

Effects of Millet Chaff Based Feeds with Concentrates on Growth Performance and Economy of Supplementation in Growing Yankasa Sheep

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ABSTRACT

The effects of feeding urea ensiled millet chaff based diets with concentrates on growth performance and economy of supplementation in growing Yankasa Sheep were evaluated. Four kg urea was dissolved in 100 litres of water sprinkled on 100kg of millet chaff kept in an airtight, anaerobic condition for 21 days (ensiled) as basal diet, fed ad libitum to ten Yankasa Sheep with average initial weights of 16.35 - 18.21 kg replicated 5 times using completely randomized design were allocated to 2 diets; 300g cottonseed cake diet 1, *Faidherbia albida* diet 2, CSC & maize offal diet 3, FA & maize offal diet 4, CSC & wheat offal diet 5 and FA & wheat offal diet 6, fed twice for 70 days. Findings revealed highest ($p < 0.05$) DM intake (756.09g/d) in diet 6. Sheep on diet 2 recorded highest average daily weight gain and FCR (75.81g/d & 7.91) than diet 4 (35.02g/day & 17.94) with least. Cost of concentrate diets was lower in diet 6 (₦ 35.82) than diet 1 (₦ 109.83), 2 (₦ 46.79), 3 (₦ 66.71), 4 (₦ 68.77) and 5 (₦ 58.50). Supplementation of urea ensiled millet chaff based diet improved growth performance and FCR. However, supplementing *Faidherbia albida* pod meal at 30% with 4kg urea ensiled millet chaff gave the highest ADG and FCR with a concomitant reduction in cost of feed, therefore is recommended for growing Yankasa sheep.

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INTRODUCTION

Small ruminants' production has been given a pride of place in animal production in Nigeria in view of its multipurpose roles. It contributes immensely to animal protein supply in Nigeria (Aruwayo, 2016). The short generation interval, ability to give multiple births and their small size make sheep adaptable to smallholder mixed crop-livestock production systems where they contribute up to 22 to 63% to the net cash income (FAO, 2004). Most of the sheep feeds are derived from natural pasture and crop residues. However, such feed resources may not fulfil the nutritional requirements of animals, particularly in the dry season, due to their inherent low nutrient content and poor quality (Alemayehu, 2006), in

that, the natural pasture which supply the bulk of ruminants, feed becomes dry and of low nutritive value during the dry season leading to a marked decrease in voluntary intake and digestibility Yusuf *et al.* (2013).

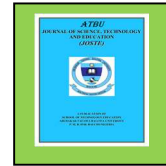
Fibrous crop residues are poor sources of fermentable nitrogen as their crude protein is below the level required by rumen microorganism. These crop residues are low in easily degraded carbohydrates, minerals and other nutrients required to balance the products of digestion to requirements, leading to limited intake, poor rumen function and low animal productivity (Anyu & Ozung, 2018). The nutritional needs of sheep can thus be addressed through the use of non-

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conventional feedstuff that are cheap and readily available (Ahamefule & Udo, 2010).

According to Akinola *et al.* (2015), cereal crop residues are given less attention as important livestock feed, where over 40% is used as fuel while only about 27.28% is used as animal feed, as such, ruminant animals in the arid and the semi-arid areas of the Sudan savanna survive almost entirely on drought tolerant pasture species and supplement their nutrient requirements generally from the available fodder trees and shrubs (Buterworth, 2002). The arid and semiarid areas are home to over 80% of small ruminants and their sustenance is reducing due to dependence on natural pastures (Kosgey *et al.*, 2008) supporting 4658% of pastoral households. The trend has started changing from the situation in which millet chaffs were considered as waste and are now being converted to animal protein for human consumption (Singh *et al.*, 2004 & Singh *et al.*, 2011).

Millet Chaff is the part of the plant that remains after the grains are harvested, and is a fibrous by-product that contains low nutritive value (Hassanat, 2007). Millet chaff can be fed to sheep. According to Subba Rao *et al.* (1995) treating millet chaff with 4% urea using maximum of 100 litres of water per 100kg air dry straw in long form, storing it under airtight condition for a period of 1-3 weeks, improves palatability, energy and protein content. Due to its high palatability and nutritive value, farmers use the chaffs almost exclusively for feeding cattle (Subba Rao *et al.*, 1995). Treating millet chaff with a 5% urea solution increases dry matter (DM) digestibility by 23% dry matter intake by 16% (from 42.6 to 49.2g/kg W0.75) and average daily gain by 12% (from 41 to 51g/kg) in Djallonke Sheep (Mattoni *et al.*, 2007). In this study, an attempt was made to evaluate the effects of feeding urea treated and ensiled millet chaff based diets with different concentrates.

Objectives

- i. To assess the Chemical Composition of the Experimental Diets Used in the Experiment

- ii. To investigate the Performance of Yankasa Sheep fed Urea Treated and Ensiled Millet Chaff Based Diets with Supplementation
- iii. To determine the economy of Supplementation of Yankasa Sheep Fed Urea treated and Ensiled Millet Chaff with Supplementation

LITERATURE REVIEW

Ruminant animals are reared in large quantity in Nigeria especially in the northern part. According to the Aruwoya *et al.* (2018) citing National Agricultural Sample Survey, Nigeria reported an estimated 19.5 million cattle, 72.5 million goats, 41.3 million sheep and 28,000 camels. This indicates that ruminant constitute the major source of animal protein. This indicates that ruminant constitute the major source of animal protein. According to FAOSTAT (2008), sheep numbers were in excess of one billion (1,078,200,000) while 861,900,000 goats were produced.

The quantity produced of these animals along with meat from other livestock has not been able to satisfy the national protein requirement. Aruwoya *et al.* (2018) reported that the level of animal protein consumption is low in Nigeria and is estimated to be about 8g per caput per day, about 27g less than the minimum requirement recommended by the National Research Council of the United State of America. Among the challenges of production, feed shortage constitutes the greatest of them. The feed shortage has been blamed on high cost of conventional sources of feed ingredients which (Aruwoya, *et al.* (2018) rated at 70- 80% of total cost production.

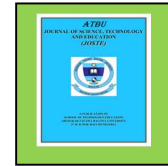
According to Williams *et al.* (2021), the population of cattle, sheep and goats increased by 0.5, 2.2 and 1.7% per year respectively between 1961-63 and 1991- 93. Sheep and goats dominate the livestock population and are said to have higher population compared to any other ruminant species (Garba and Muhammad, 2018) and well adapted to the various ecological zones of Nigeria. According to a report by CSIRO Research (2021), Nigeria has the largest small ruminant herd in

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Africa – followed by Sudan, Chad, Ethiopia and Kenya. There are 73.8 million goats and 42.1 million sheep – mainly indigenous breeds. Small ruminants are kept by smallholder farmers for meat, hides, wool and, to a lesser extent, milk.

In developing countries, the major feed resource for ruminant animals is the pasture (Fadiyimu et al., 2015) in Abdul (2022). The feed resources available for small ruminants are natural pastures, browses and crop residues and by-products. The availability and quality of these resources vary, but evidence is presented to show that when they are properly selected and combined according to their nutritional characteristics, adequate and productive diets could be provided all year round, for sustainable small-ruminant production and productivity. Pasture development, hay and silage, making of concentrates using available grains and tubers, utilization of crop residues and agro-allied by-products, all would go a long way in aiding the development of livestock in Nigeria.

Nigeria possesses about 41.3 million sheep (FMARD, 2016). It requires less capital as they can be completely maintained on pastures, browse, and agricultural waste products. A flock of sheep can provide families with food each day in the form of milk, but only in limited parts of the world are sheep milked for dairy foods. Sheep milk is an excellent raw material for the milk processing industry especially in cheese production. The Mediterranean countries are the biggest producers of sheep milk. They participate with approximately 47% in the overall world production of sheep milk. (<http://agriculturenigeria.com/farming-production/livestock/sheep>). Sheep milk yields 18 to 25 % cheese, whereas goat and cow milk only yield 9 to 10 %. (<http://agriculturenigeria.com/farming-production/livestock/sheep>). While sheep usually produce less milk than goats and much less than cows, sheep milk sells for a significantly higher price per pound, almost four times the price of cow milk. (<http://agriculturenigeria.com/farming-production/livestock/sheep>).

Livestock feed may be defined as any dietary substance that nourishes the animal's

body for maintenance and reproduction. These feeds are either roughages (forages) or concentrates (Lamorde, 1993) in Abdullahi (2019). According to Lakpini (2002) in Abdullahi (2019), feeds are substances voluntarily taken in by animals to provide nutrients such as energy, protein, mineral and vitamin metabolized in the body to maintain the body, produce body tissue, fluids and byproducts such as meat, milk and eggs. Most feeds are natural substances which most commonly are organic matter with little component of inorganic matter. Feed is in very short supply and of poor quality (Tanko, 1993) in (Abdullahi, 2019).

The author further stated that most range lands grazed by these livestock in the sub-humid, to the dry savannas produce less than 1 tonne DM/ha and contain crude protein of 9% to 8% only during the early and mid-wet season. According to Isah, *et al.* (2015), in developing countries like Nigeria, livestock are fed mainly on low quality roughages, including natural grazing and agro-industrial by-products, all of which contain large quantities of lignocellulosic material. These feeds are deficient in protein, energy, minerals and vitamins. In addition, at certain times of the year, the quality of grazing and browse deteriorates substantially due to seasonal influences, and livestock productivity consequently declines.

Cereal residues (maize, rice, millet, sorghum and wheat) residues are low in nitrogen and one way of improving their nutritive value is to feed them to animals together with a variety of forage supplements that are potentially valuable to ruminants (Adebowale, 2018). Some of these forages include cowpea (*Vigna unguiculata*), groundnut (*Arachis hypogea*), Gliricidia leaves (*Gliricidia sepium*) and *Leucaena leucocephala* etc. The beneficial effects of feeding these forages to ruminant animals are many such as increased metabolisable energy and nitrogen intake, improved palatability, increased available 41 minerals and vitamins, better rumen function and a laxative influence on the alimentary system.

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Forage resources

Forages are the single most important feed source for ruminants worldwide (Wilkins, 2000) in Babayemi *et al.* (2021). They are edible parts of plants, other than separated grain, usually with substantial contents of cell walls (Babayemi *et al.* (2021)). Forages are suited to utilization by herbivores that have a capacity for microbial digestion of cell wall constituents (Wilkins, 2000) in Babayemi *et al.* (2021). According to Babayemi *et al.* (2021) forages are plants that are cultivated for their vegetative portions and are used in fresh or preserved forms for feeding livestock.

Grass forages

Pasture grasses, mainly C4-plants frequently contain crude protein levels of 8% or less, which are inadequate for animal production (Humphreys, 2021). During the dry season, there is a drastic decrease in the nutritional quality of tropical grasses, which is reflected by low crude protein (CP) and increased lignin content in the cell wall (Paulino *et al.*, 2018).

Agro-industrial by-products

The use of agro-industrial by-products as feed is an alternative method of overcoming shortages and higher prices of conventional feeds in ruminant nutrition. Many byproducts have substantial nutritive value as animal feed. Thus, cereals can be largely replaced by these by-products and therefore competition between human and animal for nutrition is less. Furthermore, using these by-products in animal nutrition can solve related environmental problem (Mirzaei-Aghsaghali and Maheri-Sis *et al.*, 2018).

Cereal Crop residues forages

Crop residue refers to the plant material that remains in the field after the primary harvestable crop has been harvested. It consists of the parts of the plant that are not harvested or removed, such as stems, leaves, husks, stalks, and other non-edible portions. From the report of ILRI (2020) Crop residues vary depending on the type of crop and can include materials like corn stalks, wheat straw, rice straw, sugarcane tops, soybean stems, and cotton stalks, among others.

According to Isah, *et al.* (2019), in developing countries like Nigeria, livestock are fed mainly on low quality roughages, including natural grazing and agro-industrial by-products, all of which contain large quantities of lignocellulosic material. These feeds are deficient in protein, energy, minerals and vitamins. In addition, at certain times of the year, the quality of grazing and browse deteriorates substantially due to seasonal influences, and livestock productivity consequently declines.

Livestock feed in Nigeria is often limited and of poor quality. Natural grazing and agro-industrial by-products are commonly used, but they are deficient in protein, energy, minerals, and vitamins. The quality of grazing and browse deteriorates during certain times of the year, leading to decreased livestock productivity. Crop residues, such as cereal stover and legume haulms, are valuable feed resources but often have low nutritional quality. During the dry season, poor-quality roughages and crop residues are the main feed sources, resulting in negative energy and nitrogen balance for animals. Correcting these deficiencies is crucial when using crop residues and agricultural by-products as feeds. Based on this note, Isah Et al, (2019) identified these as an reason for need of supplementary feed in Nigeria, he furthermore identified some other importance for supplementary foods for sheep in Nigeria:

1. Limited Access to Quality Forage: In Nigeria, there can be seasonal variations in forage availability, especially during the dry season. This scarcity of quality forage can result in nutrient deficiencies for ruminant animals. Supplementary feed helps compensate for the nutritional gaps and ensures consistent nutrient intake throughout the year.
2. Nutrient Requirements: Ruminant animals have specific nutrient requirements to support their growth, reproduction, and overall health. While forage forms the basis of their diet, it may not always meet their nutritional needs, especially in terms of protein,

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energy, minerals, and vitamins. Supplementary feed provides a concentrated source of these nutrients, helping to fulfill their dietary requirements.

3. **Improved Growth and Productivity:** By providing balanced and nutrient-dense supplementary feed, ruminant animals can achieve better growth rates, enhanced body condition, and improved overall productivity. This is particularly important for livestock farmers who aim to maximize meat, milk, or wool production.
4. **Meeting Production Demands:** With the increasing demand for livestock products in Nigeria, including meat and milk, there is a need for efficient production systems. Supplementary feed plays a vital role in intensifying livestock production and meeting the rising consumer demand by supporting optimal animal growth and productivity.
5. **Enhancing Reproductive Performance:** Adequate nutrition is crucial for the reproductive performance of ruminant animals. Insufficient nutrient intake can lead to delayed puberty, extended calving intervals, reduced conception rates, and increased embryonic losses. Supplementary feed, tailored to the specific requirements of breeding animals, can help overcome these challenges and improve reproductive efficiency.
6. **Health and Disease Prevention:** Nutritional deficiencies can weaken the immune system of ruminant animals, making them more susceptible to diseases and infections. Providing balanced supplementary feed strengthens their immune response, improves overall health, and reduces the risk of illnesses.
7. **Cost-effective Production:** While supplementary feed requires an investment, it can contribute to cost-effective livestock production. By

optimizing nutrient intake, animals are less prone to wastage, inefficient conversion, and health issues, resulting in better returns on investment for farmers.

Feed and Nutritional Requirement for fattening sheep

Feed is the most important limiting factor in sheep fattening. Feed availability (quantity), nutritional value (quality) and price should be considered to satisfy the maintenance and production requirement of sheep. Sheep require a balanced diet that contains adequate amounts of energy, protein, vitamins, and minerals for optimal growth and production (David, 2020). Good-quality forage and pasture generally provide adequate protein for mature, nongrowing, nonlactating sheep. A minimum of 7% dietary crude protein is needed for maintenance in most sheep(). Essential macrominerals (required at 0.1% or more in diet) for sheep are calcium, phosphorus, sodium, potassium, chloride, sulfur, and magnesium.

Essential microminerals (required in parts per million) include manganese, iron, copper, cobalt, zinc, iodine, selenium, and molybdenum. As a sheep fattener one must know what, how and when to feed fattening sheep. Nutrition is referred as the process of providing and obtaining the food necessary for the health and growth of sheep (Ahsraf and Jane, 2020). It plays the major role in overall productivity, health and wellbeing of fattening sheep, thus it is important for fatteners to give top priority for nutritional management. Five major categories of nutrients that are required by sheep. These are water, energy, protein, vitamins and minerals (Ashra and Jane, 2020).

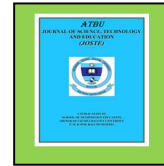
Water: Water is a major component of the animal's body and is influenced by several such factors as species, age, and dietary conditions that effect the amount in the body. Animals are more sensitive to the lack of water than food. If water intake is limited, the first indication is feed intake is reduced. As water intake becomes severely limited, weight loss is rapid and the body

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dehydrates. Dehydration with a loss of 10 percent is considered severe (Ashraf and Jane, 2020).

Energy: Every cell in sheep tissues requires energy supplying nutrients to stay alive. Additional energy is required to enable each cell to develop and grow. Cells in tissues and organs such as the brain, kidney, heart and lungs need energy to keep the whole animal alive and functioning, even if it is not growing, e.g. energy to pump blood and air into the lungs and for other muscular movements. Additional energy is required to allow a lamb or sheep to increase its muscle mass (growth of meat), or to support pregnancy and lactation (Ashraf and Jane, 2020).

Protein: As well as needing continuous supplies of energy supplying substrates, cells also have on-going requirements for amino acids to make their proteins. All cells continuously synthesize new proteins from amino acids, and then degrade some of them when they are damaged or no longer required. Proteins are the principal constituents of the organs and muscles. Protein deficiency is also a major problem. If an animal has an energy deficiency, a lack of protein in his diet aggravates the condition. Protein supplement is often mistakenly advocated when total energy (carbohydrates and fats) intake should be increased (Ashraf and Jane, 2020).

Minerals: A number of the minerals are essential and therefore must be provided in adequate amounts in the diet. Periods of rapid growth, pregnancy and lactation increase the demand for essential minerals. Mineral deficiencies are more likely in some situations than in others but can be difficult to diagnose.

Vitamins: These are required by animals in small amounts for normal body functions, maintenance, growth, health, and production, and they regulate the use of major nutrients. Vitamins must be provided to animals for many metabolic reactions within cells (Kesie et al, 2020). If the vitamins are not available, biochemical reactions cannot take place and such symptoms as loss of appetite, poor appearance, reduced growth, and feed utilization may occur.

Overview Of Millet Chaff-Based-Feed

Millet chaff, also known as millet straw, refers to the stalks and stems left over after harvesting millet grains. While millet chaff is not typically considered a primary feed source for ruminants, such as cattle, sheep, and goats, it can still be utilized as part of their diet in certain situations. Millet straw is more palatable and higher in energy and protein than small-grain straws. Several millet varieties are available and residue may vary in nutrient content, so we recommend nutrient analysis prior to feeding. Grazing is the easiest way to harvest crop aftermath. Grazing crop residues allows animals to select a higher-quality diet than would otherwise be obtained by harvesting and mechanically feeding. In grazing scenarios, ruminants will preferentially consume grain and leaves before consuming lower quality stalk material. This is an important consideration when developing diets based on crop residues.

Stocker cattle may have acceptable gains if allowed to selectively graze residues. Younger cattle should be removed from the field or supplemented with protein and energy feeds once high-quality residue components are consumed. Depending on the number of animals and the acreage, stocker cattle can graze on residues until cattle performance declines or feed quantity or quality becomes limiting. Cornfields with excess downed ears can create potential issues with founder/acidosis when grazing corn residue. Cows with experience grazing cornfields will seek out downed ears. However, stocker cattle do not initially seek out downed ears and can slowly adapt to excess downed ears. It may be necessary to step stocker cattle up to five pounds of corn before turning out. Using stocker cattle to consume excess downed corn can be a cost-effective way of adding gain while minimizing founder/acidosis issues with your cow herd. Mud and snow can reduce access to forage, limiting intake and selectivity, and ultimately reducing diet quality.

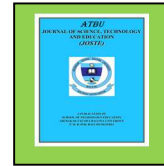
Grinding straw can increase intake 10% to 15%, according to research done at the Dickinson Research Extension Center (2017) in Greg et al (2022); however, compaction can be a

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problem in diets with high levels of chopped straw. Mixing with silage or equal parts of long-stemmed forage will reduce potential for compaction. Straw that is a year or older is usually more palatable than fresh straw.

Here are some considerations and potential uses of millet chaff as feed for ruminants as identified by Greg et al (2022):

1. **Roughage and Fiber Source:** Millet chaff can serve as a source of roughage and dietary fiber for ruminants. It contains cellulose and hemicellulose, which are important for proper rumen function and digestion. Incorporating millet chaff into the diet can help maintain rumen health and prevent issues like acidosis.
2. **Limited Nutritional Value:** Compared to millet grains, millet chaff has lower nutritional value and energy content. It is primarily composed of lignin and structural carbohydrates, making it less digestible than other feed sources. Consequently, millet chaff should be supplemented with more nutrient-dense feeds to meet the animal's nutritional requirements.
3. **Processing and Palatability:** Millet chaff is relatively coarse and may require processing or chopping to improve its palatability and digestibility. Mechanical treatment, such as grinding or pelleting, can enhance its utilization by breaking down the fibrous structure.
4. **Balancing the Diet:** When using millet chaff as part of a ruminant's diet, it is crucial to balance it with other feed ingredients to meet the animal's nutritional needs. Supplementing with high-quality forages, concentrates, and protein sources can help compensate for the lower nutritional content of millet chaff.
5. **Feed Mixing:** Mixing millet chaff with other feed ingredients, such as grains, protein meals, and mineral supplements, can create a more balanced and complete ration for ruminants. This allows for better control over nutrient intake and ensures that the animals receive a well-rounded diet.

6. **Limitations and Caution:** While millet chaff can be a useful feed component, it is important to consider its limitations. It should not form a significant proportion of the diet, especially for high-performance animals or during critical stages such as pregnancy and lactation. Regular monitoring of animal health and production parameters is essential to ensure the diet meets their requirements.
7. **Environmental Considerations:** The use of millet chaff as feed can be an environmentally sustainable practice as it utilizes a byproduct that would otherwise go to waste. However, it is important to manage the production and disposal of millet chaff in an environmentally responsible manner.

Millet straw is a byproduct from the finger millet crop, which has been widely planted in arid and semi-arid areas of the world (Sood, S.; Joshi, D.; Chandram, 2019). Therefore, millet straw is an important roughage forager source for ruminants in many areas. Finger millet straw was already used in ruminant feeding, such as sheep (Adugna, et al, 2020; Alemu et al, 2020] and heifers (Darash, 2007 in Xiaoyong, 2020). Crop straws often were specially treated by biophysical or chemical methods, such as sodium hydroxide treatment [Saleh, et al, 1987 in Xiaoyong, 2020] the addition of urea to improve the digestibility and nutritional value (Saeed, et al, 2018).

Research reported that it is essential to provide an adequate amount of rumen-degradable nitrogen (RDN) for optimum microbial protein synthesis in the rumen on straw-based diets. The result indicated that the addition of RDN in diets based on finger millet straw could increase the optimum microbial protein synthesis (MPS), nitrogen capture efficiency (NCE), and nutrient utilization in Nellore rams (Chandrasekharaiah, et al, 2011 in Xiaoyong, 2020).

MATERIALS AND METHODS

The experiment was conducted at Adamu Tafawa Balewa College of Education School Farm, Kangere, Bauchi State. The

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ingredients used for the formulation of both basal and supplemental diets include: urea, millet chaff, wheat offal, maize offal and cottonseed cake. Urea for the experiment was purchased from Bauchi metropolis, Bauchi State, Nigeria. *Faidherbia albida* pods were purchased around Bauchi metropolis. The basal diet was prepared by dissolving 4kg of urea grade fertilizer in 100 litres of water to make a 4% urea solution, then sprinkled on 100kg of crushed millet chaff, it was put inside a big plastic bucket sealed on its top with a polythene sheet and then covered firmly to make it subjected to an airtight condition which was kept for twenty one (21) days (fermented). This served as the basal diet of the experiment. The basal diet was fed to the Sheep, *ad libitum*.

Six concentrate diets were formulated using cotton seed cake, *Faidherbia albida* meal, maize offal and wheat offal. The concentrates were formulated in such a way that each diet contained one or a combination of either of the two protein and energy sources (CSC or FA & MO or WO). The concentrates designated as 1, 2, 3, 4, 5 and 6 contained CSC, FA, CSC/MO, FA/MO, CSC/WO and FA/WO respectively. The ingredients were appropriately weighed using digital and manual scales. All lumps of cottonseed cake and *Faidherbia albida* were broken using mortar and pestle to ensure proper mixing and to avoid toxicity problems when fed to animals following the following procedures:

Procedure 1: Sprinkling 100litres of Water Containing 4 kilogSheep of Urea on 100kg of Crushed Millet Chaff
1 Procedure 2: Placement of Urea Treated Crushed Millet Chaff inside a Nylon Coated Big Plastic Bucket to make it Airtight and Ensiled for 21 days.

Procedure 3: Finishing Stage in the Ensiling Process to be Kept for 21 Days. The initial live weight of individual ram was measured before the beginning of the feeding trial and subsequently on weekly basis, in the morning around 8:00 to 9:00am after an overnight fasting, before feed was offered to them using a sensitive scale to determine the live weight changes. The design of the experiment was a Completely Randomized Design (CRD) with six (6) treatment combination diets of two (2) Sheep each as a replicate. Ten (10) growing Yankasa Sheep with an average initial weight of 16.35 - 18.21 kg were procured for the study from markets around Bauchi metropolis, in Bauchi State. Two (2) Yankasa Sheep were randomly allocated to six (6) diets, in individual cubicles of 2 by 2 metres, housed in the same pen with slanted concreted floors, under a common roof. The house was fully illuminated, well ventilated and has been sanitized periodically. Prior to the arrival of the Sheep, the cubicles were cleaned and disinfected with Diskol-ES (Tiscol) at the rate of 10mls/4litres of water. Also 10% formalin was used as a fumigant.

Table 1: Gross Composition of Supplements fed to Yankasa Sheep in the Experiment

Ingredients (g)	Supplements				
	T1 CSC	T2 FA	T3 CSC/MO	T4 FA/MO	T5 CSC/WO
CSC	300.00	0.00	150.00	0.00	150.00
FA	0.00	300.00	0.00	150.00	0.00
MO	0.00	0.00	150.00	150.00	0.00
WO	0.00	0.00	0.00	0.00	150.00
Total	300.00	300.00	300.00	300.00	300.00

CSC = Cotton seed cake, FA = *Faidherbia albida* meal, MO = Maize offal, WO = Wheat offal

On their arrival, the Sheep were quarantined for two weeks during which their bodies were sprayed with acaricide, using Amitraz® 1ml/litre against external parasites.

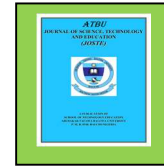
They were dewormed with Albendazole at 12.5mg/kg¹ body weight against internal parasites. Antibiotic, i.e Oxytetracycline L. A. (Kepro®) 20%, at 1ml per 10kg body weight were

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injected intramuscularly. The Sheep were kept for two (2) weeks, adaptation period prior to the commencement of the experiments. Groundnut haulms and maize offal were offered to the Sheep during the quarantine period.

All samples of the feeds were analysed for proximate composition in accordance with the procedures of AOAC (2000). Crude protein (CP) was calculated as N*6.25. Fibre fractions were analysed using the procedure of Van Soest and Robertson (1985).

Multiple Range Test (DMRT) of the same statistical package.

RESULTS

Chemical Composition of the Experimental Diets (DM) fed to Sheep in Experiment Basal and Supplementation. The chemical composition of the experimental diets is presented in Table 2. The dry matter contents of the experimental feeds for all the treatment groups were within the range of 90.63 – 94.17%. The result of the analysis of crude protein (CP) content of the diets showed that supplements 3 and 5 had

Table 2: Chemical Composition of the Experimental Diets Used in the Experiment

Parameter s (%)	Diets										
	UTMS	T1 CSC	T2 FA	T3 CSC/MO	T4 FA/MO	T5 CSC/WO	T6 FA/WO				
DM	94.58	92.01	94.17	93.46	91.31	92.87	90.63				
OM	84.83	33.07	83.53	89.15	75.35	31.16	82.06	19.13	78.50	27.88	83.23
CP	30.90	27.88	15.1	39.43	20.96	42.80	31.15	39.25	22.75	16.95	
NDF	21.34	50.39	57.27	30.50	18.47	11.65	16.50	43.00			
ADF	9.56	21.31	26.77	18.11	9.25	14.37	30.13				
Hemicelluloses	9.75	29.08	5.02				12.87				
Ash		8.48					7.40				

UTMS = Urea-Treated Millet Chaff; T1 = Cottonseed Cake; T2 = *Faidherbia albida* meal; T3 = Cottonseed Cake + Maize Offal; T4 = *Faidherbia albida* meal + Maize Offal; T5 = Cottonseed Cake + Wheat Offal; T6 = *Faidherbia albida* meal + Wheat Offal; DM = Dry Matter; OM = Organic Matter; CP = Crude Protein; NDF = Neutral Detergent Fibre; ADF = Acid Detergent Fibre; Hemic = Hemicellulose

Economy of Supplementation of the Feeds Used The cost was calculated based on the prevailing market prices of the ingredients at the time of the study as presented in Table 4. Total feed consumed per kilogram per diet was calculated where by total feed consumed was divided by total cost of feed per diet. Total cost of feed was calculated by adding all the prices of ingredients involved in making the supplements Total cost of feed per kilogram per liveweight gain per Naira (₦) was calculated where average total cost of feed per Naira (₦) per diet is divided by average total weight gain in kilogram (Kg) per diet. The data collected from the study were subjected to Analysis of Variance (ANOVA) using General Linear Model of SAS (2002). Difference among means were compared at (p<0.05) using Duncan

the highest CP values of 31.16 and 27.88% respectively. The lowest CP was obtained in diet 2 with a CP value of 15.1%. Furthermore, the fibre fractions (NDF and ADF) of the supplements were within the range of 50% and below. The highest value was obtained in D2 which had 57.27% NDF and 3 1.15% in D4 ADF respectively. Hemicellulose values were high, with 29.08, 26.77, 18.47 and 16.5% for D1, D2, D3 and D5 respectively. More so, diets 6 and D4 obtained hemicellulose values, 12.87 and 11.65% respectively. Ash values in this study were within the range of 5.02 – 18.11%.

For the basal diets, urea treated millet chaff (UTMS) recorded the highest CP of 33.07% while non-treated millet chaff (NTMS) had the highest

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value of 8.75%. Higher fibre fractions of 40.05% NDF and 30.75% ADF were obtained in non-treated millet chaff (NTMS) compared to lower values of 30.90% NDF and 21.34% ADF obtained in urea treated millet chaff (UTMS). However, hemicellulose values were similar in both urea treated and non-treated millet chaff. The value of ash was higher in urea treated millet chaff with 9.75% against 5.2% recorded in non-treated millet chaff.

Performance of Yankasa Sheep fed Urea Treated and Ensiled Millet Chaff Based Diets with Supplementation

The performance of Sheep fed urea treated and ensiled millet chaff based diets with supplementation is presented in Table 3. Supplement intakes were similar ($p>0.05$) across the treatments with values of 300g in all the diets. Basal feed intake (BFI) was also similar ($p>0.05$) among treatment groups, the values ranged from 643.94 – 765.39g/day. Similarly, daily feed intake was similar ($p>0.05$) among the diets and the values ranged from 943.94 – 1065.39 g/day. However, the dry matter intake was significantly ($p<0.05$) different among the treatments with the values ranging from 574.76 – 756.09g/day, ranging from 574.76 – 756.09g/day.

Table 3: Performance of Yankasa Sheep fed Urea Treated and Ensiled Millet Chaff Based Diets with Supplementation

Parameters	Diets						SEM	P-value
	T1 CSC	T2 FA	T3 CSC/MO	T4 FA/MO	T5 CSC/WO	T6 FA/WO		
SFI (g/d)	300	300	300	300	300	300	0.00	-
BFI (g/d)	643.94	678.14	722.30	765.39	707.46	685.79	38.55	0.3386
DFI (g/d)	943.94	978.14	1022.34	1065.39	1007.46	985.79	38.55	0.3386
DMI (g/d)	574.76 ^b	600.09 ^b	615.96 ^b	628.60 ^b	608.34 ^b	756.09 ^a	25.18	0.3677
IBW (KG)	18.20	17.48	19.52	19.66	17.08	16.30	1.00	-
FBW (KG)	20.69 ^b	22.79 ^{ab}	23.17 ^a	22.11 ^{ab}	21.83 ^{ab}	22.03 ^{ab}	0.66	0.5192
DWG (g)	35.64 ^b	75.81 ^a	52.24 ^{ab}	35.02 ^b	67.95 ^{ab}	81.19 ^a	10.54	0.3012
TWG (KG) DMI	2.49 ^b	5.31 ^a	3.65 ^{ab}	2.45 ^b	4.75 ^{ab}	5.73 ^a	0.73	0.001
%BW	2.79 ^b	2.65 ^b	2.65 ^b	2.83 ^b	2.78 ^b	3.44 ^a	0.11	0.5192
FCR	16.13 ^e	7.92 ^a	11.79 ^d	17.95 ^f	8.95 ^b	9.31 ^c	2.13	<.0001

T1 = Cotton Seed Cake alone; T2 FA = *Faidherbia albida* meal alone; T3 = Cottonseed Cake + Maize Offal; T4 = *Faidherbia albida* meal

+ Maize Offal; T5 = Cotton Seed Cake + Wheat Offal; T6 = *Faidherbia albida* meal + Wheat Offal; SEM = Standard Error of Means; LS = Level of Significance; BFI = Basal Feed Intake; DFI = Daily Feed Intake; DMI = Dry Matter Intake; IBW = Initial Body Weight; FBW = Final Body Weight; TWG = Total Weight Gain; DWG = Daily Weight Gain, FCR = Feed Conversion Ratio.

fed diet 6 (5.73kg) and 2 (5.31kg), recorded the highest means, while the Sheep on diet 1 and 4 recorded the least (2.49kg) and (2.45kg), respectively. There was significant ($p<0.05$) difference observed in the feed conversion ratio among the diets. Sheep fed diet 2 (7.92) and 5 (8.95) recorded the best FCR values followed by Sheep fed diet 6 (9.31).

Total weight gain also was significantly ($p<0.05$) different across the treatments. Sheep

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Table 4: Economy of Supplementation of Yankasa Sheep Fed Urea treated and Ensiled Millet Chaff with Supplementation

PARAMETERS	DIETS					
	T1	T2	T3	T4	T5	T6
	CSC	FA	CSC/MO	FA/MO	CSC/WO	FA/WO
Total Weight Gain (Kg)	2.49	3.28	3.65	2.45	4.76	5.68
Total Feed Intake (kg)	2.29	3.93	2.55	3.76	2.20	2.88
Total Cost of Feed (₦)	273.50	153.50	253.50	168.50	278.50	203.50
Cost of Feed/Kg/WG /₦	109.83	46.79	66.71	68.77	58.50	35.82

a, b, c, d, e = Means with the same superscripts are statistically the same; WG (₦) = Cost of Feed per Kilogram per Weight Gain in Naira. T1 = Cottonseed Cake alone; T2 = Faidherbia albida meal alone; T3 = Cottonseed Cake + Maize Offal; T4 = Faidherbia albida meal + Maize Offal; T5 = Cottonseed Cake + Wheat Offal; T6 = Faidherbia albida meal + Wheat Offal.

The economy of supplementation of millet chaff based diets with different supplementary diets is shown in Table 4. Total weight gain in kg was significantly ($p < 0.05$) different among the treatments, which ranged from (2.45 – 5.68kg). Treatment 6 (5.68kg) recorded highest value while treatment 4 (2.45kg) had lowest. Total feed intake was significantly ($p < 0.05$) different among the treatments, highest value was recorded in treatment 4 (3.76 Kg) and lowest value of 2.20 Kg was recorded in treatment 5. The total cost of feed was significantly ($p < 0.05$) different among the treatment groups throughout the experimental period which ranged from ₦ 153.50 to ₦ 278.50 observed in treatment 2, and treatment 5 as lowest and highest values respectively. Similarly, cost of feed in naira per kilogram live body weight gain were significantly ($p < 0.05$) different among the treatment groups. ₦ 35.82 was recorded in treatment 6 as the lowest value, while the highest value of ₦ 109.83 was recorded in T1.

FINDINGS OF THE STUDY

Based on the analysis, the following findings were revealed in the study;

1. Crude protein content of the basal diet, i.e. urea treated millet chaff in this study was higher than the values.

2. Addition of urea to rice straw increased the crude protein content to 13.6%.
3. A supplemental diet containing *Faidherbia albida* meal, cotton seed cake, wheat offal, maize offal and urea treated millet chaff may be considered as having adequate protein for small ruminants depending on the level of inclusion.
4. Supplementation of urea ensiled millet chaff-based diet improved growth performance.

DISCUSSION OF FINDINGS

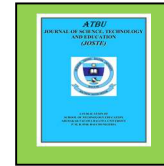
Table 2 showed that crude protein content of the basal diet, i.e urea treated millet chaff in this study was higher than the values reported by Sabo (2012) who reported CP ranges of 9.6- 11.7 % for ensiled maiwa millet with tropical legumes, 11.50% CP in natural pasture grass (Bogoro *et al.*, 2006 & Abebe, 2015), 12.4 percent in urea treated rice straw reported by Ngele (2008), the value was also higher than 6-15% reported by Aregherore (2005) when corn chaff was treated with 0 and 7 feed grade urea. However, Golmahi *et al.* (2006) found a small increment (4%) in CP of barley straw treated with urea at 0 and 4%. Adegbola (2002) reported that addition of urea to rice straw increased the crude

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protein content to 13.6%, also a significant (<0.05) increase in total dry matter intake was observed.

The value was also higher than the content of 77.5% required to satisfy ruminal microbial demands for nitrogen that would provide enough CP for the maintenance requirement of the Sheep. The NDF values for the basal diet reported in this study are comparable to the 41% recommended value that favours the growth of cellulolytic microbes, which increase salivation through eating and rumination (Jane, 2008). The ADF values obtained in this study (21.31 %) were below the range of 38 – 42% ADF recommended for all ruminants as reported by Ranjhan (2001). The possible reasons for differences in values of chemical composition in this study when compared with previous studies might be due to soil fertility and post-harvest management as reported by Alhassan *et al.* (1987) that crop residues when allowed to stay in the field long after harvesting the primary produce results in the decline in their nutritive value. Also these differences may be due to method of accessing, stage of growth and method of processing the plant.

For the supplemental diets, the dry matter, organic matter, crude protein, fibre fractions (NDF, and ADF) hemicellulose and ash vary across the diets. A supplemental diet containing *Faidherbia albida* meal, cotton seed cake, wheat offal, maize offal and urea treated millet chaff may be considered as having adequate protein for small ruminants depending on the level of inclusion (NRC, 1985).

Table 3 result of dry matter intake for Yankasa Sheep fed with urea treated and ensiled millet chaff based diets with supplements shows that dry matter intake (DMI) of the feed recorded the highest values for D4, D3, and D5 against the lowest value observed in D1. This could be as a result of utilisation of mixed supplements, as reported by Ngele (2008) that better dry matter intake is often achieved when Sheep are fed with mixed supplements (protein & energy) than single supplements (protein or energy).

Lower value of total dry matter was obtained for Sheep on CSC alone. This could be as a result of utilization of single supplement as

earlier reported by Ngele (2008). The values were similar with report of Abebe (2011) 670.63, 694.03 and 740.25g/d, when Yankasa Sheep were fed graded levels of broiler litter in replacement of cotton seed cake.

However, the values of dry matter intake obtained in the present study were lower than the values 1152.44 to 1171.41g/d reported by Ikyume *et al.* (2021) for comparative effect of garlic (*Allium sativum*) and ginger (*Zingiber officinale*) and their combination on growth, rumen ecology and apparent nutrient digestibility of sheep. Also the values were lower than 10190.00 to 1195.00g/d reported by Abdurrahman *et al.* (2021). The values obtained in this study were higher than the values 500.07 to 581.70g/d reported by Adekambi *et al.* (2021) when West African Dwarf Goats were fed graded levels of malted sorghum sprout with enzyme supplementation.

Similarly, the values in the present study were higher than 330 - 400 g/d reported by Abebe (2011) for sheep fed urea treated millet chaff based diets, and Sheep of Ukanwoko and Ibeawuchi (2009) (310.03, 291.55 and 313.42g/d), and Yusuf *et al.* (2013) (351.17, 507.06, 536.88 and 356.72g/d), 41.9, 45.1, 49.3, 51.1 and 52.8g/d for Konkan kanyal goats fed millet chaff based diets reported by AbdulWaheed *et al.* (2016) and 513.64, 557.79 and 558.35 reported by Omotoso *et al.* (2020).

It has been observed that daily weight gains in this study were highest in D6, D2 and D5 D3 compared to D4. The higher daily body weight gains of D6, D2, D5 and D3 Sheep compared to Sheep in other diets may be attributed to the higher feed and dry matter intake observed in these treatment groups, hence dry matter intake is an important factor in the utilization of feed by ruminants (Jiwuba *et al.*, 2016). The daily weight gain values in the present study (35.02 – 81.19g) were similar to 65.48, 74.40, 77.38 and 86.31g/day reported by Inuwa *et al.* (2020), 57.46, 65.39, 75.39 and 78.89 reported by Mijinyawa *et al.* (2020) for Yankasa Sheep.

However, the values were higher than 16.07, 20.48, 21.43 and 30.95 reported by Omotoso *et al.* (2020) for Yankasa Sheep. Similarly, the values were higher than 23.97,

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33.25, 63.46, 62.29 and 55.57 reported by AbdulWaheed *et al.* (2016) for Konkan kanyal goats fed millet chaff based diets. The values however similar with the values 118.57, 111.71, 87.71 and 47.71g/d for D2, D4, and D3 reported by Girgiri (2017) for Yankasa Sheep. The results of the present findings were above the range of 25.33, 25.17, 26.00, and 25.83g/d for Yankasa Sheep fed maize husk basal diet reported by Jokthan *et al.* (2013).

Feed Conversion Ratio (FCR) in this study varies significantly among the diets. The feed conversion ratio in the present study showed that D2 (7.92) is the best converter of feed to flesh followed by D5 (8.95) while D4 (17.95) was the least feed converter. The superior feed conversion ratio of D2 and D5 over other diets is a reflection of the observed higher feed utilization and higher growth rates of Sheep fed the respective diets also this signified that these Sheep fed dietary diets in these groups were more efficient in feed utilization. The best feed conversion ratio value in this study were similar and in agreement with the findings of Okunade *et al.* (2018), 7.26 feed conversion ratio reported by Odeyinka *et al.* (2020).

The FCR values in this study were higher than the results of Abebe (2011) who reported a highest FCR (9.0) with highest daily weight change of (55.67g/d), the findings of Girgiri (2017) who reported a highest FCR (18.60) with lower daily weight change (47.71), 3.36 with 78.10g/day reported by Audu *et al.* (2019) 9.71 with 57.46g/day reported by Mijinyawa *et al.* (2020). The good feed conversion ratio obtained in the present study might be associated with the pleasant taste, high dry matter and protein intake that encouraged the digestibility of the diet (Adebisi *et al.*, 2015).

Total feed intake (3.93kg) was significantly ($p < 0.05$) higher in D2, which contradicted the findings of Audu *et al.* (2019) who reported 19.93 kg as higher total feed consumed and 1429.06 as higher total cost of feed. Cost of feed per kilogram liveweight gain was higher for D1 and D4 because the Sheep had lower weight gain this is in total agreement and supported earlier report by Muhammad *et al.* (2016) as

observed by Maigandi *et al.* (2002) who reported that cost of feed per kilogram liveweight gain is an indicator of economics of sheep production. Least cost per (₦) per kg weight gain was obtain in D6 against D1 may be due to high cost of cotton seed cake (Mubi *et al.*, 2013) and because Sheep in the diet had higher live weight gain which agreed with findings of Audu *et al.* (2020) as supported by similar observations made by Maigandi *et al.* (2002).

CONCLUSION

Supplementation of urea ensiled millet chaff-based diet improved growth performance and feed conversion ratio.

RECOMMENDATION

Supplementing *Faidherbia albida* pod meal at 30% with 4kg urea ensiled millet chaff gave the highest ADG and FCR with a concomittant reduction in cost of feed, therefore is recommended for growing Yankasa Sheep.

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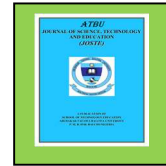
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