, 3 and 4 were statistically ($P > 0.05$) similar.

Table 4.3: Growth Performance Result of Grower Feeding Phase

Parameters (g)	Diet 1 (0%)	Diet 2 (5%)	Diet 3 (10%)	Diet 4 (15%)	Diet 5 (20%)	P-value
Final weight	503.20±9.26^{b}	459.80±21.07^{b}	451.43±19.43^{b}	396.47±5.36^{a}	360.77±21.88^{a}	0.001
Total weight gain	317.63±9.09^{c}	272.77±19.63^{bc}	265.23±13.27^{b}	232.57±2.48^{ab}	199.70±20.66^{a}	0.002
Daily weight gain	45.39±1.31^{c}	38.97±2.78^{bc}	37.90±1.91^{b}	33.23±0.37^{ab}	28.5±2.96^{a}	0.002
Total feed intake	388.97±13.31^{b}	372.67±4.17^{b}	386.80±12.10^{b}	339.23±4.81^{a}	320.20±9.11^{a}	0.001
Daily feed intake	55.57±1.88^{b}	53.23±0.58^{b}	55.23±1.72^{b}	48.47±0.69^{a}	45.73±1.32^{a}	0.001
Feed conversion ratio	1.20±0.06^{a}	1.40±0.10^{ab}	1.40±0.03^{ab}	1.40±0.03^{ab}	1.70±0.20^{b}	0.114

Values are in means of triplicate ± standard error

a, b, and c = Means on the same row but with different superscripts are significantly different ($P < 0.05$)

4.1.2.3. Finisher Feeding Phase

The results on the growth performance at the finisher phase (Table 4.4) also showed that the inclusion of *P. biglobosa* leaf meal significantly ($P < 0.05$) affected the growth parameters. Generally, the values decreased with the increased level of *P. biglobosa* leaf meal in the diets. The total feed intake and daily feed intake of the control diet though numerically higher, were statistically ($P < 0.05$) similar to those of diets 2, 3 and 4. The Feed conversion ratio (FCR) result shows similarity ($P > 0.05$) between diets 1 and 2; while the FCR values were similar ($P > 0.05$) in diets 3, 4 and 5.

Table 4.4: Growth Performance Result for Finisher Feeding Phase

Parameters (g)	**Diet 1 (0%)**	**Diet 2 (5%)**	**Diet 3 (10%)**	**Diet 4 (15%)**	**Diet 5 (20%)**	**P-value**
Final live weight	1163.58 ± 40.26^{d}	1094.00 ± 26.84^{cd}	1029.27 ± 24.94^{bc}	943.73 ± 39.16^{ab}	855.43 ± 16.50^{a}	0.00
Total weight gain	660.38 ± 31.34^{c}	634.20 ± 21.98^{bc}	578.03 ± 24.19^{abc}	547.27 ± 41.32^{ab}	494.57 ± 38.07^{a}	0.029
Daily weight gain	31.47 ± 1.48^{c}	30.2 ± 1.05^{bc}	27.53 ± 1.16^{abc}	26.07 ± 1.97^{ab}	23.54 ± 1.81^{a}	0.028
Total feed intake	217.10 ± 9.60^{b}	215.23 ± 7.55^{b}	209.33 ± 4.54^{b}	201.60 ± 2.48^{b}	177.63 ± 5.90^{a}	0.009
Daily feed intake	10.33 ± 0.47^{b}	10.27 ± 0.35^{b}	9.97 ± 0.22^{b}	9.60 ± 0.12^{b}	8.47 ± 0.28^{a}	0.010
Feed conversion ratio	0.30 ± 0.0^{a}	0.30 ± 0.03^{a}	0.40 ± 0.0^{b}	0.40 ± 0.03^{b}	0.40 ± 0.03^{b}	0.147

Values are in means of triplicate ± standard error

a, b, c and d = Means on the same row but with different superscripts are significantly different ($P < 0.05$)

4.1.2.4. Overall Performance Characteristics

The overall growth performance (Table 4.5) showed that partial replacement of soybean meal with *P. biglobosa* leaf meal significantly ($P < 0.05$) influence the final weight, total weight gain and total feed intake of the broiler chickens while the FCR were not significantly ($P > 0.05$) affected. The growth parameters values decreased with increased inclusion level of the *P. biglobosa* leaf meal for the final weight and total weight gain. The Total feed intake was statistically similar between the control diet and diets 2, 3 and 4.

Table 4.5: Growth Performance Result of Overall Performance Characteristics

Parameters (g)	**Diet 1 (0%)**	**Diet 2 (5%)**	**Diet 3 (10%)**	**Diet 4 (15%)**	**Diet 5 (20%)**	**P-value**
Final weight	1163.58±40.26^{d}	1094.00±26.84^{cd}	1029.27±24.94^{bc}	943.73±39.16^{ab}	855.43±16.50^{a}	0.000
Total weight gain	1122.83±39.78^{d}	1053.37±26.36^{cd}	988.67±24.80^{bc}	903.4±38.91^{ab}	815.03±16.75^{a}	0.000
Total feed intake	795.03±24.54^{b}	776.93±15.92^{b}	788.23±14.96^{b}	719.63±9.86^{a}	680.00±14.87^{a}	0.002
Feed conversion ratio	0.70±0.00	0.73±0.03	0.80±0.00	0.80±0.06	0.80±0.00	0.109

Values are in means of triplicate ± standard error

a, b, c and d = Means on the same row but with different superscripts are significantly different (P < 0.05)

4.1.3. Carcass analysis

The result for carcass analysis is shown in Table 4.6 where the partial replacement of soybean meal with *P. biglobosa* leaf meal significantly ($P < 0.05$) affected all the carcass indicators. The same was observed for the primal cut parts with the exception of the thigh and wings. Generally the carcass trait reduced as the inclusion of *P. biglobosa* leaf meal increased in the diet. The eviscerated weight is statistically ($P > 0.05$) similar in the control diet, diet 2 and diet 3. The trunk weight is statistically ($P > 0.05$) similar in the control diet and diet 1. The thighs and wings are statistically ($P > 0.05$) similar across diet groups, however numerical highest values were observed in diet one and diet two for the thigh and the wing respectively.

Table 4.6: Carcass analysis result of broiler chickens fed diet containing *P. biglobosa* leaf meal

Parameters (g)	**Diet 1 (0%)**	**Diet 2 (5%)**	**Diet 3 (10%)**	**Diet 4 (15%)**	**Diet 5 (20%)**	**P-value**
Live weight	1163.58±40.26^{d}	1094.00±26.84^{cd}	1029.27±24.94^{bc}	943.73±39.16^{ab}	855.43±16.50^{a}	0.000
Slaughter weight	1114.28±3.78^{e}	1067.76±3.94^{d}	1007.84±4.98^{c}	911.39±0.28^{b}	834.18±1.28^{a}	0.00
Defeathered weight	1055.23±3.31^{e}	1008.96±4.24^{d}	956.25±8.97^{c}	862.39±0.55^{b}	779.54±1.82^{a}	0.00
Eviscerated weight	857.62±50.85^{c}	861.99±3.91^{c}	826.38±2.24^{c}	734.29±2.24^{b}	642.23±0.78^{a}	0.004
Trunk weight	746.81±1.12^{d}	751.38±4.36^{d}	688.35±7.63^{c}	620.63±5.58^{b}	544.37±2.25^{a}	0.00
Prime parts/ Retail cut relative to live weight (%)						
Breast	10.89±0.44^{a}	19.77±0.40^{bc}	19.02±1.05^{bc}	22.3±2.12^{c}	18.12±0.26^{b}	0.005
Thigh	10.63±0.14	9.49±0.46	10.32±0.29	9.99±0.18	10.1±1.74	0.486
Drumsticks	12.95±0.97^{b}	9.99±0.04^{a}	9.3±0.28^{a}	8.27±0.55^{a}	8.80±0.66^{a}	0.014
Back	20.26±1.31^{b}	15.15±0.39^{a}	13.27±1.20^{a}	13.65±0.07^{a}	14.15±0.80^{a}	0.012
Wings	8.72±0.15	9.38±0.96	9.25±0.78	8.19±0.48	8.18±0.13	0.526

Values are in means of duplicate ± standard error

a, b, c, d and e = Means on the same row but with different superscripts are significantly different ($P < 0.05$)

4.1.3.1. Relative organ weight

The relative organ weight (Table 4.7) indicate that the partial replacement of soybean meal with *P. biglobosa* leaf meal as protein source significantly ($P < 0.05$) affect the gastro intestinal tract (GIT), lung spleen and the liver while the proventriculus, the gizzard, the heart and the abdominal fat were not impacted in any way by the presence of the experimental ingredient. The relative results for GIT were statistically similar in both diet 1 and diet 3; the highest relative values for GIT, proventriculus, heart, lungs, abdominal fat and liver were observed in diet 5.

Table 4.7: Relative organ weight result of broiler chickens fed diet containing *P. biglobosa* leaf meal

Parameters (%)	**Diet 1 (0%)**	**Diet 2 (5%)**	**Diet 3 (10%)**	**Diet 4 (15%)**	**Diet 5 (20%)**	**P-value**
GIT	5.03 ± 0.13^{ab}	4.42 ± 0.22^{a}	4.58 ± 0.16^{ab}	5.48 ± 0.46^{bc}	6.26 ± 0.10^{c}	0.017
Proventriculus	0.44±0.02	0.44±0.02	0.54±0.01	0.48±0.04	0.54±0.16	0.769
Gizzard (full)	3.23±0.17	3.17±0.14	2.66±0.02	2.84±0.29	3.10±0.15	0.245
Gizzard (empty)	2.20±0.05	1.93±0.20	1.86±0.04	2.05±0.07	2.09±0.02	0.265
Heart	0.45±0.07	0.50±0.08	0.48±0.01	0.56±0.01	0.56±0.07	0.594
Lungs	0.47 ± 0.04^{ab}	0.37 ± 0.03^{a}	0.43 ± 0.04^{ab}	0.54 ± 0.07^{ab}	0.59 ± 0.05^{b}	0.089
Spleen	0.12 ± 0.02^{ab}	0.10 ± 0.01^{a}	0.15 ± 0.0^{b}	0.12 ± 0.01^{ab}	0.12 ± 0.02^{ab}	0.233
Abdominal fat	0.98±0.01	0.91±0.12	1.22±0.19	1.02±0.44	1.53±0.08	0.392
Liver	1.49 ± 0.04^{a}	1.73 ± 0.21^{ab}	2.39 ± 0.05^{b}	1.86 ± 0.42^{ab}	2.51 ± 0.13^{b}	0.080

Values are in means of duplicate ± standard error

a, b and c= Means on the same row but with different superscripts are significantly different ($P < 0.05$)

4.1.4. Haematological and Serum-biochemical analysis

4.1.4.1. Haematological results

The results for haematological analysis (Table 4.8) showed that the partial replacement of soybean meal with *P. biglobosa* leaf meal did not significantly ($P > 0.05$) affect the broiler chickens.

Table 4.8: Haematological result for the broilers fed diet containing *P. biglobosa* leaf meal

Parameters	Diet 1 (0%)	Diet 2 (5%)	Diet 3 (10%)	Diet 4 (15%)	Diet 5 (20%)	P-value
PCV (%)	26.50±0.50	26.00±2.00	24.50±0.50	27.00±1.00	27.0±4.50	0.894
WBC (10^9/l)	10.80±0.00	11.20±1.00	10.85±0.75	9.75±0.05	10.40±0.00	0.494
RBC (10^6/µl)	2.35±0.05	1.90±0.60	1.40±0.20	2.45±0.15	2.05±0.45	0.360
Haemoglobin (g/dl)	2.90±0.40	2.70±0.30	2.20±0.20	2.90±0.20	2.45±1.15	0.880
MCV (ƒl/cell)	112.77±0.27	148.31±36.30	179.12±29.16	110.37±2.68	135.88±7.88	0.268
MCH (þ/cell)	12.31±14.40	15.23±32.31	15.83±8.34	12.07±3.31	11.26±31.38	0.525
MCHC (g/dl)	10.92±1.30	10.36±0.36	9.00±1.00	10.73±0.35	8.45±2.80	0.702

Values are in means of duplicate ± standard error

Legend

PCV = Packed Cell Volume; WBC = White blood cell; RBC = Red blood cell; MCV = Mean Corpuscular Volume; MCH = Mean Corpuscular Haemoglobin; MCHC = Mean Corpuscular Haemoglobin Concentration

4.1.4.2. Serum-biochemical results

The result for serum biochemical analysis (Table 4.9) showed that the lowest value for glucose and cholesterol were obtained in diet 5 containing 20% of *P. biglobosa* leaf meal. Diet five also had the highest total protein and albumin values. The cholesterol value reduced as *P. biglobosa* leaf meal increased in the diets while the total protein and its fraction increased as *P. biglobosa* leaf meal increased for the diets. In a like manner, the alkaline phosphatase (ALP), the urea, serum glutamic pyruvic transaminase (SGPT) and total bilirubin reduced as *P. biglobosa* leaf meal increased in the diets.

Table 4.9: Serum-biochemical result for the broiler chickens fed diet containing *P. biglobosa* leaf meal

Parameters	**Diet 1 (0%)**	**Diet2 (5%)**	**Diet 3 (10%)**	**Diet 4 (15%)**	**Diet5 (20%)**	**P-value**
Glucose (mmol/l)	3.95±2.15	5.95±0.15	6.15±0.05	6.15±0.05	3.4±2.30	0.529
Cholesterol (mmol/l)	4.25±0.45	4.0±0.10	3.9±0.10	3.95±0.15	3.45±0.05	0.285
Total Protein (g/l)	47.0±1.00	46.5±0.50	47.0±1.00	47.0±2.00	48.5±0.50	0.775
Albumin (g/l)	21.5±0.90	20.05±0.45	20.7±0.50	19.9±0.50	20.45±1.05	0.590
Creatine (µmol/l)	73.00±1.00	64.5±3.50	68.5±2.50	62.5±2.50	67.5±3.50	0.214
Urea (mmol/l)	$4.1±0.00^{c}$	$3.85±0.05^{b}$	$3.95±0.05^{b}$	$3.7±0.00^{a}$	$3.9±0.00^{b}$	0.002
Total bilirubin (µmol/l)	$2.95±0.15^{b}$	$2.35±0.55^{b}$	$2.0±0.10^{ab}$	$1.1±0.10^{a}$	$2.15±0.05^{b}$	0.033
ALP (µ/l)	260.5±52.50	95.00±21.0	190.5±121.50	130.00±46.00	67.5±1.50	0.330
SGPT (µ/l)	$12.5±2.30^{c}$	$5.7±1.20^{ab}$	$7.15±0.75^{b}$	$1.2±0.10^{a}$	$5.5±0.60^{ab}$	0.011
SGOT (µ/l)	$11.45±0.25^{ab}$	$6.45±0.95^{a}$	$11.65±3.95^{ab}$	$11.55±0.55^{ab}$	$15.7±3.10^{b}$	0.228

Values are in means of duplicate ± standard error
a and b= Means on the same row but with different superscripts are significantly different (P < 0.05)
Legend
ALP = Alkaline phosphatase; SGOT = Serum glutamic oxaloacetic transaminase; SGPT = Serum glutamic pyruvic transaminase

4.1.5. Feed cost benefit of broiler chickens fed diet containing *P. biglobosa* leaf meal

The result (Table 4.10) precented that the inclusion of *P. biglobosa* leaf meal in the diet of broiler chicken reduced the cost of production at all the feeding phases (starter, grower, and finisher). It was also discovered that the feed cost reduction relative to the diet increased as the inclusion level of *P. biglobosa* leaf meal increased.

Table 4.10: Feed cost benefit result of broiler chicken fed diet containing *P. biglobosa* leaf meal

Parameters	**Diet 1 (0%)**	**Diet 2 (5%)**	**Diet 3 (10%)**	**Diet 4 (15%)**	**Diet 5 (20%)**
Total weight gain starter(kg)	0.21	0.22	0.22	0.18	0.18
Total weight gain grower(kg)	0.25	0.20	0.19	0.18	0.14
Total weight gain finisher(kg)	0.84	0.87	0.78	0.74	0.66
Total weight gain(kg)	1.30	1.29	1.19	1.10	0.98
Feed intake starter(kg)	0.38	0.38	0.38	0.36	0.36
Feed intake grower(kg)	0.39	0.37	0.39	0.34	0.32
Feed intake finisher (kg)	1.95	1.94	1.88	1.81	1.6
Total feed cost starter(₦)	84.26	81.51	78.75	72.00	69.39
Total feed cost grower(₦)	78.62	70.98	71.02	58.60	52.03
Total feed cost finisher (₦)	363.15	347.22	322.85	297.71	251.57
Total feed cost (₦)	526.03	499.71	472.62	428.31	372.99
Feed cost reduction (₦)	0	26.32	53.41	97.72	153.04

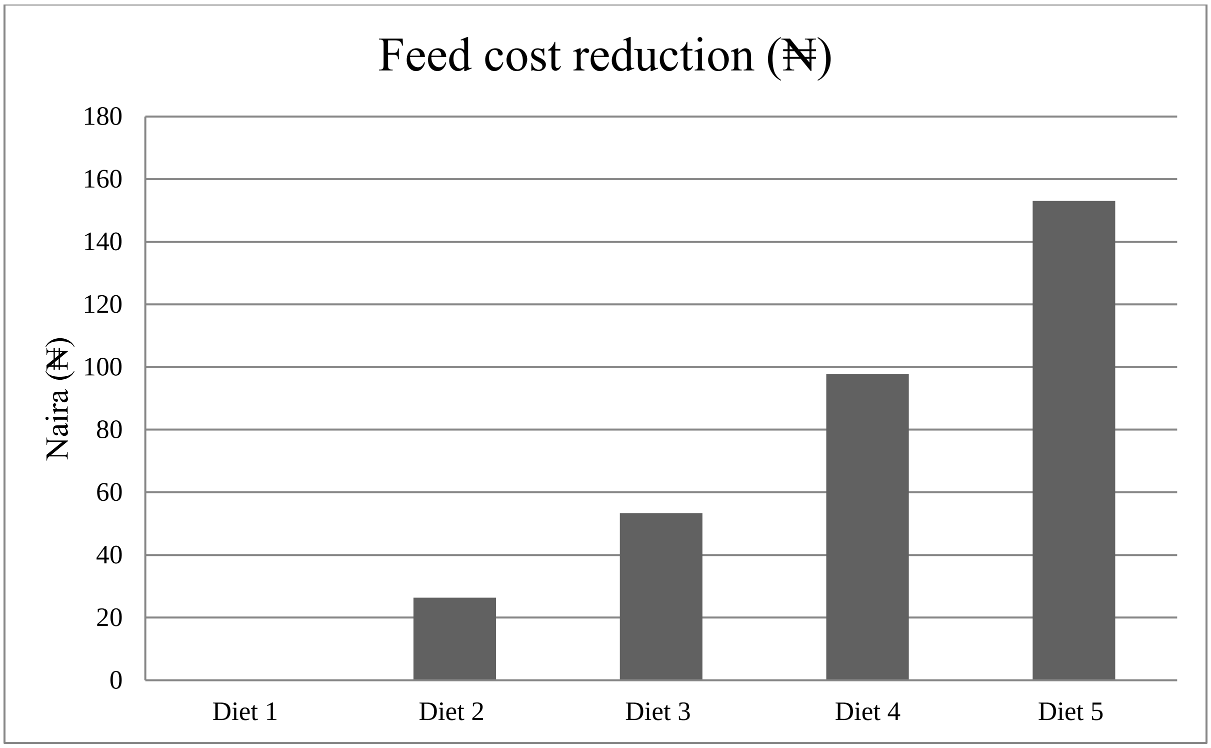

Figure 6: Bar chart showing feed cost reduction

4.2. Discussion

4.2.1. Proximate Analysis of *P. biglobosa* Leaf Meal

The present study for proximate analysis of PBLM showed that the crude protein (18.21%) and ether extract (8.13%) is greater than the results observed by Alalade et al. (2016) for crude protein (13.15%) and ether extract (1.90%). They also reported higher crude fiber, moisture, dry mater, and ash contents than the values found in this research. The crude protein (16.23%) of PBLM reported by Afolayan, Afolayan, & Muhammad (2019) was lower that the crude protein (18.21%) of the present research. The high level of protein in PBLM obtained in the study for the crude protein (18.21%) is in accordance with the result of Soetan, Akinrinde & Adisa, (2014) (18.40%). These variations in the value of crude protein may be related to variations in the geographical locations where the plants are growing and developing, as well as variations in the stage of maturity of the plants.

The proximate results of PBLM in this study is more for the crude protein (18.21%) when compared to the various leaf meal *Maerua crassifolia* leaf meal (15.17%), *Moringa oleifera* (17.01%) and *Alchornea cordifolia* (13.19%) (Aletan and Kwazo, 2019; Ogbe et al., 2021; Ngaha, Dahlan, Massoma, Mandengue & Yusuf, 2016). However the following leaf meals have a higher crude protein than PBLM presented in this study; they are neem leaf meal (22.40%), cassava leaf meal (25.37%) and *Acacia angustissima* leaf meal (23.40%) (Abu, Olaleru, Oke, Adepegba, & Usman, 2015; Ncube, Halimani, Chikosi, & Saidi, 2018; Ubua, Ozung & Inagu, 2019)

4.2.2 Growth Performance at Different Feeding Phase for Broiler Chickens Fed Diets Containing *P. biglobosa* Leaf Meal (PBLM)

4.2.2.1. Growth Performance at Starter Feeding Phase

This investigation observed that the weight gain of the broilers was equivalent for the control diet, diet 2, and diet 3. This may have been due to the broilers' feed intake. The intake of the feed had a progressive increase from the control diet to the diet with 10% inclusion level and then began to drop from the inclusion level of 15%. The initial rise in feed intake was likely due to an increase bulkiness of the feed; and bulky feeds are higher in fiber and rather low in nutrient concentration per unit volume and thus birds eat more to satisfy their needs (Adeyemi, Adekoya, & Sobayo, 2012). The decrease in feed intake, on the other hand, could be likened to the high quantity of *P. biglobosa* leaf meal in the diet was high. The anti- nutritive content at this level of inclusion and the pungent odor of the leaves in the diet could have made it unpalatable (Enu, 2016). This result is also related to Omekan's (1994) observations that a possible decline in feed intake could be because the leaf meal imparted an undesirable taste to the feed, causing the birds to not consume enough quantities of the feed.

In all treatments the feed conversion ratio of birds was significantly enhanced; however the feed conversion ratio was statistically ($P > 0.05$) similar for birds on diet 1, 2 and 3.

4.2.2.2. Growth Performance at the Grower Feeding Phase

At the grower feeding phase, the highest weight gain was discovered in the control diet and a constant decrease in weight gain was observed across the other diets. The low body weight of chicken fed diets with 15% to 20% inclusion level of *P. biglobosa* leaf meal can be linked to a lower supply of energy and minerals due to low feed intake. A large percentage of the calories and nutrients that are taken by chicks before four weeks of age go toward growth, while those consumed after four weeks have a larger proportion dedicated to keeping the bird healthy. (Saki and Alipana, 2005; Sunder et al., 2007). As a result, during the early stages of a bird's life, when energy and other nutrients are few, growth is halted (Simol et al., 2012)

The feed efficiecy of the birds were not infected by the experimental diets, as the birds have a normal feed conversion ratio (FCR) that ranges from 1.4 to 1.7 for 5% to 20% inclusion level of *P. biglobosa* leaves. Feedi (2019) confirms this result, stating that ordinary broiler chicken raised in an enclosed poultry house will undoubtedly have an FCR of 1.5 to 1.9.

4.2.2.3. Growth Performance at the Finisher Feeding Phase

The finisher feeding phase showed a significant effect of the experimental diets on the birds. At this phase the performance indicators (total live wight, total weight gain, daily weight gain, total feed intake, daily feed intake) were highest at the contol diet and had a continuious decrease from 5% inclusion level to 20% inclusion level of *P. biglobosa* leaf meal (PBLM). It appeared that the broilers at the finishers phase could not tolerate high levels of *P. biglobosa* leaf meal. Imasuen, Nwokoro, & Osa (2014) discovered that dietry inclusion of *Telfaira occidentalis* leaf (pumpkin leaf) meal depressed the growth performance rate of broilers as the levels of *Telfaira occidentalis* leaf increased. The present result showed that the feed conversion ratio of the control diet and diet 2 were similar but lower than the rest of the diets. The research of Aderemi, Alabi, Ayoola, &

Oyelami (2017) was in tandem with the present result, for they discovered that the inclusion of fermented locust bean (*Parkia biglobosa*) seed meal in poultry diet had no effect on the feed conversion ratio as it was better in control diet.

4.2.2.4. Overall Performance Characteristics

In this feeding trial, highest growth in terms of average weight gain and final body weight recorded for birds fed with control diets. The precent result was in concordance with the research of Oloruntola (2018) who discovered that the optimum growth was at the control diet for the experimental birds fed *Gliricidia* leaf meal. The poor performance of the birds could likened to the report of Tekeli, Kutlu & Celik (2011), who indicated that antibiotics or plant extract supplementation in a broiler experiment had no effect on the body weight gain of the chickens.

The reduction in the feed intake with countinues higher levels of PBLM in broiler diet in this present study, corroborates with the findings of Gudiso, Hlatini, Chimonyo, & Mafongoya (2019) where they reported that inclusion of *Acacia angustissima* leaf meal in broilers diet reduced feed intake. According to Smith et al. (2003), two processes might contribute to decreased feed intake: lower palatability and aversive post-ingestive feedback due to nutritional insufficiency (tannin-protein complexes), resulting in reduced protein availability. Another reason could be that fiber in PBLM reduced feed intake by causing bulkiness in the stomach due to reduced feed digestibility and intestinal impaction, resulting in poor broiler growth performance (Gadzirayi, Masamha, Mupangwa & Washaya, 2012).

The overall performance result showed that the inclusion of *P. biglobosa* leaf meal in the diet did not have a significant effect on the feed conversion ratio for the broiler chickens. The result of Onunkwo & George (2015) was in agreement with the present study that there was no significant difference (P >0.05) in the feed conversion ratio of broilers fed *Moringa Oleifera* leaf meal.

4.2.3. Carcass and organ quality of broilers fed *Parkia biglobosa* leaves

The eviscerated weight and trunk weight of broiler chickens fed 0% (control diet) and 5% PBLM inclusive diet were similar (P>0.05) but significantly (P<0.05) greater than those fed the 10% to 20% PBLM inclusive diet. This implies that the inclusion of PBLM will support the normal development of the muscle or edible portion of the broiler chicken up to a 5% level, but that the effect will diminish from 10% to 20%. This result is in line with the reports of Oloruntola (2018) who discovered that the control diet and 5% of *Gliricidia* leaf meal in broiler chickens diet had a similer result for the carcass quality. However, the result observed in the present study was not in agreement with the discoveries of Gulizia & Downs (2020) who stated that their test ingredient (Kudzu Leaf Meal (*Pueraria montana* Var. *lobata*)) didn't have any effect on the carcass yield.

The development in carcass characteristics of broiler breeds over the last few decades has mostly concentrated on improving the production of the breast and thighs, which are the most expensive pieces of meat due to their high market value (Fernandes, Bortoluzzi, Triques, Garcez Neto, & Peiter, 2013). When comparing live weight to the control diet, the breast and the thigh showed a higher percentage at the control diet than the rest of the body. Thus, the inclusion of PBLM had a negative effect on the bird's breast and thigh yields, indicating that the bird was less productive overall. The inclusion of PBLM in broiler chicken diets would therefore have a lower likelihood of improving the breast and thigh meat of the broiler chicken. This conclusion is not in agreement with the research of Abdulsalam, Yahaya, & Yakasai (2015) who observed that a 0.5% inclusion level of *Moringa oleifera* leaf meal could be adopted in broiler feed formulation to improve breast and thigh yield of broiler chickens. It is possible that the low carcass yield is because of the high levels of anti-nutrient factors in PBLM, as well as the leaf's relatively decreased crude protein concentration when compared to soybean meal.

4.2.3.1. Organ Quality of Broilers Chickens Fed Diets containing PBLM

The current study revealed that varying concentrations of P. biglobosa leaves in broiler chicken feed had no effect on the birds' viscera organs. This finding is congruent with those published by Shareef and Al-Dabbagh (2009) and Attia, Al-Khalaifah, Abd El-Hamid, Al-Harthi, and El-Shafey (2020), who both found that their experimental diets had no negative impact on the relative organ size of broiler chickens..

4.2.4. Haematological and Serum-Biochemical Analysis

When investigating the toxicity of a supplemented compound or plant extract on experimental animals, the haematological tests performed on the animals are extremely important (Oloruntola, Ayodele, Agbede & Oloruntola, 2016). In addition, haematological tests can be utilized to identify the physiological and pathological condition of the organisms under study (Oloruntola et al., 2016). In this investigation, all of the haematological blood markers examined were determined to be within normal limits. According to the work of Thrall, Weiser, Allison, and Campbell (2012), the normal haematology readings in thier study indicated that nutrients were adequate and that broiler hens fed with P. biglobosa leaves had a better immune system. There was no statistical significance ($p > 0.05$) for any of the haematological parameters evaluated in the present study in experimental broiler chickens. This means that feeding the experimental birds PBLM did not have a negative impact on their blood. In contrast to previous studies, which found significant differences in the haematological parameters of broiler chickens fed varying leaf meal diets (Oyebode, 2015; Tijani et al., 2015; Aikpitanyi and Egweh, 2020).

The measurements of MCHC, MCH, and MCV are used to detect anemia and also an indicator of the bone marrow's ability to produce red blood cells (RBC) (Tokofai, Idoh, Oke & Agbonon, 2020). Accordingly, the fact that the values gotten in the current study were within the normal range indicates that the birds were not anemic. An increase in the amount of *P. biglobosa* leaf meal used in the experiments was associated with higher values of haematological indices. This results corresponds with the findings of Chinko et al. (2020) who stated a higher percentage increase in the PCV, HGB, RBC, MCH, MCHC and MCV in Wister rats treated with *Amaranthus hybridus* (smooth pigweed). The findings of this study support the hypothesis that leaf meal stimulates haematopoiesis (KM et al., 2013 & Chinko et al., 2020).

4.2.4.1. Serum-Biochemical Analysis

ALP, SGPT, and SGOT concentrations are regarded diagnostic tools that can be utilized to identify particular signs of liver injury or dysfunction (Alhidary, Abdelrahman, Uallh Khan, & Harron, 2016). The current study found that the results for SGOT and SGPT were within the normal range, indicating that the experimental birds improved. This finding is consistent with the findings of Abdulbasit et al. (2020), who found that varying the amount of Persicaria odorata leaf meal (POLM) in broiler chicken diets improved the blood activity of SGOT and SGPT in the experimental birds. In a recent study, Oloruntola et al. (2018) discovered that including pawpaw and bamboo leaf meal in the diet dramatically reduced SGPT activity in broiler chicks. SGPT, commonly known as Alanine transaminase (ALT), decreased as the dietary PBLM inclusion level increased, indicating that no harmful effect within the birds' liver parenchyma was seen. This was consistent with the findings of Obikaonu et al. (2012), who found the similar impact in the experimental birds. However, in this investigation, PBLM incorporation in broiler diets had no effect on blood ALP activity ($p > 0.05$).

There was no significant ($P > 0.05$) influence on the experimental birds fed PBLM meals for glucose, cholesterol, total protein, albumin, and creatinine. This finding was consistent with the findings of Rubio et al. (2019), who found that adding Piper cubeba ethanolic extract to birds' meals had no effect on glucose, cholesterol, albumin, or total protein serum levels ($p>0.05$). The inclusion of parkia biglobosa leaf meal reduces cholesterol levels in the birds. This was consistent with the findings of Reddy, Urooj, Sairam, Ahmed, and Prasad (2017), who discovered that a polyphenol extract of Moringa oleifera had definite cholesterol-lowering effect in rats. This may help consumers' health by lowering their risk of cardiovascular disease, diabetes, and high blood pressure (Brunilda, 2021). Serum total protein and albumin levels have been shown to be directly related to protein consumption and quality (Onifade, 1998), with no negative effects on the experimental diet. This demonstrated that the proteins in the diets were properly used. Dietary interventions had an effect on the other biochemical indicators, urea and total bilirubin. The urea level was found to be considerably higher ($p>0.05$) in the control diet, which is consistent with the findings of Nath et al. (2016), who reported a similar result for urea in their research.

Several haematological parameters and serum biological indices were measured, and the results indicate that the *P. biglobosa* leaf contains a high concentration of vitamins, minerals, and antioxidants. Researchers on leaf meals have attested to the fact that leaf meals contain high level of vitamins, minerals and antioxidants (Ansari, Khan, ul Haq, & Yousaf, 2012; Alagbe, 2017; Manjaniq, Wihandoyo & Dono, 2017). This may translate into and qualify the *P. biglobosa* leaf as a medicinal leaf with a high haematopoietic potential, as previously stated by the authors (Saleh et al., 2021).

4.2.5. Feed Cost Benefit Analysis

The results obtained for cost-benefit analysis showed that the cost of feed was significantly influenced by the different diets tested. It was discovered that when the inclusion level of the dietary treatment was increased from 5% to 20%, it was discovered that the total feed cost across the diets groups reduced accordingly. It may be possible to economically replace soybean meal in commercial broiler feed with PBLM at 5% level without any detrimental effects. This would help lower cost of production and increase broiler meat affordability. These findings were in agreement with some researchers who reported in their research that the inclusion of their dietary treatment would reduce the total cost of production (Madiya, McCrindle, & Veary, 2004; Yadav, Shrivastava, Singh & Mishra, 2014; Adegbenro, Ayeni, Agbede, Onibi, & Aletor, 2017).

CHAPTER 5

5.0. SUMMARY, CONCLUSIONS AND RECOMMENDATION

5.1. Summary

Parkia biglobosa leaf meal (PBLM) was used as a partial replacement for soybean meal in broiler chicken diet. There were five diets, with PBLM included at 5%, 10%, 15% and 20% designated to diet 2, 3, 4 and 5 respectively, with diet 1 as the control diet. A randomly-assigned set of one hundred and fifty-day-old broiler chicks were divided into five dietary groups according to weight equalization, with thirty birds per treatment and ten birds in each replicate. The experimental design used was completely randomized design (CRD). The experiment lasted for a period of six weeks. Three feeding phases were used in the experiment: they are starter phase (first 2 weeks), grower phase (third week) and finisher's phase (the last three weeks). The proximate analysis of the PBLM, the effect of inclusion of PBLM on the growth performance, carcass traits, haematological indices, serum-biochemical indices of the birds and the cost benefit of inclusion of PBLM in the experimental diets were determined. At the starter phase, there was no significant ($P<0.05$) effect on growth performance in the broiler chickens fed up to 10% inclusion level of PBLM; while at the grower feeding phase it was observed that the feed conversion ratio in diets 2, 3 and 4 were significantly similar ($P>0.05$). The results for the growth performance at the finisher phase showed that the control diet and diet 2 are statistically similar for feed conversion ratio. The result of this study also showed that there was no adverse effect of PBLM inclusion on the viscera organs of the birds. The haematological and serum biochemical analysis of the broilers showed no significant ($P>0.05$) effect. The study showed that the use of PBLM will reduce the cost of feed for broiler production. These results suggested that *P. biglobosa* leaf meal can partially replace soybean meal up to 5% in broiler diets without having any detrimental or adverse effects on carcass qualities and blood parameters of the birds.

5.2. Conclusion

The competition, cost and availability of conventional feed stuffs between humans and brids have had an unprecedented growth over the years. Since the discovery of alternative feed ingredients is a necessity, further research on the usage of alternative feed ingredients is required. The present research observed that there was a positive result obtained in the inclusion of *P. biglobosa* leaves in the diet of broilers. The inclusion of PBLM in the diet showed a poor nutritive quality as seen in the growth performance and carcass quality. However it gave a positive result in the blood profile of the animal which implies that it could be used for medicinal purposes. The highest inclusion level of *P. biglobosa* leaf meal in broiler diet is at 5%, although for blood parameters enhancement and economic benefit the ingredient can be incorporated up to 20% in broiler diet. *Parkia biglobosa* leaf meal showed no significant effect on the organ quality and the hematological indices of the birds. Therefore, farmers can be informed to add *P. biglobosa* leaf meal to their feeds. The inclusion of *P. biglobosa* leaf meal in the diet of the birds can help reduce cost of feeding thereby increasing the profit of the farmer. The use of *P. biglobosa* leaf meal in feed production can be encouraged, so as to reduce the competition between man and birds for soybean meal.

5.3. Recommendation

Farmers can be encouraged to include *P. biglobosa* leaf meal up to 10% inclusion level in the diet of their birds at the starter feeding phase. This would help improve the growth performance (weight gain) of the birds as observed in this study.

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