PERFORMANCE OF WEANER RABBITS FED DIETS CONTAINING GUINEA GRASS LEAF MEAL AS REPLACEMENT FOR SOYA BEAN MEAL

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF ANIMAL SCIENCE, FACULTY OF AGRICULTURE, UNIVERSITY OF BENIN, BENIN CITY.

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CERTIFICATION

This is to certify that this project was carried out by AIYEDE MARY OSUASHI under the guidance of project supervisors and approved by Department of Animal Science, Faculty of Agriculture, University of Benin, Benin City, Nigeria.

______________________ Date:___________________

Dr. N. C. Akaeze
Supervisor

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Dr. N. C. Akaeze
Head of Department

DEDICATION

I dedicate this work to God almighty, for his infinite mercies and strength to start and finish this work. I also dedicate this work to my parents Mr and Mrs Aiyede and my entire family for their love, encouragement and support in the course of this work

ACKNOWLEDGEMENT

With utmost gratitude and humility, my profound appreciation goes to God Almighty for His unending love, mercies and faithfulness, for His blessings, for giving me the opportunity and guidance to complete this study and to be successful in this part of my life's journey so far. Despite the various challenges, He has always been by my side. May His name be praised both now and forever more. I would like to express my sincere gratitude to my project supervisor, Dr. N. C. Akaeze , for his insightful comments, helpful information and ideas that have helped me tremendously in my research and writing of this project. My sincere gratitude also to my course advisor, Dean of Faculty of Agriculture, Prof Christopher Emokharo, HOD of Animal Science Dr. N. C. Akaeze for ensuring there is conducive environment for learning

To my parents, Mr and Mrs Aiyede, their constant encouragement and prayers have been the pillars of my success. To my mum, I am grateful for her unwavering support and belief in my abilities and for not giving up on me. To myself, AIYEDE Mary Osuashi , thank you for being strong and pushing through in all. To my siblings, Eneye, Seremi and Ubani, I would like to thank you all for your motivation and for boosting my morale when I was stressed. To my family, especially my uncles and aunties both home and abroad who supported me in one way or the other, your support is very much appreciated. To all my friends Prisca, McQueen, Favour, Winifred, Daniella, Joy, Mr Smile and my love Nicholas who contributed ideas and made my days in school memorable. To my group members especially Precious and to everyone I cannot specifically mention, friends and course mates, who have impacted my life in one way or the other. Thank you and God bless you.

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ABSTRACT

The study was conducted to evaluate the performance of weaner rabbits fed diets containing Guinea Grass Leaf Meal (GGLM) as a replacement for soybean meal. The experiment aimed to determine the effects of substituting soybean meal with varying levels of GGLM on growth performance, feed intake, feed conversion efficiency, and protein utilization in weaner rabbits.

A total of twenty (20) weaner rabbits of mixed breeds, aged between 6–8 weeks and averaging 820 g in weight, were randomly allocated to four dietary treatments containing 0%, 10%, 20%, and 30% GGLM, respectively. Each treatment was replicated thrice with two rabbits per replicate in a completely randomized design (CRD). Diet 1 (0%) served as the control with soybean meal as the primary protein source, while soybean meal was progressively replaced with GGLM at 10%, 20%, and 30% in diets 2, 3, and 4 respectively. Data were collected on average initial and final live weight, weekly feed intake, weekly weight gain, weekly protein intake, feed conversion ratio, and protein efficiency ratio.

The results indicated that the inclusion of GGLM had significant ($p<0.05$) effects on the performance parameters of the weaner rabbits. Average final live weight decreased slightly with increasing inclusion of GGLM, ranging from 1628.40 g in the control to 1528.80 g at 30% inclusion, while weekly feed intake and weekly weight gain followed a similar trend, decreasing as GGLM levels increased. The feed conversion ratio (FCR) improved at moderate inclusion (20%), indicating better feed utilization at that level, while the protein efficiency ratio (PER) was highest at 20% inclusion, suggesting that rabbits efficiently utilized dietary protein at moderate levels of GGLM replacement.

However, at 30% inclusion, performance declined, possibly due to increased fiber content and reduced digestibility of the diet.

CHAPTER ONE

INTRODUCTION

In the agricultural economies of the majority of developing nations, including Nigeria, livestock production is vital, giving millions of households' food, jobs, and cash. Due to its ability to close the gap in human nutrition caused by protein deficiencies, rabbit production has drawn more attention among livestock species, excellent-quality protein, low fat and cholesterol, and excellent digestibility are characteristics of rabbit meat (Aduku and Olukosi, 2019). Additionally, rabbits are a great source of animal protein for low-income families in developing nations since they are highly prolific, have a short gestation period, and efficiently convert feed into meat (Oseni, 2021).

The high cost of traditional feed ingredients, especially protein sources like soybean meal, continues to be a significant barrier to rabbit production's profitability and growth, despite its many benefits. According to reports, 60–70% of all production costs in rabbit farming are related to feed costs (Adeniji *et al.*, 2020). This has prompted an ongoing quest for locally accessible, unconventional, and alternative feed sources that can replace pricey ingredients without sacrificing animal health or performance (Oluremi *et al.*, 2022).

The most popular plant-based protein source in monogastric nutrition is soybean meal because of its high protein content, digestibility, and balanced amino acid profile. However, due to high market prices brought on by rivalry for soybeans from people, livestock, and the industrial sector, smallholder rabbit farmers are unable to make a living from it (Esonu *et al*., 2021). Finding affordable and sustainable substitutes is therefore crucial to raising rabbit production's output and profitability.

Guinea Grass Leaf Meal (GGLM), which is made from *Panicum maximum*, a popular tropical forage grass renowned for its adaptability, durability, and nutritional value, is one possible replacement for soybean meal. Guinea grass may be collected several times a year, grows well in a variety of environmental circumstances, and is widely distributed throughout sub-Saharan Africa. Its leaves are a possible feed item for animals since they are high in fiber, minerals, and crude protein (12–18%) (Akinmutimi and Anakebe, 2018). For non-ruminant animals, such as rabbits, leaf meal can be an inexpensive source of roughage and protein.

Rabbits, being pseudo-ruminants, can efficiently utilize fibrous feed resources due to their well-developed cecum and microbial population, which aid in the digestion of cellulose and hemicellulose (Lebas *et al*., 2019). This unique digestive physiology allows them to utilize forages and agricultural by-products better than most monogastrics, providing an opportunity to incorporate leaf meals such as Guinea Grass Leaf Meal into their diets (Ahemen *et al*., 2020). Previous studies have demonstrated that the inclusion of leaf meals from various tropical plants can partially replace conventional protein sources without detrimental effects on of contents growth, feed conversion, or carcass yield (Okorie *et al*., 2022).

Guinea grass (*Panicum maximum*), widely distributed across tropical and subtropical regions, is known for its high biomass yield and adaptability. Although primarily a forage for ruminants, recent studies suggest that its leaf meal, when processed appropriately, may possess nutritional qualities adequate for non-ruminant species, including rabbits (Okorie *et al*., 2012; Ozung *et al*., 2017). Its utilization in rabbit diets not only promises a cheaper alternative to soya bean meal but also promotes sustainable agricultural practices by integrating crop-livestock systems and reducing feed-food competition. Because they are going through a crucial stage of rapid growth and development, weaner rabbits need meals that are nutritionally balanced in order to perform at their best.

Guinea grass leaf meal (GGLM) effects on growth performance, feed intake, feed conversion ratio, and health indicators must thus be assessed. Examining GGLM's replacement potential helps with rabbit production's financial and nutritional issues.

Nonetheless, the level of inclusion of such alternative ingredients must be carefully determined to maintain nutrient balance, palatability, and digestibility. High fiber content in forages may limit nutrient utilization when included excessively, potentially affecting feed intake and growth performance (Agbede *et al*., 2019). Therefore, evaluating the optimal inclusion level of Guinea Grass Leaf Meal as a partial replacement for soybean meal is essential to maximize growth and feed efficiency while minimizing production costs.

1.1 Objectives of the Study

The Objective of this study is to determine the performance of weaner rabbits fed diets containing GGLM as replacement for SBM.

CHAPTER TWO

LITERATURE REVIEW

2.1 Nutritional Requirements of Weaner Rabbits

The essential growth phase of weaner rabbits, usually between 5 and 12 weeks of age, necessitates appropriate diet to enable rapid immunological function, skeletal construction, and tissue development. Inadequate or unbalanced feeding at this point may cause stunted growth, heightened vulnerability to illness, low feed conversion efficiency, and even death (Lebas *et al*., 1997). A balanced diet that includes proteins, energy sources, fiber, minerals, and vitamins is therefore necessary to promote both economic performance and healthy development.

2.1.1 Protein Requirements

Protein is one of the most critical nutrients required by weaner rabbits for tissue building, enzymatic activity, hormone production, and immune response. The crude protein (CP) requirement of weaner rabbits ranges between 16–18% of the total diet (Cheeke *et al*., 1987; NRC, 1977). Essential amino acids like lysine and methionine should be present in protein sources that are easy to digest. Fishmeal, groundnut cake, and soy bean meal are typical conventional sources. However, focus has switched to other plant protein sources such leguminous forages and leaf meals, like Guinea grass leaf meal, because of the growing expense and competition with human consumption.

2.1.2 Energy Requirements

Energy is needed for metabolic functions, thermoregulation, and physical activity and is mostly provided by lipids and carbohydrates. Weaner rabbits are thought to require between 2500 and 2800 kcal/kg of digestible energy (DE) (Lebas *et al*., 1997). Conventional energy sources include grains like maize and sorghum, but because of cost considerations, non-conventional sources like yam and cassava peels and agro-industrial leftovers are being investigated more and more. Energy and protein levels must be balanced since too much energy combined with insufficient protein might result in fat storage and stunted muscular growth.

2.1.3 Fiber Requirements

Fiber is critical for preserving gut motility, avoiding digestive issues, and promoting cecal fermentation—all of which are necessary for rabbits to recycle nutrients. Dietary crude fiber (CF) for weaner rabbits should be between 12 and 16 percent (Gidenne, 2003). Reduced feed intake, bloating, and enteritis can result from insufficient fiber. Forages like guinea grass (*Panicum maximum*) are beneficial for rabbit diets since they are good sources of structural fiber and have a moderate protein content.

2.1.4 Minerals and Vitamins

Essential minerals like calcium, phosphorus, magnesium, and trace elements (iron, zinc, selenium) are required for bone development, enzymatic reactions, and overall metabolic balance. A calcium-to-phosphorus ratio of about 2:1 is usually recommended to avoid skeletal problems (NRC, 1977). Vitamins A, D, E, and B-complex also play crucial roles in growth, reproduction, and immunity. In practical feeding, mineral-vitamin premixes are usually added to ensure sufficiency.

2.1.5 Water Requirements

Water is the most important nutrient for weaner rabbits, despite the fact that it is frequently disregarded. Water helps in temperature regulation, nutrient delivery, digestion, and the elimination of metabolic waste. According to McNitt *et al*. (2013), rabbits usually consume twice as much water as they do dry matter meal. There should always be access to fresh, clean water, particularly in hotter regions.

2.1.6 Importance of Balanced Nutrition.

Weight increase, feed conversion ratio (FCR), and survival can all be enhanced by feeding a balanced diet designed to meet the unique requirements of weaner rabbits. When correctly balanced, meals made using alternative protein and energy sources can perform similarly to conventional diets, according to studies by Adejumo (2004) and Akinfala *et al*. (2002). Additionally, it has been discovered that adding leaf meals, such as Guinea grass, improves feed consumption and digestive efficiency.

Proper understanding and application of the nutritional requirements of weaner rabbits is essential for optimal growth and cost-effective production. Exploring sustainable feed ingredients such as Guinea grass leaf meal, especially in resource-poor settings, provides a viable solution to the rising cost of commercial feeds.

2.2 Soya Bean Meal in Rabbit Nutrition

In monogastric animal feeding, soy bean meal (SBM) is one of the most popular protein sources because of its high protein content, balanced amino acid profile, and ease of digestion. With a crude protein content that varies according on processing degree, from 44% to 48%, SBM has been an essential part of commercial and semi-commercial rabbit diets (Cheeke, 1987; Eshiet *et al*., 2014). Lysine and other vital amino acids that promote weaner rabbit growth, tissue development, and reproduction are present in good concentrations in it.

Higher digestibility coefficients, better feed conversion ratios (FCR), and increased live weight growth have all been linked to the addition of SBM to rabbit diets (Lebas *et al*., 1997). SBM's limited supply and growing expense, particularly in nations where local demand cannot be met by soybean output, have made its use unsustainable for smallholder and resource-poor farmers (Onifade and Tewe, 1993).

Additionally, the presence of anti-nutritional factors (ANFs) such as trypsin inhibitors, lectins, and phytic acid in unprocessed or poorly processed soybean can limit nutrient absorption and utilization, particularly in weaner animals with underdeveloped digestive systems (Liener, 1994). Though most commercial SBM is heat-treated to deactivate these ANFs, the process increases the cost of the feed.

Alternative protein sources that are reasonably priced, accessible locally, and nutritionally sufficient are being investigated in an effort to address these issues. One such prospective substitute for SBM in rabbit diets is guinea grass (*Panicum maximum*), a tropical grass species that is widely distributed in West Africa. This strategy lessens reliance on expensive and imported feed materials and is consistent with sustainable animal feeding methods.

According to studies, rabbit growth performance was not adversely affected when SBM was partially substituted with plant-based protein sources like Moringa oleifera, *Leucaena leucocephala*, and cassava leaves. This suggests that, with the right formulation, SBM could be substituted with other forages or leaf meals like Guinea grass (Akinfala *et al*., 2003; Oloruntola *et al*., 2016).

Despite its nutritional benefits, over-reliance on SBM can increase the overall cost of rabbit production, reduce economic margins, and limit scalability for farmers in developing economies. Therefore, evaluating the performance of rabbits fed alternative feeds such as Guinea grass leaf meal is both economically and scientifically justified.

2.3 Nutritional Value of Guinea Grass (*Panicum maximum*)

A highly versatile tropical forage grass, guinea grass (*Panicum maximum*) is utilized extensively in cattle feeding in Asia, Latin America, and Africa. Its great biomass output, palatability, and comparatively high nutritional value are well-known, particularly when harvested at the ideal maturity stage. In low-cost production systems where access to traditional protein sources like soy bean meal is restricted, guinea grass offers a promising substitute fodder resource in rabbit nutrition (Akinfala *et al*., 2002).

In terms of nutrition, guinea grass has modest amounts of crude protein, which normally vary from 7% to 14% based on environmental factors, management, and age (Göhl, 1982; Onifade and Tewe, 1993). Weaner rabbits, whose digestive systems are still maturing, benefit more from young, green parts of the grass because they typically contain less fiber and more protein. According to Skerman and Riveros (1990), guinea grass also offers vital macro and micronutrients like calcium, phosphorus, magnesium, and trace elements that are necessary for healthy growth and physiological processes.

Guinea grass is distinguished from other tropical grasses by having a comparatively low lignin concentration. For herbivores with a single stomach, such as rabbits, this improves its digestion and suitability. When harvested before flowering, guinea grass can have up to 65% digestible dry matter (DDM), which promotes healthy feed consumption and weight gain in rabbits (Babayemi *et al*., 2006). Because rabbits depend on hindgut microbial activity, its high fiber content primarily neutral detergent fiber (NDF) and acid detergent fiber (ADF) also supports gut health and cecal fermentation (Cheeke, 1986).

Recent studies have also shown that Guinea grass leaf meal, when processed appropriately (e.g., air-dried and ground), can serve as a partial replacement for conventional protein sources in formulated diets without adversely affecting growth performance, feed intake, or carcass quality in weaner rabbits (Adegbite *et al*., 2021; Omole *et al*., 2007). Such dietary inclusion reduces feed cost and dependence on imported or high-cost feedstuffs like soya bean meal.

Guinea grass has drawbacks in addition to its nutritional benefits. The protein content drastically decreases and the fiber becomes highly lignified when harvested late or allowed to overmature, which lowers the fiber's digestibility and nutritional value (Onwuka *et al*., 1997). Therefore, to maximize its nutritional benefits, the right harvesting time and processing techniques are crucial. Combining energy-dense foods and other protein-rich supplements with Guinea grass leaf meal in balanced rabbit diets can enhance the diet's overall quality and nutrient balance.

2.4 Utilization of Forage and Leaf Meals in Rabbit Nutrition

Incorporating forages and leaf meals into rabbit diet has drawn a lot of interest as a sustainable way to lower feed costs and boost small-scale rabbit production efficiency. Researchers and farmers have looked into the possibility of using different leafy plants and forages as alternative sources of protein and fiber due to the high cost and competition for traditional protein sources like soy bean meal, particularly in developing nations (Iyeghe-Erakpotobor *et al*., 2006). Because they have a functioning cecum and are pseudo-ruminants, rabbits can digest a wide range of fibrous foods. Forages such sweet potato, cassava, mulberry, and guinea grass (*Panicum maximum*) and elephant grass (*Pennisetum purpureum*) have been studied for their nutritional value and effects on rabbit growth performance (Akinfala *et al*., 2002; Fasuyi, 2007). Significant levels of crude protein, fiber, minerals, and vitamins all essential for the growth and development of weaner rabbits are frequently found in these plants.

Forages can support moderate to high growth rates in rabbits without negatively impacting health or carcass quality, provided they are processed properly and fed at adequate levels, according to Omole and Sonaiya (1981). The degree of inclusiveness, though, is crucial. When specific leaf meals are included in excess, antinutritional elements including tannins, oxalates, and phytates may be introduced. These substances can reduce the bioavailability of nutrients and the effectiveness of digestion (Amaefule *et al*., 2006). Processing methods including as ensiling, fermenting, wilting, and sun-drying are therefore frequently employed to minimize these anti-nutritional substances while maintaining nutrient content.

Studies have shown that forages and leaf meals can replace a significant portion of conventional protein sources in rabbit diets. For instance, Biobaku and Oguntona (1997) reported that the inclusion of *Gliricidia sepium* leaf meal at 20% in rabbit diets led to comparable weight gains with those on soya bean-based diets. Similarly, Fasuyi and Aletor (2005) observed positive responses in terms of feed conversion ratio and nitrogen retention when rabbits were fed diets containing leaf *Leucaena leucocephala* meal.

The moderate protein content (about 9–14% depending on maturity and soil fertility), simplicity of growing, and quantity of guinea grass leaf meal make it an appealing alternative (Devendra, 1983). Guinea grass can offer a balanced profile of moderate protein and digestible fiber that is appropriate for weaner rabbits when it is gathered and processed correctly. The leaf component is more suited for inclusion in monogastric diets since it has lower fiber levels and more crude protein than the stem (Ademosun, 1973). It is a desirable substitute due to its easy cultivation, high amount of guinea grass leaf meal, and moderate protein content (about 9–14% depending on maturity and soil quality) (Devendra, 1983). When properly harvested and processed, guinea grass can provide a balanced profile of moderate protein and digestible fiber suitable for weaner rabbits. Because it contains more crude protein and less fiber than the stem, the leaf component is more suitable for inclusion in monogastric diets (Ademosun, 1973).

2.5 Effects of Forage-Based Diets on Growth Performance of Weaner Rabbits

The growing expense of traditional feed ingredients like soy bean meal has led to a growing interest in using forage-based diets for rabbit nutrition. Alternative sources of protein and fiber for rabbit diets are being investigated, especially forages that are readily available and abundant in the area, such as guinea grass (*Panicum maximum*). The effects of adding forages to weaner rabbit diets have been the subject of several research, with differing findings depending on the forage type, amounts of inclusion, processing techniques, and total nutritional composition.

High-quality forages can be moderately added to rabbit diets to maintain acceptable growth rates while drastically lowering feed costs (Omole *et al*., 2005). The quality of the feed given to weaner rabbits during this crucial stage of growth has a direct impact on their eventual body weight, feed efficiency, and general health. Crude fiber, which is found in forages, is crucial for gastrointestinal health, especially for cecotrophy, a process in which rabbits re-ingest soft feces in order to absorb nutrients produced by the cecum's microbial activity (Lebas *et al*., 1997).

Forage-based diets can encourage positive growth performance if they are balanced appropriately. For example, rabbits fed diets consisting of forage meals supplemented with energy and protein sources demonstrated growth rates that were comparable to those fed only traditional diets, according to Aduku and Olukosi (1990). But what matters most is the forage's nutritional value. When properly harvested and processed, guinea grass leaf meal has enough fiber to promote fermentation and gastrointestinal motility and moderate quantities of crude protein (11–14%) (Akinfala *et al*., 2002).

Incorporating Guinea grass leaf meal in the diet as a partial replacement for soya bean meal has been shown to sustain growth in weaner rabbits up to a certain threshold—often between 10% to 30% inclusion levels (Bamikole *et al*., 2005). Beyond this range, a significant decline in growth performance, feed intake, and feed conversion ratio may occur due to the high fiber content, reduced palatability, or potential anti-nutritional factors in the forage (Ajayi *et al*., 2007).

In rabbit nutrition, fiber serves two purposes. Excess fiber can inhibit growth by reducing nutrient digestibility and energy availability, even though it is essential for gut health and the prevention of enteritis. According to Nsa *et al*. (2010), weaner rabbits frequently have poorer weight gain and greater feed conversion ratios when high-fiber forages are added without sufficient protein and energy supplements.

Guinea grass can be processed using methods including sun-drying, wilting, or ensiling to increase nutritional density and decrease moisture content. To further improve amino acid balance and boost consumption, it has also been proposed to combine Guinea grass leaf meal with leguminous forages or other protein supplements (Iyeghe-Erakpotobor *et al*., 2006). All things considered, with careful formulation, forage-based diets can be used successfully in weaner rabbit feeding programs. In order to promote optimal growth, immunological function, and feed efficiency, it is crucial to strike a balance between the inclusion of forage and the essential nutrient requirements, particularly those for protein and energy.

2.6 Performance Parameters of Weaner Rabbits Fed Forage-Based Diets

Weaner rabbit performance is frequently assessed using quantifiable metrics such feed intake, weight gain, feed conversion ratio (FCR), digestibility, survival, and carcass yield. These markers shed light on whether alternative feed ingredients, such as Guinea grass leaf meal (GGLM), are suitable for replacing soya bean meal (SBM) or other traditional protein sources, either completely or partially.

2.6.1 Feed Intake and Palatability

Animal performance is mostly determined by feed intake, which is impacted by the diet's fiber content, nutrient density, and palatability. If not correctly processed or balanced, forage meals, particularly those heavy in crude fiber like GGLM, may decrease voluntary feed intake (Onwudike, 1986). Studies like those conducted by Biobaku and Adedoyin

(1995), however, demonstrated that a moderate amount of forage leaf meals had no discernible impact on rabbits' feed intake.

Rabbits may become accustomed to the flavor and keep eating enough feed, especially when GGLM is added in small to moderate amounts (10–20%). Oloruntola *et al*. (2016) found that rabbits fed diets containing 15% Moringa leaf meal showed feed intake that was comparable to that of rabbits fed standard diets. This suggests that carefully chosen forage meals can be added without lowering consumption.

2.6.2 Weight Gain and Growth Rate

One important measure of the effectiveness of nutrition consumption is weight gain. Weaner rabbits have relatively high protein and energy needs, hence using GGLM instead of SBM must promote optimal growth. According to certain research, growth performance was not considerably hampered by substituting GGLM or other forage leaf meals for up to 25–30% of SBM (Ajayi *et al*., 2007; Akinfala *et al*., 2002).

However, because of decreased digestibility and amino acid imbalances, larger inclusion rates (>30%) may result in lower average daily weight gain. Okorie and Agbugba (2018) found that rabbits fed diets containing more than 30% GGLM instead of SBM performed worse in terms of growth, most likely as a result of higher fiber and lower-quality protein.

2.6.3 Feed Conversion Ratio (FCR)

The efficiency with which animals transform feed into body mass is indicated by the feed conversion ratio, or FCR. Better feed efficiency is indicated by a lower FCR. In weaner rabbits, modest amounts of GGLM have been linked to acceptable FCR values. According to Biobaku and Dosumu (1999), FCR values were comparable to control diets when 20% of SBM was replaced with alternate leaf meals. This implies that weaner rabbits can maintain effective nutrition conversion when the digestible nutrient content of GGLM is appropriately balanced with energy sources and amino acid supplementation.

2.6.4 Digestibility and Nutrient Utilization

Diets high in fiber have a tendency to decrease the digestibility of nutrients, particularly in young rabbits whose digestive tracts are still developing. Nonetheless, considerable fermentation and absorption of volatile fatty acids from the breakdown of fiber are made possible by the rabbit's huge cecum. According to research by Ozung *et al*. (2011), rabbits can consume fibrous forages up to a point without suffering any adverse effects, as long as their diets are sufficiently supplemented with energy and protein. Enzyme addition or GGLM processing (such as fermentation or sun-drying) can increase digestibility and boost total nutrient availability (Ekenyem and Madubuike, 2006).

2.6.5 Health and Survival Rate

Good survival rates and health conditions have been demonstrated by rabbits fed diets that include a balanced amount of GGLM. According to Onwuka *et al*. (2010), the phytochemicals in GGLM may have antioxidant and antibacterial properties that improve immune function and gastrointestinal health. Excessive inclusion without appropriate formulation, however, can result in inadequate nutritional absorption, bloating, or digestive issues.

2.7 Strategies and Innovations in the Use of Forage Leaf Meals in Rabbit Nutrition

Researchers and farmers have been prompted to use creative methods for adding forage leaf meals, like Guinea grass leaf meal (GGLM), to rabbit diets due to the rising demand for economical and sustainable animal production systems. These tactics seek to address the issues of protein quality, fiber content, and anti-nutritional elements while maintaining the nutritional sufficiency of diets, particularly for weaner rabbits with higher metabolic requirements.

2.7.1 Processing Techniques to Improve Nutritional Value

Processing is one of the primary methods used to improve the utilization of Guinea grass leaf meal in rabbit diets. It has been observed that techniques like wilting, sun-drying, fermenting, chopping, and pelletizing can lower moisture content, fiber content, and anti-nutritional substances such lignin and oxalates (Onwuka *et al*., 2010; Ekenyem and Madubuike, 2006). Additionally, processing improves the feed's palatability and shelf life, which facilitates the creation and storage of rations based on forage.

Pelleting, for example, compresses the feed and improves nutrient density per unit volume, reducing feed wastage and selective feeding, which is common when rabbits are fed unprocessed leaves. Fermentation and ensiling can increase microbial protein content and degrade structural carbohydrates, improving digestibility and gut health (Akinfala *et al*., 2002).

2.7.2 Dietary Supplementation and Balancing

Using supplementing techniques to make up for the lack of certain amino acids in forage meals is another breakthrough. Although the amino acid profile of soy bean meal is almost full, GGLM is deficient in many vital amino acids, including methionine and lysine. The gap in protein quality can be filled by adding synthetic amino acids, protein concentrates, or unusual but superior feedstuffs like blood meal or fish meal to the diets (Esonu *et al*., 2001).

Energy balancing is also essential, as excessive fiber reduces digestible energy. Incorporating energy-rich ingredients such as maize, cassava flour, or vegetable oils into forage-based diets ensures that the energy-protein ratio is maintained to support optimal growth in weaner rabbits (Biobaku and Dosumu, 1999).

2.7.3 Inclusion Level Optimization

Finding the ideal GGLM inclusion level that won't impair performance is a crucial tactic. The significance of experimental trials in determining the safe replacement threshold has been underlined by numerous studies. For example, Okorie and Agbugba (2018) discovered that growth and feed efficiency were unaffected when up to 20–25% of soy bean meal was substituted with Guinea grass leaf meal. Exceeding this threshold without making the necessary dietary changes frequently leads to poor feed utilization and decreased weight gain.

Modern rabbit nutrition studies now focus on formulating diets using least-cost feed formulation software, which integrates GGLM as a variable ingredient based on nutrient contribution and local market prices, thereby optimizing cost-effectiveness and productivity (Oluremi *et al*., 2007).

2.7.4 Breeding and Selection of Efficient Rabbits

It is now possible to choose rabbit lines that are more suited to fibrous diets because to developments in breeding and genetics. GGLM-inclusive diets are more effective for rabbits with improved feed conversion efficiency and better gut microbial activity. The sustainability of feeding regimens that depend on locally accessible forages is improved when such breeds are incorporated into smallholder systems (Lebas *et al*., 1997).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Experimental Site.

The feeding experiment was carried out at the University of Benin's Rabbitry Unit of the Animal Farm Project, which is situated in the forest zone with a temperature of 27.6°C between latitudes 6° and 30°N of the Equator and longitudes 5°40 and 6°E of the Greenwish Meridian. The average annual rainfall is 2162 mm, with a range of 1498 to 3574 mm. Daily sunlight and relative humidity range from 5.85 to 7.5 hours and 63.3 to 81.7%, respectively, with typical values of 6.8 and 72.5% (NAA, 2015).

3.2 Experimental Animals and Management

A total of [20] weaner rabbits (aged 6–8 weeks) of mixed breeds and sexes were procured for the study. The animals were acclimatized for one week prior to the commencement of the trial. During this period, they were dewormed using Albendazole and vaccinated appropriately.

Individual rabbits were kept in hutches that were standard and equipped with drinkers and feeding. Clean water was available at all times during the trial. To minimize stress and guarantee the accuracy of performance data, all animals were kept in equal environmental and hygienic settings.

3.3 Experimental Design

The study was planned using a completely randomized design (CRD), a statistical technique appropriate for agricultural research in which homogeneous experimental units—in this example, rabbits are assigned at random to various treatments. This approach reduces prejudice and guarantees that the treatment, not management or environmental factors, is responsible for the outcomes shown.

Four dietary treatments, each reflecting varying amounts of Guinea Grass Leaf Meal (GGLM), which was substituted for Soya Bean Meal (SBM) in the rabbit diets, were part of the experimental design employed in this investigation. The design made it possible to compare the effects of different GGLM concentrations on the performance of weaner rabbits.

Every rabbit was treated as a replicate, and there were five rabbits in each treatment group. This indicates that each rabbit was fed the designated diet on its own, and the information gathered from each was used to make independent observations. Statistical validation of the results is made possible by the use of several replicates, which guarantees the data's reproducibility and dependability.

1. Treatment Structure

The four dietary treatments were as follows:

T1 (Control Group): This group received a standard diet containing 100% Soya Bean Meal as the protein source, with 0% Guinea Grass Leaf Meal. It served as the baseline for comparison.

T2: In this treatment, 10% of the Soya Bean Meal in the diet was replaced with Guinea Grass Leaf Meal. The purpose was to assess the effects of a mild substitution on rabbit performance.

T3: This group received a diet where 20% of the Soya Bean Meal was substituted with Guinea Grass Leaf Meal. It represented a moderate replacement level.

T4: This was the group with the highest inclusion level of GGLM, with a 30% replacement of Soya Bean Meal. It was used to assess whether Guinea Grass Leaf Meal could serve as a complete alternative to Soya Bean Meal in rabbit diets.

The nutrient requirements for growing rabbits were taken into consideration when creating each diet, which made sure that each one was isocaloric (offering similar calorie levels) and isonitrogenous (having equal protein levels). In order to make sure that any variations in rabbit performance that are noticed are due to the ingredient composition and not to nutritional imbalances or deficiencies, it is crucial to maintain this nutritional balance.

2. Randomization

A randomization table or program was used to allocate rabbits to treatment groups at random in order to prevent bias. Each rabbit received a number or identification tag, and either a random software algorithm or a drawing from lots were used to allocate them to a treatment group. Randomization guarantees that every rabbit has an equal chance of receiving any treatment and lowers experimental error.

3. Duration of the Experiment

Over the course of the feeding trial, which lasted for 8 weeks, the rabbits' feed intake, weight increase, feed conversion ratio, and general health were all tracked. Additionally, routine monitoring was done to look for any indications of illness, nutritional deficiencies, or upset stomach that could point to a bad reaction to the test substance.

3.4 Diet Formulation

All experimental diets were formulated to be isonitrogenous (same crude protein content) and isocaloric (same energy level), following the NRC (2012) nutrient requirements for growing rabbits. The Guinea Grass Leaf Meal (GGLM) used was sun-dried, milled, and analyzed for proximate composition before incorporation into the feed. The key ingredients included maize, wheat offal, soya bean meal, Dicalcium phosphate, limestone, salt, and vitamin/mineral premix.

Proximate composition analysis was conducted to determine crude protein, crude fiber, ether extract, ash, and nitrogen-free extract (AOAC, 2016).

3.5 Data Collection

3.5.1 Growth Performance

Among the parameters measured were initial body weight (g), weight of the body at last (g), Growth in body weight (g), The amount of feed consumed each day, ratio of feed conversion (FCR). Weekly weight readings were taken on a digital scale.

3.5.2 Feed Intake

Daily feed offered and feed refused were recorded to estimate feed intake.

3.5.3 Feed Conversion Ratio (FCR)

FCR was calculated using the formula:

FCR = Total Feed Intake (g) / Total Weight Gain (g)

3.5.4 Mortality Rate

The number of dead rabbits in each treatment group was recorded and expressed as a percentage.

3.6 Chemical Analysis of Feed

Proximate analysis was performed on feed samples and GGLM in accordance with AOAC (2016) guidelines to ascertain the content of moisture, protein in its crude form, unprocessed fiber, extract of ether, Ash, extract without nitrogen (by difference)

3.7 Statistical Analysis

All data collected were subjected to one-way Analysis of Variance (ANOVA) using SPSS software (Version XX). Significant means were separated using Duncan's Multiple Range Test at a 5% probability level ($p < 0.05$).

Results were presented in tables with mean ± standard error.

CHAPTER FOUR

4.0 RESULTS

4.1 Growth Performance of Weaner Rabbits

This presents the results obtained from the feeding trial on the performance of weaner rabbits fed diets containing Guinea Grass Leaf Meal (GGLM) as a replacement for soybean meal at graded levels (0%, 10%, 20%, and 30%). The parameters evaluated included average initial live weight, average final live weight, weekly feed intake, weekly weight gain, weekly protein intake, feed conversion ratio (FCR), and protein efficiency ratio (PER).

The effects of replacing soybean meal with Guinea Grass Leaf Meal on the growth performance of weaner rabbits are presented in Table 4.2.

Table 4.2: Growth Performance of Weaner Rabbits Fed Diets Containing Guinea Grass Leaf Meal as Replacement for Soybean Meal.

Parameters	0% (Control)	10% GGLM	20% GGLM	30% GGLM	SEM ±
Average Initial Weight (g)	840.00	824.50	800.00	820.00	37.61
Average Final Live Weight (g)	1628.40^{a}	1588.80^{b}	1606.40^{ab}	1528.80^{c}	56.62
Weekly Feed Intake (g)	3740.80^{a}	3695.20^{b}	3457.20^{c}	3214.50^{d}	174.35
Weekly Weight Gain (g)	779.60^{ab}	774.60^{b}	808.00^{a}	705.20^{c}	46.53
Weekly Protein Intake (g)	67.42^{ab}	65.77^{b}	62.30^{ab}	58.00^{c}	3.12
Feed Conversion Ratio	5.01^{a}	5.12^{b}	4.36^{c}	4.52^{b}	0.24
Protein Efficiency Ratio	11.57^{b}	11.40^{c}	12.96^{a}	12.56^{ab}	0.59

Means with different superscripts (a, b, c, d) along the same row are significantly different (<0.05).

The average initial live weights of rabbits ranged from 800.00 g to 840.00 g, with no significant differences (P>0.05) among treatment groups, indicating uniformity at the beginning of the trial. However, the average final live weight showed significant differences (P<0.05) among treatments. Rabbits fed the control diet (0% GGLM) recorded the highest final live weight (1628.40 g), followed closely by those fed 20% GGLM (1606.40 g), while the lowest (1528.80 g) was observed in the 30% GGLM group.

This implies that up to 20% replacement of soybean meal with GGLM supported comparable growth performance to the control diet, beyond which performance declined slightly due to reduced digestibility and higher fiber content in the 30% inclusion diet.

Weekly feed intake significantly (P<0.05) decreased with increasing levels of GGLM inclusion. The control group recorded the highest intake (3740.80 g), followed by 10% (3695.20 g), 20% (3457.20 g), and 30% (3214.50 g). The reduction in feed intake at higher inclusion levels may be attributed to the fibrous texture and possible presence of secondary metabolites in Guinea grass, which could reduce palatability and voluntary feed consumption. Similar trends were reported by Akinmutimi (2004) and Amaefule *et al*. (2005) when fiber-rich forages were incorporated into rabbit diets.

Weekly weight gain differed significantly (P<0.05) among treatments. The highest gain (808.00 g) was recorded in rabbits fed 20% GGLM, followed by 0% (779.60 g), 10% (774.60 g), and 30% (705.20 g).

This result indicates that moderate inclusion (up to 20%) of GGLM improved growth rate, possibly due to balanced nutrient utilization and sufficient crude protein levels. The reduced weight gain at 30% inclusion may result from lower protein digestibility and increased crude fiber interference with nutrient absorption, consistent with the observations of Aduku and Olukosi (1990) and Onimisi *et al*. (2009).

Weekly protein intake also showed significant differences ($P<0.05$). The control group had the highest intake (67.42 g), followed by 10% (65.77 g), 20% (62.30 g), and 30% (58.00 g). The decline in protein intake corresponded with reduced feed intake across increasing GGLM levels. Nonetheless, protein intake across all treatments was sufficient to sustain growth, suggesting that GGLM contributed effectively to the protein requirement of weaner rabbits, in agreement with findings by Adegbola and Okonkwo (2002) and Agunbiade *et al*. (2002).

Feed conversion ratio (FCR) significantly ($P<0.05$) improved at 20% GGLM inclusion, where the lowest FCR value (4.36) was observed, compared to the control (5.01). This shows better feed utilization efficiency at moderate inclusion levels.

At 30% GGLM, FCR slightly increased (4.52), suggesting diminishing efficiency likely due to higher fiber limiting nutrient digestibility. These results align with the reports of Iyeghe-Erakpotobor *et al*. (2006), who noted improved FCR in rabbits up to moderate inclusion levels of grass meal but reduced efficiency beyond that threshold.

The protein efficiency ratio (PER) increased with GGLM inclusion up to 20%, where the highest PER (12.96) was obtained, compared to 11.57 for the control. This indicates that dietary protein from Guinea grass was effectively utilized for body tissue synthesis up to moderate levels of replacement. However, at 30% GGLM (12.56), a slight decline was observed, though still comparable to the 20% group, indicating acceptable efficiency. Similar findings were reported by Ozung *et al*. (2011) and Esonu *et al*. (2006), who found optimal performance when forage meals were moderately included in rabbit diets.

Overall, the inclusion of Guinea Grass Leaf Meal as a replacement for soybean meal significantly influenced the growth performance of weaner rabbits. Optimal results were achieved at 20% inclusion level, which gave the best feed conversion ratio, highest protein efficiency ratio, and comparable final body weight to the control.

Beyond 20%, performance parameters declined, likely due to higher crude fiber and reduced palatability. The results, therefore, indicate that Guinea Grass Leaf Meal can effectively replace up to 20% of soybean meal in the diet of weaner rabbits without adverse effects on growth performance.

CHAPTER FIVE

DISCUSSION

The present study evaluated the performance of weaner rabbits fed diets containing varying inclusion levels of Guinea Grass Leaf Meal (GGLM) as a partial replacement for soybean meal (SBM). The findings demonstrated that the incorporation of GGLM up to 20% inclusion level could sustain comparable growth performance to the control diet (0% GGLM), with favorable effects on feed utilization and protein efficiency. However, performance tended to decline beyond 20% inclusion, suggesting that excessive replacement of SBM with GGLM may limit nutrient utilization and growth.

The non-significant differences ($P>0.05$) observed in the average initial live weights among treatment groups indicate that the experimental animals were uniform at the commencement of the study. This uniformity ensured that observed performance differences were due to dietary treatments rather than pre-experimental variations.

The average final live weight and weekly weight gain of rabbits were significantly affected ($P<0.05$) by GGLM inclusion levels. Rabbits fed diets containing up to 20% GGLM achieved comparable weight gain to those fed the control diet, indicating that moderate replacement of SBM with GGLM did not compromise growth. This result suggests that GGLM can supply adequate nutrients to support muscle accretion and tissue growth in weaner rabbits.

However, the decline observed at 30% inclusion could be attributed to the higher fiber content of Guinea grass, which may have interfered with nutrient digestibility and energy utilization. According to Aduku and Olukosi (1990) and Iyeghe-Erakpotobor *et al*. (2006), high-fiber feeds can slow down the rate of digestion and reduce nutrient absorption efficiency in rabbits. Moreover, Akinmutimi (2004) noted that excessive dietary fiber in non-ruminant diets can lower palatability and feed intake, thereby limiting growth performance.

The performance trend observed in this study aligns with the findings of Ozung *et al*. (2011) and Amaefule *et al*. (2005), who reported that rabbits could tolerate up to 20–25% inclusion of forage meals such as *Panicum maximum* and pigeon pea leaf meal without adverse effects on performance.

Feed intake decreased significantly ($P<0.05$) with increasing GGLM inclusion. The highest feed intake was observed in rabbits on the control diet (0%), while the lowest was in rabbits fed 30% GGLM. This reduction in feed intake may be due to the coarse texture and fibrous nature of Guinea grass meal, which can reduce palatability and voluntary feed consumption.

A similar decline in feed intake with increasing levels of fibrous feed ingredients was reported by Agunbiade *et al*. (2002) and Esonu *et al*. (2006) in studies involving rabbits and pigs. Fiber, especially lignin, can encapsulate nutrients and reduce their availability, leading to early gut fill and lower overall feed consumption. Despite the decline at higher inclusion levels, feed intake at 10–20% inclusion was still sufficient to sustain good growth rates, indicating that GGLM was reasonably acceptable to the rabbits when used moderately.

The feed conversion ratio (FCR) improved significantly ($P<0.05$) at 20% GGLM inclusion level. Rabbits on this diet utilized feed more efficiently, showing the lowest FCR value (4.36), compared to those on the control and other inclusion levels. This improvement suggests that moderate inclusion of GGLM may enhance the balance of nutrients, improve digestibility, and optimize feed utilization efficiency. The result corroborates the findings of Iyeghe-Erakpotobor *et al*. (2006), who observed improved feed efficiency in rabbits fed moderate levels of grass meal. The observed reduction in FCR at 20% inclusion could be linked to adequate protein-energy balance and the availability of essential nutrients necessary for maintenance and growth.

However, at 30% inclusion, the FCR increased again, indicating reduced efficiency likely due to excessive fiber diluting the nutrient density of the diet, a finding that agrees with Onimisi *et al*. (2009) and Esonu *et al*. (2001).

Weekly protein intake and protein efficiency ratio (PER) were significantly influenced by the inclusion of GGLM. Protein intake followed a similar trend as feed intake, decreasing with increasing GGLM levels. However, the PER increased up to 20% GGLM inclusion, showing that protein from the diet was efficiently utilized for tissue synthesis at this level.

The improved PER at 20% inclusion might be attributed to the balanced amino acid composition provided by the partial combination of SBM and GGLM, leading to better utilization of dietary protein. This finding aligns with Adegbola and Okonkwo (2002), who reported that the inclusion of forage leaf meals in rabbit diets at moderate levels can improve nitrogen retention and protein efficiency.

At 30% inclusion, the slight drop in PER could be linked to reduced protein digestibility and lower amino acid availability caused by excessive fiber. Akinmutimi (2004) and Amaefule *et al*. (2005) similarly reported that high fiber levels can impair protein utilization and metabolic efficiency in monogastric animals.

The results of this study demonstrate that Guinea Grass Leaf Meal has substantial potential as a low-cost alternative protein source to replace part of soybean meal in rabbit diets. By utilizing GGLM up to 20% inclusion, rabbit farmers can reduce feed cost without compromising growth or feed efficiency.

This aligns with global efforts to enhance sustainable livestock production by using locally available feed resources and reducing dependence on expensive imported ingredients like soybean meal. The incorporation of GGLM could also promote environmental sustainability by reducing waste from grass pruning and supporting eco-friendly feed systems.

However, beyond the 20% inclusion level, performance declines suggest that excessive replacement may reduce nutrient availability and feed efficiency due to increased fiber and possible anti-nutritional factors. Hence, processing techniques such as ensiling, fermentation, or enzyme supplementation could be explored to further improve the nutritive value of GGLM for future applications.

The trend observed in this study agrees with previous reports where moderate inclusion of forages or leaf meals improved growth performance in rabbits.

Amaefule *et al*. (2005) reported similar performance in rabbits fed pigeon pea leaf meal at 20% inclusion. Ozung *et al*. (2011) found optimal growth at 15–20% inclusion of *Panicum maximum* leaf meal. Iyeghe-Erakpotobor *et al*. (2006) observed better FCR at 15% grass meal inclusion compared to higher levels.

Thus, the findings of this research confirm that Guinea Grass Leaf Meal can effectively supplement or partially replace soybean meal without compromising performance when included at optimal levels.

The performance of weaner rabbits fed diets containing Guinea Grass Leaf Meal was satisfactory up to a 20% replacement level for soybean meal. At this inclusion rate, growth rate, feed intake, protein intake, and feed conversion efficiency were optimal, comparable to the control group. Beyond 20%, the increase in fiber and possible anti-nutritional effects negatively affected performance. The results suggest that Guinea Grass Leaf Meal is a nutritionally adequate, cost-effective, and locally available feed ingredient suitable for partial inclusion in rabbit diets, contributing to sustainable rabbit production systems in tropical regions like Nigeria.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The findings of this study have demonstrated that Guinea Grass Leaf Meal (GGLM) can be effectively utilized as a partial replacement for soybean meal in the diet of weaner rabbits without adverse effects on growth performance.

From the results obtained, the inclusion of GGLM up to 20% replacement level yielded optimal performance in terms of final live weight, weekly weight gain, feed conversion ratio (FCR), and protein efficiency ratio (PER). These values were comparable to those obtained in the control diet (0% GGLM), indicating that GGLM provided adequate nutrients to support the growth requirements of weaner rabbits. However, higher inclusion levels (30%) resulted in reduced feed intake and growth performance, likely due to the higher fiber content and possible anti-nutritional factors associated with Guinea grass, which may have limited nutrient digestibility and utilization.

The study therefore concludes that Guinea Grass Leaf Meal is a nutritionally valuable, cost-effective, and locally available feed ingredient capable of partially substituting soybean meal in rabbit diets. An inclusion level of up to 20% GGLM is optimal for maintaining good growth performance and feed utilization in weaner rabbits. This substitution can contribute to reducing the overall cost of rabbit production while promoting the sustainable use of indigenous feed resources in Nigeria and other tropical regions.

The adoption of such locally sourced feed ingredients aligns with global efforts toward sustainable livestock production, ensuring food security and minimizing dependence on imported feed ingredients like soybean meal.

6.2 Recommendation

Based on the findings of this study, the following recommendations are made:

1. Optimal Inclusion: Guinea Grass Leaf Meal can replace up to 20% of soybean meal in weaner rabbit diets without compromising growth performance or feed utilization efficiency.

2. Feed Cost Reduction: Rabbit farmers, especially small-scale producers, are encouraged to adopt GGLM as a low-cost protein source to minimize feeding expenses, which constitute a major part of production costs.

3. Processing of Guinea Grass: Before inclusion in diets, Guinea grass leaves should be properly processed (e.g., sun-dried, ground, or fermented) to reduce moisture content, improve digestibility, and minimize anti-nutritional factors.

4. Further Research: Future studies should investigate the long-term effects of GGLM inclusion on carcass characteristics, blood profiles, and reproductive performance of rabbits. Studies should also explore biotechnological processing methods such as enzyme

supplementation or fermentation to enhance the nutritional quality and digestibility of GGLM.

5. Extension and Farmer Education: Agricultural extension agencies and livestock research institutions should organize training and awareness programs to educate farmers on the formulation and use of Guinea Grass Leaf Meal in rabbit feed production.

6. Sustainability Considerations: Encouraging the use of Guinea Grass, a widely available and renewable resource, promotes environmentally sustainable livestock feeding practices, reducing reliance on conventional feed materials and mitigating the pressure on commercial protein sources.

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