GROWTH PERFORMANCE OF WEANED RABBIT FED DIET CONTAINING *Tectona grandis* AND OXIDIZED O IL

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CERTIFICATION

The is to certify that this project has been read and approved as meeting the requirement of the Department of Agricultural Technology, Institute of Applied Sciences, Kwara State Polytechnic, Ilorin for award of Higher National Diploma in Agricultural technology.

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DEDICATION

This project is dedicated to Almighty God Who granted me the wisdom, moral kno wledge and understanding and Who had made it possible for me to embark on an d complete this project work.

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Abstract

The experiment was carried out to determine the growth performance of wean ed rabbit fed diet containing Tectona grandis and oxidized oil. Twenty four homo genous sex rabbit kits at four weeks old was randomly allocated to four dietary treatment s D1, D2, D3 and D4, non-oxidized oil, oxidized oil, oxidized oil plus BHA and oxidized oil pl

us 10% TGLM respectively, replicated three times. The rabbit were fed and managed for e ight weeks. The following growth performance traits were measured; initial body weigh t, weight gain, average weight gain, feed intake, average feed intake and feed c onversion ratio. The result shows that initial body weight, feed intake and aver age feed intake were not significantly (P>0.05) affected while final body weigh t, weight gain, average body weight and feed conversion ratio were positively i nfluenced by addition of 10% TGLM. Feed containing 3% oxidized oil and 10% TGLM had better performance on the rabbits and thereby recommended.

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CHAPTER ONE

1.0. INTRODUCTION

1.1. INTRODUCTION

Rabbit meat is commonly consumed in Europe and Africa countries playing a cru cial role in their national economic (Ebeid *et al*., 2013). Rabbit meat is highly nutrit ive and healthy because it is low in cholesterol and rich in protein of high biologic al values and polyunsaturated fatty acids constituting up to 35-40% of total fatty acids (Mattioli *et al*., 2017) and mainly contributing to human health (Abdel-Hami d *et al*., 2020). Additionally rabbit meat is considered a unique function food that possesses various important elements (eg minerals, vitamins, amino acids e.t.c) which can be further enriched by intelligent feeding approaches (Pla, M. and Dalle Z otte, 2000). Oxidative stress is a disturbance in cellular redox reactive oxygen speci es, ROS at rates that exceed the cellular production of internal antioxidant (Osma n *and Salama, 2021*). Abdel-Hamid *et al*. (2020) oxidative stress has deleterious e ffects on farm animals health, performance and production, subsequently affecti ng the domestic animal industry economic efficiency (Hendary *et al*., 2019). Reac tive oxygen species naturally emit as by-products of normal oxygen metabolism i n aerobic organisms. Free radicals significantly trigger lipid oxidation of sub cellul ar membrane in animals muscle (Ashore *et al*., 2022) which remarkably accelerat es meat products postmortem oxidative rancidity (Morrissey *et al*., 1998). Becaus e of its high content of polyunsaturated fatty acids, rabbit meat is susceptible to li pid oxidation indicated by rancidity and color determination, which reduce its shel f life (Dalle zotte and Endro 2011). Therefore, natural and synthetic antioxidant ar e used to combat free radicals internal pro-diction and improve meat quality (Ash ore *et al*., 2022).

Several plants have proven to have an antioxidant effect on growth performance of weaner rabbit by which the demand for antioxidants of plant origin capable of replacing synthetic antioxidants in feeds and foods has increased considerably in recent tears. Many herbs and spices contain active components capable of exerti ng antioxidant action such as phenolic substance (Flavonoids, Tannins, Phenolic Acids and phenolic determine) and vitamins E, C and A. These plants feed against oxidative deterioration during storage, and enhancing the oxidative stability of me

at and meat products during storage or ripening for the latter purpose. Herbs and spices (oregano, rosemary, sage, thyme, cinnamon, mint, ginger, clove etc.) or their extracts (prepared from the plant material). Can be also directly added to the meat products during processing. Pla, M. and Dalle Zotte, (2000) reviewed the antioxidant e ffects of the herbs and spices that had been tested.

Rabbit growth and feed conversion ratio were also enhance through dietary suppl ementation (150 mg/kg feed) of Siberian ginseng (*Eleutherococcu senticosus*) ex tract (Chrastinova et al., 2009) or 150 mg/kg feed of commercial phytogenic feed additive (Cuxarom spice master) composed of a mixture of brown algae, basil, fu nnel garlic, cinnamon and essential oil from aniseed and thyme (Chrastinova et a l., 2009) one example of a typical antioxidant plant is *Tectona grandis*.

Tectona grandis commonly known as teak, is a tropical tree species native to Sou theast Asia, research has shown that T. grandis extract possess an antioxidant an d phytochemical, and other essential biological value that can suppress oxidative stress in livestock.

Butylated hydroxyl anisole (BHA) is a synthetic phenolic antioxidant, comprising t wo isomers: 85% of 2 tert-buty 1.4methoxyphenole and 15% of 3-fert-buty-4-meth oxyphenole (Wu *et al.*, 2022) it is used mainly as a food preservative because of it s chain breaking function in lipid peroxidation (Wu *et al.*, 2022). Animal studies de monstrated a wide range of biological behaviors towards this compound. Dietary administration of BHA was reported to protect rats against acute radiation expose d and multiple xenobiotic (Kahl, 1984). It was also reported to inhibit chemically i nduced tumor (Kahl, 1984). The defensive activities of BHA are attributed to its po tential capacity to stimulate phase 2 detoxifying enzymes such as epoxide hydrol ases, glutathione s-transferases, uredines 5 - diphosphos- glucuronosy transferas es and quinone reducetase. It also modulates cytochrome - p450 mono oxygenas e activity, which is involved in pathways of detoxification and carcinogenase. Anti oxidant activities are usually associated with better metabolism and vital organs f unctionality, according to Wu *et al.* (2022).

1.2. JUSTIFICATION

Over the years the performance of rabbits and other livestock spices have been fa

ced with a challenges of feeding and feed availability, often use oxidized oil provi de excellent source of energy but still exposed livestock to oxidative stress. The us e of *Tectona grandis* leaf meal may serve as antioxidants to combat the effect of oxidized oil on oxidative stress and growth performance in weaner rabbits. Improv e growth performance aims to investigative whether *Tectona grandis* leaf meal ca n improve growth performance in weaner rabbit fed oxidized oil.

1.3. OBJECTIVE

General objective

To evaluate the influence of antioxidant level of *Tectona grandis* on performance of rabbit fed oxidized oil.

Specific objective

- To determine the weight gain and feed intake of rabbit fed *Tectona gra ndis* and oxidized oil.
- To evaluate the feed conversion ratio of rabbit fed *Tectona grandis* and oxidized oil.

CHAPTER TWO

2.0. LITERATURE REVIEW

2.1 livestock production and militating factors

Livestock systems occupy about 30 percent of the planet's ice-free terrestrial surf ace area and are a significant global asset and plays a key role in global food sys tem as one of the main sources of animal protein (milk, meat and egg), contribute to crop productivity through provision of draught power and manure, and to the liv elihood in low and middle income countries. The livestock sector is increasingly o rganized in long market chains that employ at least 1.3 billion people globally and directly support the livelihoods of about 600 million poor smallholder farmers in t he developing world (Robinson, 2011).

Livestock are important in supporting the livelihoods of poor farmers, consumers, traders, and labours throughout the developing world. The greatest impact of lives tock in sustainable development is designed to help the poor in enhancement of li vestock-production systems, during the past decade, it contributed to total Nigeria n livestock cash income (Adams, 2016).

In Nigeria, presently, there has been incidence of extreme poverty and malnutrition in the country, livestock contribute directly to the economy through employment g eneration, increase in savings and investment, foreign exchange earnings, contrib

ution to human food and nutrition. Livestock also contribute indirectly to food sec urity by increasing crop output through providing manure, and serve as a buffer to mitigate the impact of fluctuations in crop production on the availability of food f or human consumption, thereby, stabilizing food supply (Adams, 2016). Despite it s smaller output compared with that of staple crops, productivity and income gro wth in the livestock sector have strong income multiplier and poverty reduction im pacts (Adams, 2016).

2.2. Problems Militating Against Sustainable Livestock Production

Livestock sector worldwide focus numerous daunting challenges that will require i nnovations, new technologies and new ways of approaching agriculture if the foo d, feed and fibre needs of global population are to be met. Animal population tren ds are said to be influenced by strong demand driven factors such as population growth, urbanization, income growth, high cost of animal feed, animal diseases, a ccess to veterinary services, vaccines and drugs, level of education of famers, role of government in policies making, market structure, storage facilities, adequate ex tension services, insufficient supplies of man power, transportation insufficient a nd poor transportation channel, inadequate basic animal husbandry infrastructur e, climatic and environmental factors, animal welfare, attitude to animal productio n system (Etuk *et al.*, 2014).

2.2.1. Effects high cost of conventional feed and the need for exploring novel fe edstuffs

Nutritious animal feeds are essential for full development and productivity of ani mals. Animal feeds are not readily available and where they are they are not easily affordable for an average farmer. Since farmers go into animal production for pro fit they need to obtain feed at a price where they do not only break-even: but also make reasonable profit. Perhaps the livestock industry of ruminants does not feel the impact as much as the poultry industry which is mostly intensive in nature req uiring constant supply of feeds for maximum productivity unlike the livestock whi ch can still be fed on pastures and forage or allowed to scavenge for food. Due to the high cost of feeds, various research alternatives have sought for other means of providing animal feeds to ameliorate the effects of cost of feed such as the us e of activated sludges (Etuk *et al.*, 2014). Many livestock and poultry farmers com

pound their own feed themselves for their farm animals but they face the challen ges of raw materials for compounding the feed which may be very expensive or u navailable (Etuk *et al.*, 2014).

Attempt has recently been taken to reduce the cost of feed, including the incorpor ation of agro-industrial by-products in broiler diets as an energy source (Sugiharto *et al.,* 2018a). However, some limitations may exist when using agro-industrial by-products as ingredients in broiler rations. The high and low contents of fibre and protein in the by-products may limit the digestibility and thus inclusion level of su ch by-products (Sugiharto *et al.,* 2018a). In addition to the agro-industrial by-prod ucts, the application of leaf meal as the ingredient in broiler feeds has also been c onducted (Mustafa, 2019). Compared to agro-industrial by-products, the content o f crude protein in leaf meal is much higher (Sugiharto *et al.*, 2018a). This may be beneficial in reducing the proportion of the conventional expensive protein-rich fe ed ingredients in broiler rations.

It has been known that some particular foliage contain a number of bioactive co mpounds that are beneficial for the health of chickens. These compounds include vitamins, phenolic acids, flavonoids, isothiocyanates, tannins as well as saponins (Vergara-Jimenez *et al.*, 2017). In this regard, the use of leaf meal in rations may n ot only reduce the cost of feeds, but also elicit the health-promoting effect on broil er chickens. Apart from their benefits, the use of leaf meals in broiler diets may be limited by their high content of crude fibre. In general, broiler chickens showed low tolerance to dietary fibre, and therefore feeding diets containing high levels of leaf meal may improve nutrient digestibility and thus alleviated growth performance o f broilers (Rama Rao *et al.*, 2019).

1.3. TECTONA GRANDIS Linn

2.3.1. Morphology

Teak is a large tree, which can attain a height more than 30 m. It has a simple root system. Colour of the bark varies from pale brown to grey. Leaves have some disti nct features by which it can easily be identified. It bears a pair of leaves that stan ds at right angle to the next upper or lower pair and in each pairs; two leaves are si tuated at a node on the opposite side. Young leaves are red in colour but become dark green at maturity. Leaves are broad towards apex, oval in outline, widest at th

e centre and bear small star shaped hairs. Inflorescence large, flowers are white in colour and become inflated at maturity. Fruit is fleshy and bears 1-4 seeds which are enclosed in a stony covering. Teak sheds leaves from November to January. T he flowers appear from June to September and fruits ripen from November to Jan uary (ICFRE.2009).

2.3.2. Taxonomy of *T. grandis* Linn

Kingdom	Plantae
Super division	Angiosperms
Division	Eudicots
Class	Asterids
Order	Lamiales
Family	Verbenaceae
Genus	*Tectona*
Species	Grandis (ICFRE.2009).

2.3.3. Utilization

Teak is recognized as the best timber for the manufacture of door, window frames and shutters, wagon and carriage, furniture, cabinets, ships, agricultural implemen ts, decorative flooring and wall paneling because of its moderate weight, appropri ate strength, dimensional stability and durability, easy workability and finishing q ualities and most appealing grain, texture, colour and figure (ICFRE, 2009).

Teak is also used in a variety of ways apart from its use as timber. Various parts of the tree, including the wood are credited with medicinal properties. Kernels yield fatty oil (about 2 per cent). Flowers are considered useful against a number of dis eases such as biliousness, bronchitis and urinary discharges. Both flowers and se eds are considered diuretic. Leaves are used in indigenous medicine and their extr act indicates complete inhibition of Mycobacterium tuberculosis. The leaves also contain yellow and red dyes, which have been recommended for dyeing of silk, wo ol and cotton. The leaves are occasionally used as plates for dining purposes, for

making cheap umbrellas and for thatching temporary huts in some places. The bark is regarded as an astringent and considered useful in bronchitis. Various valuable compounds have been isolated and identified from the wood, bark, root and leaves of the tree. Activated charcoal can be prepared from its saw dust (ICFRE, 2009).

2.3.4. Distribution

Natural distribution of teak ranges from the Indian sub-continent through Myanmar and Thailand. It is common in deciduous forests and well-drained alluvial soils. India has one-third of the natural distribution. It is discontinuously distributed throughout Peninsular India below the latitude of 24°N, in the states of Madhya Pradesh, Maharashtra, Tamilnadu, Karnataka and Kerala. In Myanmar, the species is distributed throughout the country up to latitude 25°N. In Thailand, it occurs naturally up to 17.5°N and from 97° to 101°E in the watershed areas of Mae Khong, Salween and Chao Phya rivers. Teak has been introduced as a plantation species in as many as 36 tropical countries across tropical Asia, Africa and South and Central America (Indira and Mohanadas, 2002).

2.3.5. Use in Traditional Medicines

Apart from its wide spread application as timber plant, teak is also considered as a major constituent in many traditional medicines. The extracts prepared from various parts of teak are found to be effective against biliousness, bronchitis, diabetes, leprosy, anthelmintic etc. and thus shows expectorant, anti-inflammatory, anthelmintic properties. The plant extracts are also well known for analgesic, diuretic activity, gastroprotective activity, anti-haemolytic anaemia activity, Hair growth activity, Antioxidant activity etc. They are also used for treating inflammatory swelling (Neamatallah *et al.*, 2005).

2.4. Phytochemical Constituents of *Tectona grandis*

Several classes of phytochemicals like alkaloids, glycosides, saponins, steroids, flavonoids, proteins and carbohydrates have been reported in *Tectona grandis* (Rodney *et al.*, 2012). Secondary metabolites such as tectoquinone, 5-hydroxylapachol, tectol, betulinic acid, betulinic aldehyde, squalene, lapachol were also extracted from the plant (Rodney *et al.*, 2012). Acetovanillone, E-isofuraldehyde, Evofolin, syri

ngaresinol, medioresinol, balaphonin, lariciresinol, zhebeiresinol, 1- hydroxypinoresinol together with two new compounds Tectonoelin A and Tectonoelin B were extracted from the leaves of *Tectona grandis*. 9,10 dimethoxy-2 methyl-anthra-1,4-quinone ,5-Hydroxylapachol along with tecomaquinone,methylquinizarin, lapachol, dehydroxy-α- lapachone were isolated from the heartwood of *Tectona grandis* (Rodney *et al*., 2012). Teak wood contains naphthoquinone (lapachol, deoxylapachol, 5-hydroxylapachol), naphthoquinone derivatives (α- dehydrolapachone, β-dehydrolapachone, tectol, dehydrotectol), anthraquinones (tectoquinone,1-hydroxy-2-methylanthraquinone, 2-methyl quinizarin, pachybasin), and also obtusifolin, betulinic acid, trichione, β-sitosterol and sqaulene.Roots are rich in lapachol,tectol, tectoquinone, β-sitosterol, and diterpenes, tectograndinol (Goswami *et al*., 2009).

2.4.1. Pharmacological activities of *Tectona grandis*

Teak is considered as one of the major constituent in folklore medicines. Medicinally, it has various pharmacological activities like antibacterial, antioxidant, antifungal, anti-inflammatory, anti-pyretic, analgesic, anti-diuretic and hypoglycemic activities (Neha and Sangeeta, 2013).

Traditionally; **the bark**: is used as astringent, constipation, anthelmintic and depurative, also used in bronchitis, hyperacidity, dysentery, verminosis, burning sensation, diabetes, difficult labour, leprosy and skin diseases. **The leaves**: are used in haemostatic, depurative, anti-inflammatory and vulnerary. They are useful in inflammations, leprosy, skin diseases, pruritus, stomatitis, indolent ulcers, haemorrhages and haemoptysis. **The wood**: is used as Acrid, cooling, laxative, sedative to gravid uterus, useful in treatment of piles, leucoderma and dysentery. Oil extracted from the wood is best for headache, biliousness, burning pains particularly over a region of liver (Rodney *et al*., 2012). **The roots**: are useful in anuria and retention of urine (Rodney *et al*., 2012). While **the flowers**: are acrid, bitter dry and cures bronchitis, biliousness, urinary discharge (Varier, 1996). According to Unani system of medicine, oil extracted from the flowers is useful in scabies, and promotes the hair growth (Ragasa *et al*., 2008).

- **Antibacterial activity**

Antibacterial activity of *T. grandis* bark extracts towards *S. aureus* and other bacterial strains was reported by Rafullah and Suleiman (1999). The leaf extracts of *Te*

ctona grandis was found to contain two quinones: naphthotectone and anthratect one that were mainly responsible for the antibacterial activity and good antiradica l properties (Neamatallah *et al.*, 2005). The other active ingredient that contribute to antibacterial activity was found to be 5-hydroxy-1,4- naphthalenedione (Juglon e). Mahesh and Jayakumaran (2010), showed the antibacterial activity of leaf, ba rk and wood extracts of *T. grandis* against *Staphylococcus aureus* (ATCC 25923), *Klebsiella pneumoniae* (ATCC 700603), hospital strains of *Salmonella paratyphi* a nd *Proteus mirabilis* by disc diffusion assay. They also found that methanol extra ct of leaf and ethyl acetate extract of wood was also able to show fairly good acti vity against gram positive and negative species. Teak extract present good antiba cterial activity against both Gram positive (*S. aureus, B. subtilis)* and Gram-negati ve (*P. aeruginosa)* bacteria.

- **Antifungal activity**

The available literature reveals that tectoquinone and anthraquinone from teak sa wdust, possess antifungal activity. Other phytochemicals reported from teak viz., j uglone, lapachol and deoxylapachol (Naphthoquinones) also possess antimicrobi al activity (Sumthong *et al.*, 2006).

The leaf and bark extracts of *Tectona grandis* prepared in solvents (ethanol, meth anol, ethyl acetate and water) were tested for the antifungal activity against test f ungi. The antifungal activity of the extract was assessed by the presence or abse nce of zone of inhibition which shows a clear zone of inhibition measured (in m m) around the discs. Antifungal and antibacterial activity of wood and bark of tea k has been reported earlier by Sumthong *et al.* (2006).

Suseela and Parimala (2017) reported that both leaf and bark extracts of *Tectona grandis* prepared using ethanol, methanol, ethyl acetate and water were found to be efficient in inhibiting the growth of pathogenic bacteria and fungi. Among diffe rent extracts prepared using leaf and bark of teak plants, ethanolic extracts showe d significant antibacterial and antifungal activity.

- **Antioxidant activity**

Sumthong *et al.* (2006) examined the antioxidant activity of *T. grandis* Linn. Leaf extracts employing four *in vitro* assay systems, i.e., Total phenolic content, reduci ng power, Super oxide radical scavenging activity, Inhibition of H_2O_2 induced eryth rocyte haemolysis method, in order to understand the usefulness of this plant as

a foodstuff as well as in medicine. The plant extracts of 17 commonly used India n medicinal plants were examined for their possible regulatory effect on nitric oxi de (NO) levels using sodium nitroprusside as an NO donor *in vitro*. *T. grandis* Linn shows potential scavenging activity among all other plant extracts. Antioxidant a ctivity of leaf, bark and wood of Hexane, chloroform, ethyl acetate and methanol e xtracts was checked with 1, 2-diphenyl 1-picryl hydrazil (DPPH) and ABTS+ free ra dical. Ethyl acetate extract of wood showed very high activity with 98.6 % inhibitio n against DPPH and ABTS+ free radicals (Sumthong *et al.*, 2006).

- **Anti-haemolytic anaemia activity**

Traditional oral report indicates that *T. grandis* Linn, is used in the treatment of an emia in Togo (Aboudoulatif *et al.*, 2008). The ethanol extract of leaves of *T. grandi s* Linn was evaluated on anemia model of rat induced by intraperitoneal injection of phenylhydrazine at 40 mg/kg for 2 days. This anemia which resulted from the early lysis of the RBCS was naturally reversed 7 days later by the regeneration of t hese blood cells due to the increase of the reticulocytes. Oral administration of lea ves ethanol extract of 1 mg/kg/ day and 2 mg/kg/day, to the rats previously treate d with phenylhydrazine, significant increased the concentration of Hb, RBCs num ber, haematocrit and reticulocytes rate mainly 7 days after phenylhydrazine admin istration. So the study suggested that, the extract could stimulate erythropoiesis p rocess and which may increase the number of young RBCs (reticulocytes) (Aboud oulatif *et al.*, 2008).

- **Anti-inflammatory Activity**

Denaturation of proteins is a well-documented cause of inflammation. As part of t he investigation on the mechanism of the anti-inflammation activity, ability of diff erent solvent plant extract protein denaturation was studied. It was effective in inh ibiting heat induced albumin denaturation. Maximum inhibition 89.61% was obse rved from methanol extract followed byethanol 86.81% and water 51.14%. All the solvent extracts inhibited the albumin denaturation, the methanol extract stood fir st compared to ethanol and water extracts. Aspirin, a standard anti-inflammation drug showed the maximum inhibition 75.89% at the concentration of 200µg/ml (S hruthi *et al.*, 2012).

- **Anti-ulcer Activity**

Lapachol, a naphthaquinone isolated from the roots of *Tectona grandis* given at a dose of 5 mg/ kg twice daily for 3 days was found to have an anti-ulcerogenic effect on subsequently induced experimental gastric and duodenal ulcers in rats and guinea-pigs. Its action appears to be associated with an effect on the protein content of gastric juice, and it reversed aspirin-induced changes in peptic activity, protein and sialic acid (Shruthi *et al.*, 2012).

1.5. Rabbit Production

Rabbits (*Oryctolagus cuniculus*) are small herbivorous mammals widely used in research, as pets, and for meat and fur production. Their efficient feed conversion, high reproductive rates, and adaptability make them an excellent model for studying dietary interventions and nutritional strategies. The increasing competition between rabbit for available gains and feed coupled with Nigeria's neglect of Agriculture, has led to high cost of available feed resources.

Rabbit meat is lean meat of high nutritive value, because it is rich in essential amino acids, polyunsaturated fatty acids (PUFA), vitamins, minerals, low in cholesterol contents, and does not contain uric acid compared with other meats. The profitability of rabbit farms is partly depending on the effectiveness of weaned rabbits to grow healthy and to protect them from high mortality rates during the fattening period. Antibiotics are frequently used in the diets of growing rabbits because digestive disturbances are the main reason for morbidity and mortality in the rabbit industry.

The aim of livestock farmer is to produce the animal protein in the shortest possible time to meet the demand for animal protein. To achieve this aim, the use of antibiotic growth promoter in livestock production to promote growth by enhancing feed utilization and inhibition of pathogens activities are being considered by the farmers. However, the awareness of possible microbial resistances in farm animals and the eventual antibiotic residue in animal products later formed a major discouragement for the use of antibiotic growth promoter for animal production (Ayodele, 2016). This thereafter fuelled the search for and the use of the alternative to antibiotic growth promoters or complementary medicines to enhance performance, immunomodulation, and general health maintenance in animal production. Herbs of medicinal values are currently in increasing demand as they are being found suitable for the animal with the benefits of low cost and total safety. Medicinal plant

parts, when incorporated in the rabbit diets, could serve as protein source suitable for replacing in full or part the conventional and expensive protein feedstuff and a lso as a phytobiotic growth promoter (Oloruntola *et al*. 2016). Herbs in monogastr ic diets are known for impacting the metabolism by combating microbial activitie s and stress (Dhama *et al*. 2015) through the prevention of pathogens colonizatio n and enhancement of the digestive enzymes production and activities by the phy togenic components of the plants' parts (Dhama *et al*. 2015). Numerous plants p ossess anti-microbial traits which are synthesized during secondary metabolism of the plant (Ayodele, 2016).

2.5.1 Importance of Rabbits in Livestock Production

- Meat Production: Rabbit meat is a lean, high-protein source with low cholesterol levels, making it ideal for health-conscious consumers.
- Reproductive Efficiency: Rabbits have short gestation periods (28–3 1 days), high litter sizes, and the ability to breed throughout the ye ar, ensuring steady production.
- Adaptability: Rabbits can thrive in diverse environments and utilize for ages, agricultural by-products, and unconventional feed resources s uch as leaves.

2.5.2. Rabbit Nutrition

Rabbits feed on fresh and dry legumes and grasses, and occasionally on roots an d tubers, straw and stem. They are one of the few animals that do not compete wi th humans for available limited conventional feed. Unlike the poultry farmer, the s mall-scale rabbit fanner should not face problems with food supplies at any time of the year. Even when the grasses have withered, the leaves from tall trees and sh rubs are available for food. However, care must be taken as to what is given to yo ung rabbits and pregnant and nursing does, as they are particularly sensitive to so me plants (Fawzia *et al*., 2020).

Rabbit have the ability to utilize forages and fibrous agricultural by-products are a ttributes in favor of rabbit production. Though there are two types of nutrition pro grams are used for raising rabbits: hay and grain diets or commercial balanced pe llet rations. Pellets meet all of a rabbit's nutritional requirements and are more con venient than formulating a hay and grain ration. Pregnant does and those with litt

ers should fed ad-libitum. Bucks and does without litters need 6 to 8 ounces of pel lets a day. When raising Angora rabbits, you should avoid feeding hay because th e dust will contaminate the wool and lower its quality. Rabbits require fresh, clean water every day (Iyeghe-Erakpotobor *et al.*, 2002). Automatic watering systems off er a continuous water supply while reducing waste and contamination. A doe and her litter need 1 gallon of water a day in warm weather. Rabbits also enjoy receivi ng small amounts of greens as a treat. In spite of these apparent advantages, rab bit production has not yet achieved its potential in the tropics. Productivity is 50% or less of what is typical in temperate areas (a characteristic not unique to rabbit s). While heat stress is a major factor accounting for the low productivity, inadequ ate nutrition is also very important. The limiting nutritional factor is probably dige stible energy. Feeding programs that incorporate cull bananas, plantains, cassava, and various tropical fruits, sugar cane products, and agricultural byproducts such as rice bran and other grain-milling by-products, should be developed. These mate rials are excellent sources of digestible energy, and can be used to supplement leg ume forages (e.g. tree legumes) which are good sources of protein (Shi-yi *et al.*, 2 019).

Rabbit have been reported to perform better on different feed ration ranging from fodder, forage, grains and forage combination and compounded feed (Heba *et al.*, 2021). Heba *et al.* (2021) reported that while digestibility of protein, fibre and ene rgy of tropical grasses is very low in rabbits, many of the tropical legumes are as digestible as temperate forages. High digestibility of dry matter, crude protein, cru de fibre and nitrogen free extract was reported by Iyeghe-Erakpotobor**,** (2006) indi cating that the rabbits were able to utilize nutrients in the high forage and low con centrate combinations. Iyeghe-Erakpotobor**,** (2006) reported that combinations of concentrate, grass and forage would be adequate for grower rabbits. Though soy bean forage treatments gave the lowest rate of gain, the difference was not signifi cant. In the rural areas where soybean cheese waste meal, groundnut haulms, sw eet potato vines and soybean forage are available, these could be efficiently utiliz ed for feeding grower rabbits.

In general, rabbits will eat about 80 percent of available plants. However, they hav e their favourites, including the leaves below the crown of cabbages (*Brassica aler acea*), groundnut leaves, juice plant (*Euphorbia heterophylla*), *Centrosema pubes*

cens and wild marigold (M*elanthera scandens*). They eat all types of grass. Altho ugh freshly cut and dried greens, together with food waste from the house, are sui table for small-scale enterprises (FAO, 2005). Fortunately, the availability of pellets in West Africa has increase the development of rabbit farming on a commercial s cale. It is possible, however, for rabbit farmers to mix their own feeds which will m eet the requirements of a balanced diet and ensure fast growth, good milk product ion and good health. Although the rabbit is regarded as herbivorous animal, many rabbit farmers feed their animals with poultry feed, which often contains dried fis h. Rabbits will consume dried but not fresh fish (De-Blas and Mateos, 2010).

Nutritional Composition of Tectona grandis Leaves

Crude Protein: The leaves contain 15–18% crude protein, which meets a sign ificant

portion of the protein requirement for rabbits (Oloruntola *et al.*, 2018).

Fiber Content: The high fiber content (30–40%) supports gut health and enhance s nutrient absorption in rabbits, which are hindgut fermenters (Akinwande & Akinola,

2018).

Antioxidants: The leaves are rich in phytochemicals such as flavonoids, polyphe nols, and tannins, which act as natural antioxidants to combat oxidative stre ss (Ebenebe *et al.*, 2013).

Benefits of Tectona grandis Leaves in Rabbit Diets.

Growth and Weight Gain: Rabbits fed diets containing Tectona grandis leaves a chieved comparable or superior growth performance to those fed conventional fe eds, likely due to the leaves' high protein and antioxidant content (Oloruntola *e t al.*, 2018)

Digestibility: The fiber in Tectona grandis leaves supports healthy digestion, re ducing incidences of enteritis and diarrhea in rabbits.

The anti-nutritional factors (Soetan and Oyewole, 2009). The adverse e ffect of some anti-nutrients in feed can be overcome by repeated was hing with water which makes the feed more palatable by reducing its bitt