

**EFFECT OF TIME (21 DAYS) ON SOME CHEMICAL AND  
PHYSICAL COMPOSITION OF MAIZE COBS ENSILED WITH  
WOOD ASH EXTRACT**

**BY**

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BENIN CITY.**

**NOVEMBER, 2025**

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**A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF  
ANIMAL SCIENCE, FACULTY OF AGRICULTURE,  
UNIVERSITY OF BENIN, IN PARTIAL FULFILLMENT OF THE  
REQUIREMENT FOR THE AWARD OF BACHELOR OF  
AGRICULTURE**

**NOVEMBER, 2025**

## CERTIFICATION

This is to certify that the project work was carried out by Precious Ijeoma OJEL, Department of Animal Science, Faculty of Agriculture, University of Benin, Benin City, Nigeria, under the supervision of Mrs. O. B. Abiloro.

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**Mrs. O. B. Abiloro**

*Project Supervisor*

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Signature & Date

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**Dr. N. C. Akaeze**

*Head of Department*

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Signature & Date

## **DEDICATION**

This research work is dedicated to God Almighty and myself and my family.

## ACKNOWLEDGEMENT

Firstly, honour and thanks to God Almighty for divine blessings throughout my research work to complete the research work completely.

I would like to express my deep and utmost gratitude to my Project supervisor, Mrs. Abiloro for her continuous support and guidance throughout this research. I also appreciate the Dean of Faculty of Agriculture Prof. C.O. Emokaro, Head of Department, Dr. N.C. Akaeze and to my lovely lecturers; Prof. S.O. Nwokoro, Prof. M.A. Bamikole Prof. J.M. Omoyhaki,, Prof J.A. Imaseun, Prof. F.U. Igene, Prof. J.O. Oyedeji, Dr. P.A. Ebabhamiegbo, Dr. G.I.O. Odafe, Dr. (Mrs). G.O. Egigba, Dr. (Mrs). I. Iwaneegbe, Mr. Paul Aduba, Dr. W.O. Agbonghae, Dr. G. Bello-onaghise, Mrs. B.O. Issac, Mr. E.S. Abel, Dr. Ekom Udofia, and Mrs. V.E. Ekhurutomwen, for their relentless efforts towards impacting knowledge, advice and good morals to me.

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## ABSTRACT

The persistent challenge of feed scarcity, especially in regions with seasonal droughts, underscores the critical need to convert abundant agricultural residues into sustainable livestock feed. Despite being a widely accessible agricultural by-product, maize cobs are not very useful due to their high fiber content and poor digestion. This study sought to determine how the chemical and physical composition of the maize cobs were affected by ensiling with different volume of wood ash extract for 21 days. Four treatments were evaluated: T1 (UMC): Untreated maize cob (control); T2 (WMC): maize cob soaked in water; T3 (MCWAE<sub>250ml</sub>): maize cob ensiled with 250ml WAE; T4 (MCWAE<sub>500ml</sub>): maize cob ensiled with 500ml WAE. Results indicated that ensiling, particularly with WAE, significantly altered the nutritional profile. T2 showed the highest Crude Protein (CP=5.53%), a substantial increase from the control (T1, CP=3.21%). Fiber analysis revealed that the higher WAE volume in T4 effectively reduced Crude Fibre (CF=25.37%) compared to T1 (CF=30.42%) and T3 (CF=39.87%). Mineral analysis demonstrated that WAE enrichment significantly increased key minerals; T3 had the highest Calcium (Ca=128.30 mg/100g) and Zinc (Zn=2.05 mg/100g), while T2 recorded the highest Nitrogen (N=893.50 mg/100g). Physical properties improved, with T4 exhibiting a dark brown colour and less abrasive texture deemed desirable for silage. The study concludes that ensiling maize cobs with wood ash extract, particularly at 250ml (T3), optimally enhances the mineral profile (Ca, Zn) and at 500ml (T4) reduces fiber content, converting them into a digestible, nutrient-rich, and stable feed, thereby presenting a practical method for agricultural waste recycling.

## CHAPTER ONE

### 1.1 Introduction

The imperative to enhance the utilization of agricultural by-products for sustainable animal feed has intensified research into the ensiling of lignocellulosic materials. Maize cobs, a widely available residue after grain harvest, represent a significant untapped nutritional resource but are limited by their high lignin and low crude protein content.

Maize (*Zea mays* L.) remains one of the most widely cultivated cereal crops globally, serving as a staple food for humans and a crucial feed resource for livestock. Beyond the grain, the crop generates large quantities of agricultural by-products, notably maize cobs, which are often underutilized despite their potential as a feed component. However, various preservation and treatment strategies, including ensiling, chemical additives, and biological methods, have been explored to enhance the nutritional quality and physical attributes of such crop residues. Ensiling, in particular, is recognized as an efficient and sustainable means of preserving fibrous crop residues, yet its success is strongly influenced by the type of additive employed and the duration of storage (Kung *et al.*, 2018). Maize cobs are often used as bulking agents or combined with moist byproducts such as brewer's grain due to their high fiber content, low digestibility, and limited protein concentration, maize cobs are typically

considered of low nutritive value in ruminant feeding systems. Studies show that inclusion levels and particle size influence porosity, packing density, and fermentation quality (Ososanya *et al.*, 2020). Sampling at appropriate intervals is a standard method to track silage fermentation and stabilization (Kung *et al.*, 2018, Ososanya *et al.*, 2020,)

Wood ash, a by-product of biomass combustion, is increasingly being investigated as a potential additive in silage fermentation due to its alkaline properties, abundance of minerals (particularly calcium, potassium, and magnesium), and its role in improving fermentation conditions (**Oloruntola *et al.*, 2022**). Wood ash extract has been shown to influence the fermentation process by modifying pH, suppressing undesirable microbial activity, and potentially enhancing the chemical composition of ensiled materials. Nevertheless, empirical evidence on its application in ensiling maize cobs remains limited, particularly in relation to the temporal dynamics of fermentation. Most existing studies have focused on conventional silage additives such as molasses, urea, or microbial inoculants, leaving a knowledge gap on the use of wood ash extract as a low-cost and environmentally sustainable alternative (Borreani *et al.*, 2018).

Time is a critical factor in silage fermentation. The duration of ensiling influences microbial activity, nutrient stability, and the physicochemical properties of the material (McDonald *et al.*, 2011). While short-term ensiling may result in incomplete fermentation, excessively long periods can cause nutrient losses through spoilage or leaching. The 21-day period is particularly significant, as it is generally considered

sufficient for lactic acid bacteria to establish dominance and achieve stable fermentation in most silage systems (Kung *et al.*, 2018). However, how this period interacts with wood ash extract in modifying the chemical and physical composition of maize cobs has not been adequately explored. Understanding these changes is crucial in determining the feasibility of maize cobs ensiled with wood ash extract as a sustainable livestock feed resource.

## **1.2 Justification of the Study**

Feed scarcity is a chronic problem in Nigerian livestock systems, especially during dry seasons when natural pastures are insufficient. Maize grain is prioritized for human consumption, making maize residues like cobs a promising but underexploited resource to support animal nutrition. However, raw maize cobs are low in protein and high in fiber, limiting their nutritional value and digestibility.

**Ensiling maize cobs with supplements like wood ash extract can potentially reduce nutrient losses, enhance mineral content (Akinfemi *et al.*, 2020), and inhibit spoilage microorganisms, thereby creating a more stable feed supply**

This practice also aligns with sustainable agriculture by adding value to agricultural waste products and reducing environmental residue burning.

By studying the effect of 21-day ensiling on the chemical composition (dry matter, crude protein, fiber content) and physical attributes (pH, texture, color) of maize cobs

treated with wood ash extract, this research contributes knowledge to optimize feed conservation and increase productivity in Nigerian livestock systems.

### **1.3 Objectives of the Study**

The broad objective is to evaluate the effects of time (twenty-one days) on the chemical and physical properties of maize cobs ensiled in wood ash extract.

The specific objectives are:

- To analyze changes in the chemical composition of maize cobs ensiled with wood ash extract over 21 days, focusing on parameters such as dry matter, crude protein, fiber, N.F.E., fat and mineral content.
- To evaluate how the physical properties (color, texture, and pH) of maize cobs are affected by a 21-day ensiling period with wood ash extract.
- To assess the potential benefits of wood ash-treated maize cob as a sustainable livestock feed option in Nigerian production systems, helping bridge seasonal feed gaps.

## **CHAPTER TWO**

## **2.0 Literature Review**

### **2.1. Maize Cobs as Feed Resources**

Maize is one of the most important cereal crops worldwide, contributing not only grain for human consumption but also substantial amounts of crop residues. Among these residues, maize cobs are produced in large quantities during grain harvesting and processing. Maize cobs are produced in large quantities during grain harvesting and processing (FAO, 2023). Despite their abundance, maize cobs are underutilized in livestock feeding due to their low nutritive value, characterized by low crude protein (2–5%), high lignin, and high fiber content, which reduces digestibility (Nuss and Tanumihardjo, 2019). In regions such as sub-Saharan Africa, where seasonal feed shortages are common, finding cost-effective ways of upgrading crop residues like maize cobs is of high priority for sustainable animal production. This has led to an increasing research interest in feed preservation and treatment strategies aimed at enhancing the nutritive quality of maize cobs.

### **2.2. Ensiling as a Preservation and Feed Improvement Strategy**

Ensiling is a biochemical process in which plant materials are preserved under anaerobic conditions, mainly through lactic acid fermentation. During ensiling, sugars are fermented into organic acids, lowering the pH and creating an environment unfavorable for spoilage organisms (McDonald *et al.*, 2011). Ensiling not only

prevents feed spoilage but can also improve palatability, reduce anti-nutritional factors, and, in some cases, enhance digestibility. The success of ensiling, however, depends on various factors such as the moisture content of the material, the presence of fermentable carbohydrates, the microbial community involved, and the use of additives (Kung *et al.*, 2018). While most research has focused on ensiling maize stover, grasses, and legumes, relatively few studies have examined maize cobs as a substrate for silage production, mainly because of their high lignocellulosic content and low sugar availability. This creates a gap for exploring suitable additives that can facilitate fermentation and improve the quality of maize cob silage.

### **2.3. Role of Additives in Silage Fermentation**

The incorporation of additives during ensiling has been widely studied as a means of enhancing fermentation efficiency and nutritional quality. Additives such as molasses, urea, microbial inoculants, and alkali treatments (e.g., lime, sodium hydroxide) have been used to stimulate fermentation, increase crude protein content, or break down fibrous fractions (Borreani *et al.*, 2018). However, chemical additives can be costly or environmentally harmful, while microbial inoculants require controlled conditions for optimal performance. This has motivated the search for low-cost, locally available, and environmentally sustainable alternatives. Wood ash, a readily available by-product of biomass combustion, has emerged as a promising candidate due to its alkalinity,

mineral content, and potential role in regulating silage fermentation (Oloruntola *et al.*, 2022).

#### **2.4. Wood Ash Extract as a Potential Additive**

Wood ash contains significant amounts of calcium, potassium, magnesium, and trace minerals which are known to influence rumen fermentation and animal nutrition (Oloruntola *et al.*, 2022). In silage production, its alkaline nature can buffer fermentation pH, reduce the proliferation of undesirable microbes, and potentially enhance the chemical composition of fibrous residues. This aligns with the well-documented effects of other alkali-based solutions (such as lime or sodium hydroxide), which have been shown to improve digestibility, reduce fiber content, and increase crude protein availability in treated crop residues (Sundstøl and Owen, 1984). However, direct investigations on the use of wood ash extract in ensiling maize cobs are scarce, leaving an important gap in the literature. The potential of this abundant and inexpensive by-product to improve the chemical and physical quality of silage remains underexplored.

#### **2.5. Effect of Ensiling Time on Fermentation and Composition**

Ensiling time is a critical determinant of silage quality. The duration of fermentation influences microbial succession, organic acid production, nutrient stability, and physical characteristics of silage (Kung *et al.*, 2018). Typically, 21 days is considered

a benchmark period for the establishment of lactic acid bacteria dominance and the stabilization of fermentation in many silage systems. Shorter periods may lead to incomplete fermentation, while prolonged storage can cause secondary fermentation, nutrient losses, or spoilage (Borreani *et al.*, 2018). Although some studies have assessed temporal changes in silage quality when using conventional additives, little is known about how maize cobs respond to ensiling with wood ash extract over a standard 21-day fermentation period. This presents a critical knowledge gap for optimizing the use of maize cobs as an alternative feed resource.

## **2.6. Significance of Ensiling**

Ensiling is a crucial preservation method that maintains the nutritive value of forage crops and crop residues for livestock feeding, ensuring feed availability throughout the year, especially during dry seasons when fresh forage is scarce (Gordo *et al.*, 2023). It preserves high moisture biomass through anaerobic fermentation, primarily by lactic acid bacteria (LAB), which produce organic acids that lower pH and inhibit spoilage microorganisms, thereby minimizing nutrient losses (Kaewpila *et al.*, 2021).

Silage enhances feed digestibility by partially breaking down plant fiber components like cellulose and hemicellulose during the fermentation process, which increases the availability of nutrients to ruminants (Kaewpila *et al.*, 2021). The process also allows the use of otherwise low-quality agricultural residues, such as maize cobs, converting

them into economically valuable and digestible feed, reducing reliance on expensive commercial feeds (Du *et al.*, 2023).

Importantly, controlled ensiling assures stable feed supply, supports better animal growth and production, improves feed intake, and reduces health risks associated with moldy or spoiled feed. This has been shown to enhance animal productivity and farmer income, especially in regions with marked seasonal feed variability (Kaewpila *et al.*, 2021).

Ensiling plays a pivotal role in enhancing livestock feed security in Nigeria by preserving nutrient-rich forage and crop residues for use during feed-scarce seasons.( Babangida *et al.* 2022) demonstrated that ensiling maize cobs treated with urea over periods extending up to seven weeks significantly improved silage quality by increasing crude protein and reducing fiber content, thereby enhancing feed digestibility and availability for ruminants in Nigerian conditions. The increase in nutritional value of ensiled maize cobs underscores the benefits of ensiling as a preservation method that conserves and enhances feed resources otherwise prone to spoilage and nutrient loss.

The Nigerian agricultural sector widely recognizes ensiling as an effective intervention to convert abundant agricultural by-products into valuable livestock feed (Federal Ministry of Agriculture and Rural Development ([FMARD], 2024). Research

funded by the Nigerian government highlights ensiling as a climate-smart and economically sustainable practice that mitigates feed shortages and supports resilient livestock production systems in the face of climate variability.

In addition, ensiling mitigates environmental concerns by providing a valuable use for crop residues that might otherwise be burned, a practice highlighted in strategies for sustainable livestock production (Du *et al.*, 2023). The adoption of ensiling technology also addresses key environmental challenges. It mitigates the air pollution caused by residue burning and reduces the carbon footprint of livestock production by minimizing greenhouse gas emissions from the decomposition of unused forage and crop residues. The use of additives, including mineral sources like wood ash, can enhance the fermentation process by stabilizing pH and enriching silage nutrient content (Hartinger *et al.*, 2024), ensiling reduces post-harvest feed wastage and improves farm income by enabling smallholder farmers to store feed efficiently through dry seasons. The process also aligns with sustainable agricultural goals by reducing environmental pollution through minimized burning of crop residues (FMARD, 2024). Collectively, Nigerian research and policy frameworks emphasize ensiling as a transformational technology pivotal to enhancing food security, rural livelihoods, and sustainable livestock production amidst Nigeria's agroecological challenges.

## 2.7. Physical Composition of an Ensiled Maize Cobs

Physical composition of ensiled maize cobs is a critical determinant of silage quality, affecting both preservation efficacy and animal acceptability. The main physical parameters assessed include color, texture, moisture content, pH, aroma, and particle size distribution, each influencing the ensiling process and eventual nutritive value.

**Color:** The color of ensiled maize cobs typically shifts from the original pale yellow or cream of fresh cobs to various shades of brown, green, or dark brown during ensiling. This change results from biochemical and microbial activities that alter pigment compounds. Uniform color with minimal black or moldy spots indicates good fermentation and aerobic stability (Lamidi *et al.*, 2020).

**Texture:** Texture changes with ensiling time and treatment additives. Fresh maize cobs are hard and coarse, but fermentation softens the material as fiber components (cellulose, hemicellulose) partially degrade enzymatically. Ensiled cobs exhibit a softer, more pliable texture, improving mastication and digestibility by ruminants (McDonald *et al.*, 2011). Coarser texture can arise due to inadequate compaction during ensiling, leading to poor fermentation.

**Moisture Content:** Moisture or water content in ensiled maize cobs typically ranges between 60% and 70%, critical for promoting anaerobic microbial activity and acid production. Too high moisture (>70%) risks effluent losses and clostridial

fermentation, while too low moisture (<55%) hampers fermentation due to poor anaerobic conditions (Lamidi *et al.*, 2020). Proper moisture ensures efficient lactic acid fermentation and preservation.

pH: The pH of silage is a key quality characteristic. Ensiled maize cobs usually reach a pH between 3.8 and 4.5 within 21 days of fermentation. This acidic environment inhibits growth of spoilage microbes like molds and clostridia, stabilizing nutrient quality. Rapid pH decline is facilitated by water-soluble carbohydrates fermented by lactic acid bacteria (Lamidi *et al.*, 2020)

Aroma: A sweet, pleasant smell is a sign of good lactic acid fermentation, indicating low levels of undesirable volatile fatty acids or ammonia. A sour, putrid, or musty odor suggests poor fermentation or aerobic spoilage, reducing feed palatability and animal intake (Lamidi *et al.*, 2020).

Particle Size and Density: Maize cobs are typically chopped before ensiling to a length of 2–4 cm to optimize packing density and fermentation efficiency. Good compaction reduces oxygen pockets, facilitating anaerobic conditions. Low bulk density or uneven particle size distribution can cause spoilage and nutrient loss (McDonald *et al.*, 2011).

These physical changes collectively influence silage intake, storage stability, microbial quality, and the availability of nutrients to ruminant animals. With optimum physical

characteristics, ensiled maize cobs serve as affordable, high-fiber, and readily digestible feed, essential for sustainable livestock production in Nigeria

## **2.8. Effects of ensiling duration on maize/corn silage chemistry**

Ensiling duration plays a critical role in determining the chemical composition and fermentation quality of maize or corn silage. The changes that occur during storage are primarily driven by microbial activity, substrate availability, and environmental conditions within the silo.

### **2.8.1 pH dynamics and fermentation acids**

The decline in pH is one of the most important indicators of successful fermentation. Research consistently shows that the majority of the pH drop occurs within the first 7 to 14 days as lactic acid bacteria (LAB) rapidly ferment water-soluble carbohydrates into lactic acid (McDonald *et al.*, 2011, Huang *et al.*, 2021). By day 21, pH generally stabilizes at levels that inhibit spoilage organisms such as *Clostridia* and *Enterobacteria* (Jatkauskas *et al.*, 2024 McDonald *et al.*, 2011). Lactic acid is the dominant fermentation product, while acetic acid increases gradually over longer storage and contributes to aerobic stability (Aragón *et al.*, 2012). Short storage ( $\leq 21$  days) may yield a silage that is stable in pH but not yet maximized in acetic acid levels, which are associated with improved shelf life once exposed to air (Huang *et al.*, (2021). The ensiling process aims to achieve a stable, low pH through lactic acid

fermentation, a state typically reached within a 21-day period for many crops, providing a practical benchmark for assessing silage quality (Kung *et al.*, 2018; Ososanya *et al.*, 2020).

### **2.8.2 Protein dynamics and nitrogen fractions**

Crude protein (CP) content is usually stable during ensiling; however, proteolysis leads to the breakdown of true protein into non-protein nitrogen (NPN) fractions such as ammonia-N and amino acids. The extent of proteolysis depends on ensiling duration. Ammonia-N concentration typically increases during the first three weeks as plant proteases and microbial enzymes degrade protein, and then plateaus as LAB lower the pH and inhibit further protease activity (Cueva *et al.*, 2023, McDonald *et al.*, 2011 ). Studies have reported that ammonia-N can reach up to 8–12% of total N by 21 days, after which changes are minimal (Ferraretto, 2019). Therefore, the 21-day period represents a critical point for assessing protein preservation in maize silage.

### **2.8.3 Crude Fiber**

Neutral detergent fiber (NDF) and acid detergent fiber (ADF) are structural carbohydrates that largely define forage digestibility. Ensiling does not drastically change NDF or ADF concentrations within the first 21 days because lignocellulose is resistant to microbial degradation (Gordo *et al.*, 2023). However, soluble hemicellulose can decrease slightly due to partial microbial activity, leading to minor

reductions in NDF (Cueva *et al.*, 2023). More substantial fiber degradation tends to occur during longer storage (60–120 days) when cell-wall solubilization and acid hydrolysis have had more time to act.

#### **2.8.4 Starch and carbohydrate availability**

Ensiling time is strongly linked to starch digestibility. During the first 21 days, starch granules are partially protected by the protein matrix (zein) and lignocellulosic barriers in maize kernels. With longer storage (>30 days), proteolytic and acidic conditions degrade these barriers, increasing starch availability for rumen microbes (Cueva *et al.*, 2023). At 21 days, starch degradability is often only modestly improved compared to fresh material, suggesting that extended storage is needed to maximize energy availability from maize silage (Ferraretto, 2019). Maize cobs primarily consist of carbohydrates, fiber components such as cellulose, hemicellulose, and lignin, and contain low crude protein and ether extract compared to conventional feed sources (Feedipedia 2023 ). The chemical composition changes during ensiling reflect both the biological activity of fermentative microbes and the physical-chemical interactions within the silage mass.

During ensiling, water-soluble carbohydrates (WSC) serve as substrates for lactic acid bacteria (LAB), which ferment them into organic acids, primarily lactic acid. This acidification reduces pH to around 3.8 to 4.2, creating a hostile environment for

spoilage organisms and preserving the integrity of nutrients (Kung *et al.*, 2018, Aljameel *et al.*, 2022).

### **2.8.5 Dry matter (DM) losses and stability**

Dry matter losses occur throughout the ensiling process due to microbial respiration and fermentation. During the first 21 days, most DM loss results from the activity of aerobic microorganisms before anaerobiosis is fully established and from rapid LAB fermentation (Aragón *et al.*, 2012). Losses are generally within 2–5% during this period, provided the silage is well-packed and oxygen is excluded. Longer ensiling can lead to higher cumulative losses but also results in more stable silage if managed correctly. Dry matter content typically decreases slightly due to fermentation losses, but fiber fractions undergo partial degradation. The decline in neutral detergent fiber (NDF) and acid detergent fiber (ADF) can be significantly enhanced by enzymatic and microbial additives that break down hemicellulose and cellulose, as demonstrated in sugarcane bagasse silage (Kaewpila *et al.*, 2021). This improves the overall digestibility of the maize cob silage. Crude protein levels often increase due to microbial protein synthesis during fermentation, especially when additives rich in nitrogen or minerals, such as wood ash, are applied (Romdhane *et al.*, 2021)

### **2.8.6 Aerobic stability and spoilage resistance**

Although 21 days is sufficient for silage to achieve a stable pH, aerobic stability often improves with longer ensiling durations due to higher concentrations of acetic acid and other antifungal metabolites (Jatkauskas *et al.*, 2024). Silages opened after only three weeks may therefore be more prone to heating and mold growth during feed-out compared to silages stored for 45–90 days.

Ash content increases during ensiling, attributable to mineral enrichment and concentration effects. Wood ash specifically contributes minerals like calcium, potassium, and magnesium, which enhance buffering capacity, stabilize pH, and improve fermentation quality (Romdhane *et al.*, 2021). The biochemical transformations that occur during the fermentation of maize cob silage, including the breakdown of fibrous components, are directly linked to improvements in its nutritive quality (Kaewpila *et al.*, 2021; Ososanya *et al.*, 2020).

The stage of maturity at harvest influences chemical composition; more mature maize cobs have higher fiber and dry matter but lower crude protein and digestibility. Ensiling compensates somewhat by breaking down fibrous fractions and stabilizing nutrients. Overall, ensiling maize cobs for 21 days leads to increased crude protein, reduced fiber fractions, and a stable acidic pH essential for good silage quality and improved ruminant feed value (Oladumnoye *et al.*, 2014; Ososanya *et al.*, 2020; Kaewpila *et al.*, 2021).

## **CHAPTER THREE**

### **3.0 MATERIALS AND METHODS**

**3.1 EXPERIMENTAL SITE:** This study was conducted at the Animal Science Laboratory, Faculty of Agriculture, University of Benin, Benin City, Edo State, Nigeria. The laboratory is located at latitude 6°20'N and longitude 5°37'E, with an altitude of approximately 78 meters above sea level. Benin City experiences a tropical climate with average annual rainfall 2000-2500mm and mean temperature ranging between 25°c and 28°c.

### **3.2 SOURCE OF MATERIAL**

#### **3.2.1 Maize Cobs**

Maize cobs were obtained from maize cob vendors at New Benin market, Benin City, Edo State. The cobs were collected immediately after shelling of maize grains to ensure freshness. Only clean, undamaged cobs free from mold contamination were selected for the study. The maize variety used was the commonly grown yellow maize hybrid in the region.

### **3.2.2 Wood Ash**

Wood ash was sourced from food vendors in Edo State. The wood ash was sieved through a 2mm mesh to remove large particles and debris, and stored in airtight container prior to extraction

### **3.2.3 Preparation of Wood Ash Extract**

One kilogram (1kg) of sieved wood ash was mixed with 10 litres of clean water in a plastic container, giving a ratio of 1:10. The mixture was stirred thoroughly and allowed to stand for 24hours at room temperature with intermittent stirring every 6 hours. After 24 hours, the mixture was filtered through a clean cloth to obtain a clear extract. The extract was stored in plastic containers.

## **3.3 EXPERIMENTAL DESIGN AND TREATMENTS**

The maize cobs were ensiled with different quantity of wood ash extract.

Treatment 1 (UMC): this was untreated ground maize cobs (250g) not soaked in water. It served as the control

Treatment 2 (WMC): This was ground maize cobs (250g) soaked in 1 litre of clean water for 30 minutes, then thereafter sieved and sundried.

Treatment 3 (MCWAE20ml): This was ground maize cobs (250g) soaked in 1 litre of clean water for 30 minutes, then thereafter sieved and ensiled in 250mls of wood ash extract for 21 days and sundried.

Treatment 4 (MCWAE<sub>500ml</sub>) This was ground maize cobs (250g) soaked in 1 litre of clean water for 30 minutes, then thereafter sieved and ensiled in 500mls of wood ash extract for 21 days and sundried.

### **3.4 ENSILING PROCEDURE**

#### **3.4.1 Preparation of maize cobs**

The maize cobs were first broken manually into smaller pieces then was grinded with milling machine.

#### **3.4.2 Soaking process**

For treatment involving water (WMC), the grinded maize cobs were placed in plastic containers and covered with clean water at a ratio 1:2 (w/v). For wood ash extract treatments MCWAE and MCWAE, the prepared wood ash was used instead of water at different volumes 250ml and 500ml for 500grams of maize cob.

#### **3.4.3 Fermentation conditions**

All containers we're covered tightly with polythene sheets to create anaerobic conditions necessary for proper ensiling. The containers were kept at ambient room temperature (25-28°C) in a well ventilated room. The experiment units designated for 21-day treatments were opened after 504 hours.

### **3.5 PHYSICAL PROPERTIES DETERMINATION**

### **3.5.1 Colour characteristics**

Colour characteristics were assessed visually and recorded for each treatment. The observations included colour intensity (light brown, brown, dark brown) and a uniformity of colour distribution. Digital photographs were taken under standard lighting conditions for documentation.

### **3.5.2 Texture assessment**

Texture of the ensiled products was assessed manually by feel and visual observation. The smoothness, coarseness, and physical integrity of the samples were recorded. Any signs of degradation, mold growth, or fly attraction were also documented

## **3.6 MINERAL ANALYSIS**

Mineral analysis was conducted at the Laboratory using standard analytical procedures. Samples were first digested using the wet digestion method with a mixture of nitric acid and per chloric acid.

### **3.6.1 Sample digestion**

Two grams (2 g) of each milled sample was weighed into a digestion flask. Twenty milliliters (20 ml) of a mixture of concentrated nitric acid and perchloric acid in a ratio

of 3:1 (v/v) was added. The flask was heated gently on a hot plate until the solution became clear. The digest was cooled, filtered, and made up to 50 ml with distilled water.

### **3.6.2 Mineral determination**

The following minerals were determined from the digest:

**Nitrogen (N):** Determined by Kjeldahl method and expressed in mg/100g

**Phosphorus (P):** Determined using the vanadomolybdate colorimetric method and expressed in mg/100g

**Potassium (K), Calcium (Ca), Sodium (Na):** Determined using flame photometry and expressed in mg/100g

**Zinc (Zn):** Determined using Atomic Absorption Spectrophotometry (AAS) and expressed in mg/100g

All mineral determinations were performed in duplicate and mean values recorded.

### **3.7 DATA COLLECTION**

Data were collected on the following parameters for each experimental unit:

- Physical properties: moisture content, colour, and texture
- Proximate properties: CP, CF, E.E, CHO, MC, and Ash.
- Mineral content: nitrogen, phosphorus, potassium, calcium, zinc, and sodium.

### **3.8 PROXIMATE ANALYSIS**

Proximate analysis of experimental materials was carried out in the Central Laboratory, Faculty of Agriculture, University of Benin, Benin-City, Edo state. The standard methods of analysis of the Association of Official Analytical Chemist (AOAC, 2000) was used to determine the moisture content, dry matter, crude protein, ash content, ether extract (crude fat) and nitrogen free extract.

#### **3.8.1 MOISTURE DETERMINATION**

Moisture is determined by the loss in weight that occurs when a sample is dried to a constant weight in an oven. About 2g each of the maize cobs treatments was previously dried and weighed. The sample was then dried in an oven for 650°C for 36 hours, cooled in a dessicator and weighed. The drying and weighing continues until a constant weight was achieved.

Since the water content of feed varies widely, ingredients and feeds are usually compared for their nutrient content on moisture free or dry matter (DM) basis.

$\%DM = 100 - \%Moisture$

### **3.8.2 ASH**

Ash is the inorganic residue obtained by burning off the organic matter of feedstuff at  $550 \pm 50^\circ\text{C}$  in Muffle furnace for 6 hours. 2g each treatment sample was weighed into a pre-heated crucible. The crucible was placed into the Muffle furnace at  $550 \pm 50^\circ\text{C}$  for 6 hours or until whitish-grey ash is obtained. The crucible was then placed in the dessicator and weighed. Organic matter was determined by subtraction the value of ash from 100

$\% \text{ Organic matter} = 100 - \text{Ash}$

### **3.8.3 ETHER EXTRACT**

The ether extract of a feed represents the fat and oil in the feed. Soxhlet apparatus is the equipment used for the determination of ether extract. It consists of 3 major components: an extractor, comprising the thimble which holds the sample; condenser for cooling and condensing the ether vapor and a 250ml flask.

**Procedure:** 150ml of an anhydrous diethyl ether (petroleum ether) of boiling point of  $40-60^\circ\text{C}$  is placed in the flask. 5g of the sample was weighed into a thimble and the thimble is plugged with cotton wool. The thimble with content was placed into the extractor. The ether in the flask was then heated. As the ether vapor reaches the condenser through the side arm of the extractor, it condensed to liquid form and drop

back into the sample in the thimble. The ether soluble substances were dissolved and were carried into solution through the siphon tube back into the flask. The extraction continued for at 4 hours. The thimble was removed and most of the solvent was distilled from the flask into the extractor. The flask was then disconnected and placed in an oven at 65°C for 4 hours, cooled in a dessicator and weighed.

%Ether extract= weight of oil/weight of samples ×100/1

### **3.8.4 CRUDE FIBRE**

The organic residue left after sequential extraction of feed with ether can be used to determine the crude fibre. The fat-free sample materials were then transferred into a flask or beaker. 200ml of pre-heated 1.25% H<sub>2</sub>SO<sub>4</sub> was added and the solution was gently boiled for about 30 minutes, maintaining constant volume of acid by the addition of hot water. The Buckner flask funnel fitted with Whatman filter was pre-heated by pouring hot water into the funnel. The boiled acid sample mixture was then filtered hot through the funnel under sufficient suction. The residue was then washed several times with boiling water (until the residue is neutral to litmus paper) and transferred back into the beaker. Then 200ml of pre-heated 1.25% Na<sub>2</sub>SO<sub>4</sub> was added and boiled for another 30 minutes. Filter under suction and washed thoroughly with hot water and twice with ethanol. The residue was dried at 650°C for about 24 hours and weighed. The residue was transferred into a crucible and placed in Muffle furnace (400-600°C) and ashed for 4 hours, then cooled in a dessicator and weighed.

$\% \text{ Crude fibre} = \frac{\text{weight of CF}}{\text{weight of samples}} \times 100/1$

### **3.8.5 CRUDE PROTEIN**

Crude protein is determined by measuring the nitrogen content of the feed and multiplying it by a factor of 6.25. This factor is based on the fact that most protein contains 16% nitrogen. Crude protein is determined by Kjeldahl method. The method involves: Digestion, Distillation and Titration.

**Digestion:** 2g of the sample was added into a Kjeldahl flask and 25 ml of concentrated sulphuric acid, 0.5g of copper sulphate, 5g of sodium sulphate and a speck of selenium tablet were added. Heat in a fume cupboard slowly at first to prevent undue frothing. Digestion continued for 45 minutes until the digesta became clear pale green. It was left until completely cool and thereafter 100ml of distilled water was rapidly added. The digestion flask was rinsed 2-3 times and the rinsing added to the bulk.

**Distillation:** Markham distillation apparatus is used for distillation. The distillation apparatus was steamed up and 10 ml of the digest was added into the apparatus via a funnel and allowed to boil. 10 ml of sodium hydroxide was added from the measuring cylinder so that ammonia was not lost. Distillation into 50 ml of 2% boric acid containing screened methyl red indicator was done.

**Titration:** The alkaline ammonium borate formed is titrated directly with 0.1N HCl. The titre value which was the volume of acid used was recorded. The volume of acid used was fitted into the formula which became:

VA = volume of acid used

W = weight of sample

% Crude protein = %N x 6.25

### **3.8.6 NITROGEN FREE EXTRACT (NFE)**

NFE is determined by mathematical calculation. It was obtained by subtracting the sum of percentages of all the nutrients already determined from 100.

$\%NFE = 100 - (\%Moisture + \% CF + \% CP + \% EE + \% Ash)$

NFE represents soluble carbohydrates and other digestible and easily utilizable non-nitrogenous substances in the sample.

### **3.9 STATISTICAL ANALYSIS**

Data obtained from the experiment was subjected to an ANOVA using GENSTAT 12th edition.

Means were separated using Duncan Multiple Range Test (DMRT) at significance level of  $p < 0.05$

## **CHAPTER FOUR**

### **4.0 RESULTS**

#### 4.1 PHYSICAL PROPERTIES OF MAIZE COB ENSILED IN WOOD ASH EXTRACT

The physical properties of maize cob ensiled in wood ash are shown in Table 1.

**Table 1: Physical Composition of Maize Cobs Ensiled Wood Ash Extract**

Parameters	Colour	Texture	Odour
Treatment 1	Light brown	Granular, rough	Slightly vegetal
Treatment 2	Taupe	Coarse and damp	Slightly sweet
Treatment 3	Light brown	Coarse and slightly slimy	Earthy
Treatment 4	Dark brown	Less abrasive and slimy	Alkaline

Note: Treatment 1; UMC= Untreated maize cob, Treatment 2; WMC= Wet maize cob, Treatment 3; MCWAE<sub>250ML</sub>=Maize cob ensiled in wood ash extract 250ml, Treatment 4; MCWAE<sub>500ML</sub>=Maize cob ensiled in wood ash extract 500ml.

## 4.2 PROXIMATE ANALYSIS OF MAIZE COBS ENSILED IN WOOD ASH EXTRACT.

The proximate analysis of ensiled maize cobs in wood are presented in Table 1.

**Table 2: Proximate Composition of Maize Cobs Ensiled in Wood Ash Extract**

Sample	Mc (%)	CP (%)	EE (%)	CF (%)	Ash (%)	CHO (%)
Treatment 1	11.93 <sup>a</sup>	3.207 <sup>a</sup>	0.45 <sup>c</sup>	30.42 <sup>c</sup>	1.55 <sup>b</sup>	55.44 <sup>d</sup>
Treatment 2	17.48 <sup>c</sup>	5.53 <sup>d</sup>	0.57 <sup>d</sup>	29.75 <sup>b</sup>	1.28 <sup>a</sup>	45.39 <sup>c</sup>
Treatment3	14.09 <sup>b</sup>	4.66 <sup>c</sup>	0.42 <sup>b</sup>	39.87 <sup>d</sup>	2.33 <sup>c</sup>	38.63 <sup>a</sup>
Treatment4	29.77 <sup>d</sup>	3.28 <sup>b</sup>	0.36 <sup>a</sup>	25.37 <sup>a</sup>	1.66 <sup>d</sup>	39.54 <sup>b</sup>

Note: Treatment 1;UMC=Untreated maize cob, Treatment 2; WMC= Wet maize cob, Treatment 3; MCWAE<sub>250ML</sub>=Maize cob ensiled in wood ash extract 250ml, Treatment 4; MCWAE<sub>500ML</sub>=Maize cob ensiled in wood ash extract 500ml, E.E =Ether extract, CP = Crude protein, CF = Crude fibre, CHO = Carbohydrate content. Mean values with the same letters along the same column are not significantly different at 5% probability level ( $p>0.05$ ).

The table presents the proximate composition of maize cobs ensiled in wood ash, showing the percentage values of key nutritional components in different treatment samples. Here's an explanation of each parameter.

**Moisture (%):**

This represents the water content in the sample. The treatment 1 has the lowest moisture content at 11.93%, the treatment 2 has 17.48%, there was a decrease in treatment 3 at 14.09%, while treatment 4, have higher moisture content at 29.77% compared to treatment 3 at 14.09%, indicating greater water absorption at higher soaking level.

**CP (Crude Protein, %):**

This measures the total protein content, an essential nutrient for animal feed. The treatment 1 was lower at 3.20% but treatment 2 slightly increased at 5.53%, while fermentation slightly decreased with higher soaking volume with treatment 4 at 3.28% relative to treatment 5 at 4.663%, this reduction maybe due to leaching of soluble Nitrogen compound into the soaking medium.

**Fat (%):**

This represents the crude fat (lipid) content, which provides energy. The treatment 1 has a fat content of 0.46%, while treatment 2 slightly increased at 0.57%, and treatment 4 has the lowest at 0.3633%, indicating that fermentation may affect the fat content.

**CF (Crude fibre, %):**

This indicates the fibre content, which is important for digestion in animals. Treatment 1 and treatment 2 have fibre content of 30.42% and 29.75% respectively, while the ensiled samples has reduced fibre content, with treatment 4 at 25.37%, showing fermentation may break down fibre.

**Ash (%):**

This represents the total mineral content in the sample. . The treatment 1 has 1.55% and 1.28% for treatment 2, while fermentation alters ash content, with treatment 4 showing 1.66%, indicating higher mineral availability.

**CHO (Carbohydrates, %):**

This represents total carbohydrates, calculated by subtracting protein, fat, fiber, and ash from 100%. The treatment 1 and treatment 2 have higher carbohydrate percentage at 55.44% and 45.39% respectively while ensiled samples generally have lower

carbohydrate percentages, with treatment 3 at 38.63% and treatment 4 at 39.54%, suggesting fermentation breaks down complex carbohydrate.

### 4.3 MINERAL ANALYSIS OF MAIZE COB ENSILED IN WOOD ASH EXTRACT.

The mineral analysis of ensiled maize cob are presented in Table 3.

**Table 3: Mineral Composition of Maize Cob Ensiled in Wood Ash Extract**

Sample	N(mg/100g)	P(mg/100g)	K(mg/100g)	Ca(mg/100g)	Zn(mg/100)	Na(mg/100g)
Treatment1	501.40 <sup>a</sup>	68.79 <sup>d</sup>	329.10 <sup>d</sup>	37.30 <sup>a</sup>	1.64 <sup>c</sup>	37.91 <sup>a</sup>
Treatment2	893.50 <sup>d</sup>	42.81 <sup>c</sup>	247.70 <sup>a</sup>	96.50 <sup>c</sup>	1.00 <sup>d</sup>	39.86 <sup>c</sup>
Treatment3	800.00 <sup>c</sup>	23.93 <sup>b</sup>	318.20 <sup>c</sup>	128.30 <sup>d</sup>	2.05 <sup>c</sup>	46.95 <sup>d</sup>
Treatment4	529.10 <sup>b</sup>	21.27 <sup>a</sup>	309.00 <sup>b</sup>	85.50 <sup>b</sup>	1.39 <sup>b</sup>	38.85 <sup>b</sup>

Note: Treatment1; UMC= Untreated maize cob, Treatment 2; WMC= Wet maize cob, Treatment3; MCWAE<sub>250ML</sub>=Maize cob ensiled in wood ash extract 250ml, Treatment4; MCWAE<sub>500ML</sub>=Maize cob ensiled in wood ash extract 500ml, N = Nitrogen, P = Phosphorus, K = Potassium, Ca = Calcium, Zn =Zinc, Na = Sodium. Mean values with the same letters along the same column are not significantly different at 5% probability level (p>0.05).

The table presents the mineral composition of maize cobs ensiled in wood ash extract, showing the concentrations of key minerals in different treatment samples. Here's an explanation of each mineral parameter:

**N (Nitrogen, mg/100g):**

It is essential for growth and development in the animal. The treatment 3 has higher Nitrogen content at 800.0 mg/100g while treatment 4 has a reduced Nitrogen content at 529.1 mg/100g indicating Nitrogen content decreases with higher soaking volume due to the mineral diffusion into the soaking medium

**P (Phosphorus, mg/100g):**

This is essential for energy metabolism, bone formation, and cell function. Treatments 1 and 2 was higher at 68.79% and 42.81% respectively while treatment 3 has 23.93

mg/100g, and treatment 4 has the lowest at 21.27 mg/100g, meaning phosphorus leached during ensiling.

**K (Potassium, mg/100g):**

Important for nerve function, muscle contraction, and fluid balance, treatment 2 has 318.2 mg/100g, while treatment 3 has 309.0mg/100g, showing that fermentation increases potassium levels.

**Ca (Calcium, mg/100g):**

Essential for bone development and muscle function in animals. The treatment 3 has higher Calcium content at 128.3 mg/100g, while treatment 4 has the lowest at 85.5 mg/100g, indicating that calcium content decreases with higher soaking volume.

**Zn (Zinc, mg/100g):**

Helps in cell growth, repair and immune system support, treatment 4 has 1.39mg/100g while treatment 3 has the highest at 2.050mg/100g indicating fermentation enhances Zinc content.

**Na (Sodium, mg/100g):**

Helps maintain electrolyte balance and supports nerve function. Treatment 2 and treatment 3 has 39.86mg/100g and 46.95 mg/100g, respectively while has the lowest treatment 1 and treatment 4 at 37.91mg/100g and 38.85 mg/100g respectively, indicating sodium content decreases with higher soaking volume.

## CHAPTER FIVE

### 5.0 DISCUSSION

#### 5.1 PROXIMATE COMPOSITION OF MAIZE COB ENSILED IN WOOD ASH EXTRACT

##### 5.1.1 Moisture Content

The moisture content varied dramatically, ranging from 11.93% in Treatment 1 to 29.77% in Treatment 4. High moisture content, as seen in Treatment 4, causes a dilution of other nutrients when expressed on a fresh weight basis, making direct comparisons between treatments with differing dry matter content invalid without correction. This is a fundamental principle of feed analysis, as established in foundational animal nutrition resources (McDonald *et al.*, 2011). From a practical standpoint, high moisture content is a critical determinant of shelf-life. Products with moisture above 15% are highly susceptible to microbial growth, mycotoxin production, and oxidative rancidity, necessitating specialized storage or preservation techniques (AOAC, 2016). In contrast, Treatments 1 and 3, with lower moisture levels, would inherently have better storage stability.

### **5.1.2 Protein and Lipid:**

Crude Protein (CP), estimated from total nitrogen, is vital for growth, tissue repair, and metabolic functions (NRC, 2016). Treatment 2, with the highest CP (5.53%), stands out as the most protein-rich option. This makes it a superior choice for supporting growth phases or for species with high protein requirements. Conversely, Treatments 1 and 4 have significantly lower protein levels 11.93% and 3.28% respectively and this may be due to the alkaline soaking solution which may have caused soluble nitrogenous compounds to be lost from the cobs into the surrounding liquid, thereby reducing the final measurable CP in the solid feed (Ojewole et al., 2017)., this may be inadequate as a sole feed for high-performance animals.

Ether Extract (EE), representing the crude fat or lipid content, is a concentrated energy source and a carrier for fat-soluble vitamins (McDonald *et al.*, 2011). Although the absolute values are low across all treatments, Treatment 2 (0.57%) again ranks highest. The significantly lower EE in Treatments 3 and 4 suggests a lower dietary energy density from lipids, which must be compensated by energy from other components like carbohydrates.

### **5.1.3. Fiber and Carbohydrates:**

The most striking variation is in the Crude Fiber (CF) and Carbohydrate (CHO) fractions. Crude fiber represents the less digestible structural carbohydrates (e.g., cellulose, hemicellulose), and high levels are often inversely correlated with

digestibility in monogastric animals (Van Soest, 2018). Treatment 3 has an exceptionally high CF content (39.87%), which would likely result in low digestibility and poor metabolizable energy value for non-ruminants. This is directly reflected in its low CHO value (38.63%), as the CHO is calculated by difference and primarily consists of the more digestible Nitrogen-Free Extract (NFE) like starches and sugars.

In contrast, Treatment 1, despite having high CF (30.42%), has the highest CHO content (55.44%). This indicates that Treatment 1 contains a substantial portion of highly digestible non-fiber carbohydrates, making it a high-energy feed. However, the high fiber may still limit its total energy utilization. Treatment 2 presents a more balanced profile, with moderate fiber and high digestible carbohydrates, suggesting good overall energy availability.

#### **5.1.4 Ash Content:**

The ash content signifies the total inorganic mineral matter. Treatment 3 has the highest ash content (2.33%), which is consistent with its high fiber content, as plant structural materials often contain associated minerals (Van Soest, 2018). This could be desirable if the minerals are essential nutrients (e.g., calcium, phosphorus) or undesirable if they include soil contaminants or silica. The low ash in Treatment 2 (1.28%) indicates a purer organic composition with less inorganic filler.

## **5.2 MINERAL COMPOSITION OF MAIZE COB ENSILED IN WOOD ASH EXTRACT**

The mineral composition of maize cob ensiled in wood ash extract at different volume (250ml and 500ml) reveals significant variations in nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), zinc (Zn), sodium (Na) content.

### **5.2.1 Nitrogen (N):**

Treatment2 resulted in the highest nitrogen concentration (893.50 mg/100g), which was significantly greater than all other treatments. This suggests that Treatment2 may have involved a high-nitrogen fertilizer or a condition that strongly promoted nitrogen uptake and assimilation. Nitrogen is a fundamental component of amino acids, proteins, and chlorophyll, and its availability is often the primary limiting factor for growth (Marschner, 2012). The low nitrogen in Treatment4 (529.10 mg/100g) indicates a markedly different nutritional environment or plant response.

### **5.2.2 Phosphorus (P):**

A clear inverse trend to nitrogen is observed for phosphorus. Treatment1 had the highest P content (68.79 mg/100g), which was significantly greater than all others. Treatment2, despite its high nitrogen, had intermediate P, while Treatment3 and Treatment4 had the lowest and statistically similar P levels. This antagonistic relationship between nitrogen and phosphorus uptake is documented; high nitrogen availability can sometimes suppress phosphorus acquisition, and vice versa, depending on the chemical forms and soil pH (Güsewell, 2004).

### **5.2.3 Potassium (K):**

The potassium levels show a different pattern. Treatment1 and Treatment2 form one statistical group (with high K values, 329.10 and 247.70 mg/100g, respectively), while Treatment3 and Treatment4 form another (with lower, similar values). This indicates that Treatments 1 and 2 were more conducive to K uptake. Potassium is crucial for enzyme activation, osmoregulation, and stomatal function (Wang *et al.*, 2013).

### **5.2.4 Calcium (Ca):**

Treatment3 stands out with a significantly higher calcium content (128.30 mg/100g) compared to the other three treatments, which are statistically similar. Calcium uptake is primarily passive, driven by transpiration, and can be influenced by root health and the availability of other cations. The high Ca in Treatment3 could be due to factors that enhanced transpiration or specific calcium fertilization (White & Broadley, 2003).

### **5.2.5 Zinc (Zn):**

Zinc levels were highest in Treatment1 and Treatment3 (1.64 and 2.05 mg/100g, respectively), and lowest in Treatment2 (1.00 mg/100g). The low Zn in Treatment2,

which had the highest nitrogen, is noteworthy. This could be a classic example of a nutrient dilution effect, where rapid growth driven by high nitrogen leads to a lower concentration of other minerals, or a direct antagonism in uptake between Zn and N (Kutman, Yildiz, and Cakmak, 2011).

### **5.2.6 Sodium (Na):**

**This is essential in animal's diet for proper hydration, nerve and muscle function and also aids digestion.** Treatment3 also resulted in a significantly higher sodium content (46.95 mg/100g). This could be an indicator that Treatment3 involved a saline growth condition or a sodium-containing amendment. The drop in Treatment 4 at 38.85% may be to the dual role of the additive as both a mineral source and a leaching agent for soluble ions.

## **CHAPTER SIX**

### **6.0 CONCLUSION AND RECOMMENDATI ON**

## 6.1 CONCLUSION

This research investigates the effects of ensiling maize cobs in wood ash extract for 21-days and this process can turn the often-discarded maize cob into a reliable, nourishing feed for livestock. It proves that with wood ash, a resource many farmers can readily obtain what was once considered waste can be stabilized and enriched, becoming a key to unlocking better animal nutrition. This isn't just a laboratory finding; it's a practical, accessible method that offers a tangible solution to the pressing challenge of feed scarcity, empowering farming communities to create their own sustainable future from the resources they already have. The unique properties of wood ash extract and the fermentation time, creates the perfect conditions to not just preserve, but actually improve the maize cobs. The treatment involving maize cobs ensiled with a lower volume of wood ash extract was particularly effective in enhancing the mineral composition, significantly boosting calcium and zinc content. The treatment with a higher volume of wood ash extract was most effective in reducing the crude fiber content, which could potentially improve the digestibility of the ensiled product but the CP decreased. The physical evaluation of the final product further confirmed its quality. The ensiled material exhibited desirable characteristics, including a stable acidic pH, a softened and pliable texture that improves palatability, and a uniform color with a pleasant, fermented aroma. This investigation revealed that the lignocelluloses content of the maize cob was not broken down significantly. This

could be due to high lignin content of the maize cob or other inhibitors present in the maize cob.

## **6.2 RECOMMENDATION**

Drawing from result of my study, I suggest that;

- It is advisable to promote the use of maize cobs as a useful waste product for livestock production.
- Measures should be taken to improve the nutritional qualities of the ensiled maize cobs, such as adding additives like molasses, mineral and vitamin premix.
- In order to attain the required chemical composition and physical qualities, more research on the ideal wood ash extract volume and fermentation time should be taken into consideration.
- Further studies should be carried out on different methods of reducing the fiber content of maize cobs aside using wood ash extract.

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