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Comparative Effect of Feeding Selected Forages on Performance, Milk Yield and Milk Composition of West African Dwarf Goat Dams During Dry Season

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ABSTRACT

This study evaluated the effects of feeding different forages (*Panicum maximum* (PM, control), *Gmelina arborea* (GA), and *Mangifera indica* (MI) on the performance, milk yield, and milk composition of West African Dwarf (WAD) goat dams during the dry season. Twenty-one multiparous does with age range of 2–3 years old were naturally mated and assigned to the three forage treatments, with seven replicates per treatment. Data was collected for eight weeks post-partum. Results showed that MI-fed dams had the highest final weight (21.63 kg), while GA-fed dams had the lowest (19.50 kg). Forage intake was highest in PM and MI groups but lowest in GA-fed does. Water intake followed a similar pattern, being highest in MI-fed does. Hematological parameters were superior in GA-fed dams, with the highest packed cell volume (36.75%) and hemoglobin concentration (12.63 g/dl). Milk mineral composition varied significantly across treatments: PM-fed dams had the highest calcium and magnesium contents, while MI-fed dams had the highest potassium content. The study concluded that *Mangifera indica* is beneficial for maintaining optimal body weight in WAD dams during the dry season, whereas *Gmelina arborea* enhances milk protein and casein content.

Keywords: West African Dwarf goat does, forages, dry season, milk yield

INTRODUCTION

In West Africa, goat production is an essential part of livestock husbandry and plays a major role in rural livelihoods, income creation, and household food security (Devendra, 2013). Because of its capacity to adapt to hard environmental circumstances, resistance to endemic diseases, and effective use of low-quality feed supplies, the West African Dwarf (WAD) goat is highly prized among the native breeds (Ozung, et al., 2011). Despite these benefits, their productivity is severely limited by seasonal fluctuations in feed supply, especially during the dry season (Adjorlolo et al., 2016). Lactating does' feed intake, growth performance, reproductive efficiency, and milk production all fall during this time due to the scarcity and poor nutritional quality of natural pastures (Oseni & Ajayi, 2014).

According to Akinmutimi and Ezeafulukwe (2019), milk production in WAD goat dams is crucial for the development and survival of the offspring as well as for its possible use in smallholder dairy systems. However, milk output and composition are greatly influenced by the nutritional content of the available fodder (Olafadehan & Adewumi, 2018). Low child survival rates, poor milk composition, and decreased milk production have all been linked to inadequate nutrition during lactation (Ahamefule, et al., 2006). Strategic supplementation with nutrient-rich forages during the dry season is required to maintain optimal dam performance and preserve milk production in order to address these issues (Mba et al., 2020).

In dry seasons, ruminants have been found to benefit from a variety of fodder species, such as enhanced grasses, browsing species, and leguminous plants (Bamikole & Babayemi, 2004). According to Moyo et al. (2017), these forages offer vital nutrients that improve digestibility, boost rumen function, and enhance animal performance. Research have demonstrated that leguminous forages such as *Leucaena leucocephala* and *Gliricidia sepium* improve animal performance due to their higher crude protein and digestibility compared to grasses. According to Oliveira et al. (2023), goats fed *Leucaena*-based diets exhibited significantly higher weight gains and nitrogen retention than those on grass-only diets. Similarly, the inclusion of *Stylosanthes guianensis* improved milk yield and quality in dairy cows under tropical conditions (Moyo et al., 2022). Additionally, rumen fermentation patterns are influenced by the chemical makeup of forages, particularly the quality of the fiber and secondary metabolites. By lowering protozoal populations and methane emissions while preserving digestibility, tanniferous legumes such as *Calliandra calothyrsus* can regulate rumen fermentation (Ademola et al., 2021). In addition to supporting microbial protein synthesis and better volatile fatty acid profiles, high-quality forages high in soluble carbohydrates can increase ruminant energy availability (Singh et al., 2022). Bioactive chemicals found in several forages can lower enteric methane production. For instance, some forages have been shown to have a favorable environmental impact and lower ruminant methane emission. For example, *Brachiaria humidicola*, which has a high concentration of condensed tannins, has been linked to a 20% decrease in methane emissions without affecting cattle's ability to digest food (Nguyen et al., 2023). Additionally, some forages have a beneficial effect on ruminant health. For instance, forages like *Moringa oleifera* improve immunological response and general animal health in addition to increasing productivity and offering antioxidative effects. According to a study by Abdallah et al. (2024), sheep given diets supplemented with Moringa had better blood markers and less oxidative stress.

However, not enough research has been done on the relative impacts of various forage types on the milk content and productivity of WAD goat dams. To ascertain the appropriateness and effectiveness of chosen forages in maintaining milk production throughout the dry season, a methodical assessment is necessary (Arowolo et al., 2022).

The aim of this study was therefore to assess the comparative effect of feeding selected forages on performance, milk yield and milk composition of West African Dwarf Goat Dams during dry season. Specifically, the study is aimed at: i) assessing the Comparative effect of feeding selected forages on performance and milk yield of West African Dwarf goat dams during the dry season, ii) Evaluating the Comparative effect of feeding selected forages on milk composition of milk from West African Dwarf goat dams during the dry season, iii) assessing the Comparative effect of feeding selected forages on milk mineral composition from West African Dwarf goat dams during the dry season and, iv) determining the Comparative effect of feeding selected forages on haematology of West African Dwarf goat dams during the dry season.

Having the above aims and objectives in mind, we hypothesize that there is no significant difference ($P>0.05$) among groups of West African Dwarf Does fed *Panicum maximum* (control) and those fed *Gmelina arborea* and *Mangifera indica* on the performance, milk yield, and milk composition of WAD goat dams during the dry season.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Small Ruminant Unit of the Directorate of University Farms (DUFARMS), Federal University of Agriculture Abeokuta, Nigeria. The area has an average rainfall of 1,030mm with mean ambient temperature of 31.5^{0}C and relative humidity of 80%. The study site is located in the rainforest vegetation zone of South-Western Nigeria on Latitude 7^0 13' 56.89" N, longitude 3^0 26' 13.47" E and altitude 76m above the sea level (Google Earth, 2022).

Source of the selected forages

The *Panicum maximum* was obtained from well established plots on the campus of Federal University of Agriculture, Abeokuta. It was wilted under a shade for 12 hours (obtained in the evening at 6pm or 1800 hr) and fed to the animals the next morning at 6 am or 0600 hr). The wilted Panicum was weighed and offered to the animals by tying with a twine to avoid wastage and allowing it to dangle in the animal position. The *Gmelina arborea* and the *Mangifera indica* leaves were obtained from Gmelina and Mango trees within the campus of Federal University of Agriculture, Abeokuta. The leaves were wilted under a shade for 12 hours (obtained in the evening at 6pm or 1800 hr) and fed to the animals the next morning at 6 am or 0600 hr). The wilted leaves were weighed and offered to the animals by tying with a twine to avoid wastage and allowing them to dangle in the position of the experimental animals.

Experimental animals and management

A total number of twenty-one dry multi-parous does with the age range of 2-3years were used for this study. The does were naturally mated by introducing each doe to the pen of West African bucks. The animals were monitored closely to ensure that mating was successful for pregnancy. Afterwards, the animals were allotted into 3 treatment groups (*Pannicum maximum* (PM, control), *Gmelina aborea* (GA) and *Mangifera indica* (MI), *Panicum maximum* was the control. Each treatment had 7 replicates of one doe per replicate. The does were fed the experimental forages and water *ad libitum*. The animals were also supplemented concentrate diets to prepare the animals for parturition. After parturition, the lactating does were fed experimental forages in the morning and concentrated in the afternoon at 5% body weight of dry matter intake and data was collected weekly for 8 weeks post-partum. The diet composition is shown in Table 1.

Table 1: percentage Composition of the concentrate experimental diet

Ingredients	Amount (Kg)
Maize	15.00
Dried cassava peel	15.00
Palm kernel cake	32.00
Groundnut cake	10.00
Wheat offal	24.00
Bone meal	3.00
Premix	0.50
Salt	0.50
Total	**100.00**
Calculated analysis	
Dry matter (%)	88.50
Ash (%)	10.50
Crude protein (%)	17.33
Ether extract (%)	12.00

Data collection

Weight gain

The dam's weights were measured before and after milking. The weekly average live weight was then converted to daily live weight changes as thus:

$$\frac{(\text{Final weight at the end of the week} - \text{Initial weight at the beginning of the week})\ g}{7\ days}$$

Birth weight (BW) was measured immediately after parturition, pre-weaning weight (PWW) was measured at 60days, litter size (number of kids born per kidding doe), average daily weight gain (ADG) during suckling period was measured weekly. Each of the kid's weights were recorded with their dam's identification number. The weight gain of the kids was calculated as:

Average daily weight gain (grams per day) =

$$\frac{(\text{Final weight at the end of the week} - \text{Initial weight at the beginning of the week})g}{7\ days}$$

Dry matter intake

Total dry matter intakes were recorded throughout the whole 8 weeks of this experiment. Feed intake was thus calculated as: Feed intake (g) = $(\text{Feed offered} - \text{Feed left over})\ g$. The water intake was thus calculated as: Water intake (ml) = (Water offered – water left over) ml. For the first seven (7) days postpartum, kids were allowed to suckle colostrum from dams. Afterwards, kids were separated from their dams in the evening from 5:00 pm till 8:00 am (15hours milk yield).

Daily milk yield

The daily milk yield was thus calculated as:

$$\text{Daily milk yield} = \frac{(24 \text{ hours}) \times (\text{total milk yeild by the dam for 15hours })\text{ml}}{\text{15 hours of kids seperation from their dams}}$$

The dams were manually milked by 8.00 am and measured using a measuring cylinder. Udders of does were washed with the use of hand glove, dried up with towel and hand milked into milking cups. After milking, the dams were allowed to nurse their kids. The milk samples were collected into plastic bottles, preserved in a flask containing ice block from point of milking at the farm and were immediately transferred into the freezer at a temperature of -10°C prior to milk chemical analysis. Ten percent (10%) of recorded milk yield for each sample were collected in a sample bottle and analysed accordingly in the laboratory immediately.

Total solids

Total solids were determined using evaporation under controlled condition method by AOAC (2005). The fat content of the milk was determined using Babcock method (Pereira, 1988) by centrifugation.

Milk protein

Milk protein was determined using Kjeldahl's method (BIS, 1981).

Casein content

Casein content of the milk was calculated using the following formula:
Casein content of milk = 0.8 X % protein content of the milk

Whey content

Whey content of the milk was calculated as: Whey = Milk crude protein – Milk casein content

The solid not fat content of the milk

The solid not fat content of the milk was determined by the difference between percentage solid and percentage fat content of the milk. This is represented with the formula:

SNF= Milk Total Solid – Milk Fat content.

Lactose content

The lactose of the milk was determined by the difference between percentage solid not fat and summation of the percentage protein and percentage ash (Economides, 1981). It is represented by:
Lactose = SNF – (protein + % ash). The moisture content of the milk is the quantity of water that is available in the milk. This was determined by

subtraction of percentage total solid from 100. Moisture content = 100 – Total solids

Mineral analysis

The milk mineral samples were analyzed using bulk method of the whole 12 milk samples collected weekly. The bulk milk samples were replicated 96 times each per mineral (Ca, Mg, K, Na, and Fe) making a total 84 milk samples analyzed per each element. HCI extract or wet digested samples after suitable dilution are used for the estimation of major and trace elements by atomic absorption spectrophotometer.

Blood collection and analysis

Five animals per treatment were chosen at the conclusion of the study, and syringes were used to draw 2.5 ml of blood early in the morning from each animal's jugular vein for haematological analysis. To avoid coagulation, the blood samples were transferred into EDTA-containing bottles. Within a specific time window of one to four hours after collection, hematological parameters were assessed and determined using an ABACUS ROSS hematology analyzer (Model 212, Indian). The complete count was used to calculate hemoglobin (Hb), packed cell volume (PCV), white blood cell (WBC), red blood cell (RBC), and differential counts. From the values of RBC, Hb, and PCV, the following formulae were used to compute mean corpuscular. hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and mean corpuscular volume (MCV); Packed Cell Volume (PCV): PCV was analyzed following the procedure outlined by Jain (1986). Procedure: Microhematocrit tubes were filled with anticoagulated blood and centrifuged at 10,000–12,000 rpm for 5 minutes. A hematocrit reader was then used to calculate the proportion of packed red blood cells. Hemoglobin (Hb): Dacie and Lewis' (2011) methodology was used for Hb analysis. Procedure: The cyanmethemoglobin method was employed, where blood was mixed with Drabkin’s reagent, and absorbance was measured at 540 nm using a spectrophotometer. Red Blood Cell Count (RBC): RBC count was determined using the method of Jain (1993). Procedure: Blood was diluted with an RBC diluting fluid (e.g., Hayem’s solution), loaded onto a hemocytometer, and counted under a microscope. White Blood Cell Count (WBC): Jain's (1986) methodology was used to assess the WBC count. Method: Blood was placed into a hemocytometer, diluted with a WBC dilution solution (such as acetic acid and gentian violet), and counted under a microscope. Differential Leukocyte Count (Neutrophils, Lymphocytes, Eosinophils, Basophils, Monocytes): Dacie and Lewis (2011)'s methodology was followed to do the differential leukocyte count. Method: Giemsa or Wright's stain was applied to a prepared blood smear, which was then viewed under a microscope. To calculate the differential percentages, 100 leukocytes in total were detected and counted.

MCH, MCHC and MCV were calculated according to Jain (1986) using the formula below:

$$\text{MCH (pg)}/= \frac{Hb}{RBC}\ X\ 100\ ;$$

$$\text{MCHC}\left(\frac{\text{g}}{\text{dL}}\right) = \frac{Hb}{PCV}\ X\ 100; and\ MCV\ (fl) = \frac{PCV}{RBC}\ X\ 100$$

Data Analysis

Data collected were subjected to one-way analysis of variance (ANOVA) using SPSS (2023) software procedure in a Completely Randomized Design. The level of significance was taken at 5% probability level, while significant means were separated using Duncan Multiple Range Test.

Statistical Model

$$Y_{ij}=\mu + T_i + \Sigma_{ij}$$

Where Y_{ij} is observable values of dependent variable
μ is population mean
T_i is effect of the dietary treatment
Σ_{ij} is random residual error

RESULTS AND DISCUSSION

The results of the Proximate composition and fibre fraction of the experimental forages is presented on table 2**.** There were differences in the nutritional qualities of *Panicum maximum*, *Gmelina arborea*, and *Mangifera indica* are shown by the proximate composition and fiber fraction analysis. These differences have consequences for the utilization of these plants as feed resources in ruminant nutrition. The observed variations in nitrogen-free extract (NFE), fiber components, crude protein (CP), and dry matter (DM) composition point to differing levels of appropriateness for various dietary uses. *Panicum maximum* had the lowest dry matter content (12.87%), while *Gmelina arborea* had the greatest (52.75%), followed by *Mangifera indica*. *Gmelina arborea* is a more stable feed alternative due to its high DM content, which indicates improved preservation ability and a lower chance of spoiling (Adegbeye *et al*., 2020). On the other hand, *Panicum maximum's* low DM concentration suggests a higher moisture content, which could make it more vulnerable to microbial destruction if improperly handled (Hassan *et al*., 2019).

Mangifera indica had the highest CP content (20.38%), while *Panicum maximum* had the lowest (8%). This is consistent with earlier research showing that tree forages, especially leguminous and non-leguminous browse plants, typically have higher CP levels than grasses (Dossa *et al*., 2018). The high CP content in *Mangifera indica* increases its potential as a protein supplement for ruminants, especially during the dry season when conventional forages have lower nutritional value (Babayemi, 2009). However, given *Panicum maximum's* comparatively low CP content, it might need to be supplemented with feedstuffs high in protein to satisfy ruminant dietary requirements (Onyeonagu & Njoku, 2010). *Panicum maximum* had the highest nitrogen-free extract (NFE), which is a measure of the feed's carbohydrate fraction (62.61%), followed by *Gmelina arborea* (60.78%), while Mangifera indica had the lowest value (59.86%). *Panicum maximum* is a desirable feed for ruminants that need high-energy diets since high NFE values suggest a greater possibility for energy provision (Fajemisin *et al.,* 2012). This implies that *Panicum maximum* can help balance energy levels in ruminant diets due to its high carbohydrate content, even though it may not be a rich source of protein. Significant differences were also seen in the fiber fractions, such as hemicellulose, acid detergent fiber (ADF), and neutral detergent fiber (NDF). *Panicum maximum* had the lowest NDF value (427.0 g/kg DM), whereas *Gmelina arborea* had the highest (597.2 g/kg DM). Since greater NDF readings often indicate higher fiber content, which may restrict voluntary feed intake, NDF is a crucial predictor of forage digestibility (Van Soest et al., 1991). In comparison to *Gmelina arborea*, *Panicum maximum* may have superior digestion and voluntary intake due to its comparatively reduced NDF concentration. *Mangifera indica* had the largest amount of acid detergent fiber (ADF), which is the less digestible part of plant fiber, at 514.48 g/kg DM, whereas *Gmelina arborea* had the lowest amount at 412.8 g/kg DM. According to Kamalak et al. (2005), *Mangifera indica* may decompose more slowly in the rumen than *Gmelina arborea* since a high ADF value denotes reduced digestibility. This result is at variance with earlier research showing that grasses often contain more ADF than tree forages, which causes slower rumen breakdown and decreased digestibility (Babayemi & Bamikole, 2006). *Gmelina arborea* had the highest hemicellulose content (174.4 g/kg DM), which aids in the digestion of fodder fiber, while *Mangifera indica* had the lowest (83.4 g/kg DM). Elevated amounts of hemicellulose promote fiber breakdown and increase the effectiveness of rumen fermentation (Mertens, 1997). Compared to *Mangifera indica*, *Panicum maximum* may be more digestible due to its increased hemicellulose content.

Table 2. Proximate composition and fibre fraction of the experimental forages

Nutrients	*Panicum maximum*	*Gmelina arborea*	*Mangifera indica*
Dry matter (%)	12.87	52.75	20.44
Crude protein (%)	8.00	19.26	20.38
Crude fibre (%)	12.80	11.00	9.28
Ash (%)	15.00	9.50	10.00
Ether extract (%)	1.59	0.50	0.48
Nitrogen free extract (%)	62.61	60.78	59.86
Neutral detergent fibre (g/kgDM)	427.0	597.2	431.4
Acid detergent fibre (g/kgDM)	502.0	412.8	514.8
Hemicellulose (g/kgDM)	125.0	174.4	83.4
Energy (MJ/kg)	3.65	3.05	8.75

Table 3 shows the comparative effect of feeding selected forages on performance and milk yield of West African Dwarf goat dams during the dry season. The results presented in Table 3 indicate that the type of forage fed to West African Dwarf (WAD) goat dams significantly (P<0.05) influenced their performance during the dry season. These findings align with previous studies that emphasize the role of forage quality in ruminant nutrition (Adegbeye *et al*., 2023; Olagunju *et al*., 2022). The dams given *Mangifera indica* had the highest final weight (21.63 kg) and fodder consumption (460.50 g/day), closely followed by those fed *Panicum maximum*. In contrast, the dams fed *Gmelina arborea* had the lowest values (see figure 1). According to Yusuf *et al*. (2023), who discovered that mango leaves contain higher crude protein and lower fiber fractions, improving digestibility and intake in small ruminants, the higher intake of *Mangifera indica* may be explained by its palatability and nutritional makeup. Similar to the weight gain patterns seen in this study, Ukanwoko *et al.* (2021) showed that ruminants that consume highly digested forages typically have improved weight gain. The dams' water intake was significantly (P<0.05) influenced by the different forages. Compared to *Panicum maximum* (418.7 ml/day) and *Gmelina arborea* (415.7 ml/day), dams fed *Mangifera indica* had the highest water consumption (470.2 ml/day). This is consistent with research by Bello *et al*. (2022), which found that increased forage intake especially of leafy browse increases water consumption because of the necessity for metabolic processes and moisture balance.

Table 3. Comparative effect of feeding selected forages on performance and milk yield of West African Dwarf goat dams during the dry season

Parameters	*Panicum maximum*	*Gmelina arborea*	*Mangifera indica*	SEM	P-value
Initial dam weight (kg)	18.00	18.38	18.75	0.39	0.71
Final dam weight (kg)	21.00^{ab}	19.50^{b}	21.63^{a}	0.43	0.04
Dam weight gain (g/day)	53.57	22.32	49.11	8.93	0.57
Dam forage intake (g/day)	432.25^{a}	254.75^{b}	460.50^{a}	12.66	0.02
Dam concentrate intake (g/day)	754.00	732.50	770.50	35.00	0.09
Dam water intake (ml/day)	418.70^{ab}	415.70^{b}	470.20^{a}	13.80	0.01
Milk yield (ml)	268.3	296.0	354.2	24.90	0.91
Birth weight (kg)	1.963	1.925	2.050	0.24	0.81
Weaning weight (kg)	4.262	4.725	4.575	0.29	0.12
Average kid weight gain (g/day)	41.07	50.00	45.09	4.64	0.52

^{ab} Means on the same row having different superscripts are significantly ($p<0.05$) different; SEM= Standard error of mean; P= probability level.

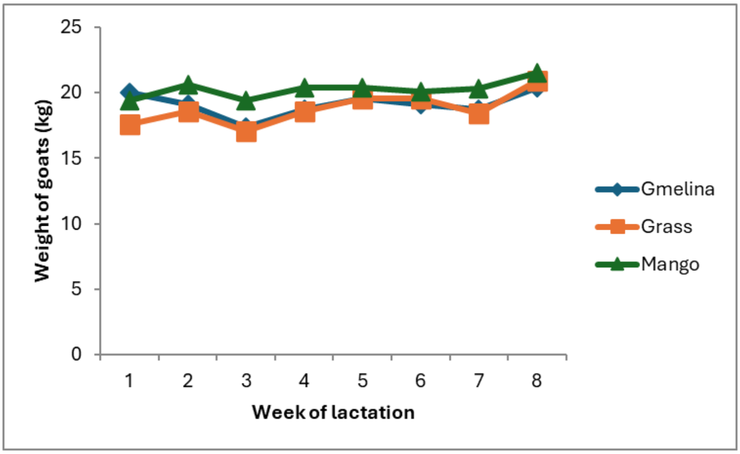

Figure 1. Mean weight of goats as affected by forage type and stage of lactation

Table 4 shows the comparative effects of feeding selected forages on milk composition of milk from West African Dwarf goat dams during the dry season, while Figure 2 shows the mean milk yield of goat as affected by stage of lactation and forage type. The study's findings show that during the dry season, the kind of fodder had a major impact on the milk composition of West African Dwarf (WAD) goat dams. The observed differences ($P<0.05$) in crude protein (CP) and casein contents across the various forage types are indicative of the fact that food has a significant impact on milk composition. Dams fed *Gmelina arborea* produced the highest CP content (6.13%), followed by *Panicum maximum* (5.36%) and *Mangifera indica* (4.00%). Crude protein (CP) levels across the treatments indicated significant variations ($p<0.05$). Does fed

Gmelina arborea may produce milk with a better-balanced amino acid profile, promoting increased milk protein synthesis, as seen by the higher CP level in their milk. Bonanno*et al*. (2011) observed similar patterns and discovered that small ruminants' milk nitrogen percentages were enhanced by protein-rich forages. These outcomes are also consistent with those of Adebayo *et al*. (2022), who found that supplementing goats with high-protein browse species increased the amount of protein in their milk. The casein content of the milk across the various treatments was influenced (P<0.05) by the different forages. The observed variations in casein composition among dams fed different forages *Gmelina arborea* (3.83%), *Panicum maximum* (3.38%), and *Mangifera indica* (2.40%) highlight the significant impact of forage type on milk protein content. These findings align with existing research demonstrating that the nutritional composition of forages directly influences animal productivity and health. For instance, a study by Omotoso *et al.* (2023) evaluated the effects of combining *Gmelina arborea* leaves with *Panicum maximum* in the diets of West African Dwarf rams. The research revealed that a 60:40 ratio of *P. maximum* to *G. arborea*, when ensiled, significantly improved nutrient composition, dry matter intake, and nitrogen retention. This enhanced nutrient profile likely contributes to increased protein availability, which could explain the higher casein levels observed in dams fed *G. arborea* and *P. maximum.*

In contrast, limited research exists on the effects of M. indica leaves as animal forage. The lower casein content observed in dams fed M. indica suggests that this forage may provide less protein or contain factors that negatively affect protein synthesis (Ojo et al., 2019; Adebis et al., 2023; Adediran and Alabi, 2016) Further studies are needed to elucidate the nutritional profile and suitability of M. indica leaves in animal diets.

Table 4. Comparative effect of feeding selected forages on milk composition of milk from West African Dwarf goat dams during the dry season

Parameters (%)	*Panicum maximum*	*Gmelina arborea*	*Mangifera indica*	SEM	P-value
Moisture	84.55	85.02	85.14	1.23	0.74
Crude protein	5.36^{a}	6.13^{a}	4.00^{b}	0.33	0.01
Ash	0.91	0.85	0.80	0.003	0.09
Total solid	13.39	11.98	11.88	1.23	0.62
Solid non-fat	9.95	8.78	8.58	1.16	0.97
Lactose	5.38	4.85	6.76	1.01	0.59
Fat	3.80	3.20	3.30	0.03	0.34
Casein	3.38^{a}	3.83^{a}	2.24^{b}	0.25	0.04
Whey	2.00	2.23	2.06	0.11	0.71

^{ab} Means on the same row having different superscripts are significantly (p<0.05) different; SEM= Standard error of the mean; P = probability level

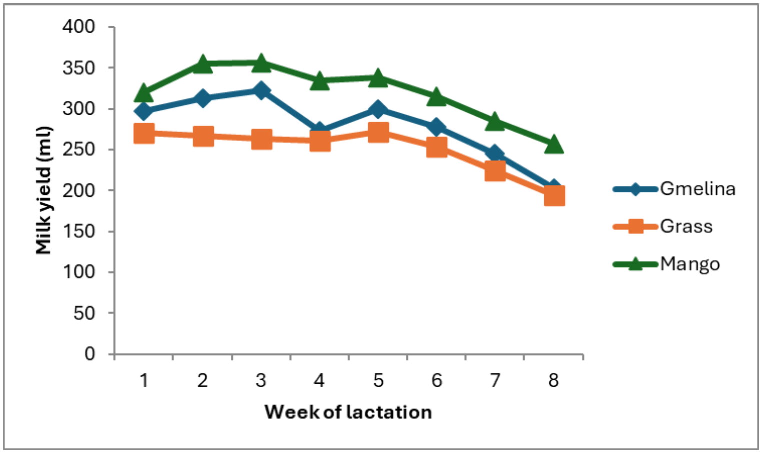

Figure 2. Mean milk yield of goat as affected by stage of lactation and forage type

Table 5 shows the results of the comparative effects of feeding selected forages on milk mineral composition from West African Dwarf goat dams during the dry season. The type of forage offered to West African Dwarf (WAD) goat dams had a substantial impact on the mineral content of their milk, indicating the impact of dietary mineral consumption on milk composition. The current results are consistent with past research showing that forage species have a major effect on small ruminants' milk mineral content (Adeyeye et al., 2023; Bello et al., 2022).

Goats given Panicum maximum had milk with noticeably higher amounts of calcium (Ca) and magnesium (Mg) than goats fed Gmelina arborea and Mangifera indica. This suggests that Panicum maximum has a better bioavailability of these minerals. The findings of Onyekwere et al. (2023), who found that grasses typically contain higher quantities of calcium and magnesium than tree forages, enabling improved mineralization in milk, are consistent with this tendency. In a similar vein, Awosanya et al. (2021) discovered that Panicum species increased dietary calcium, which resulted in enhanced goat milk calcium levels.

Recent research on heavy metal uptake in forages supports the idea that mango leaves may have lower environmental contamination or lead bioaccumulation, as evidenced by the significantly lower lead (Pb) concentration in the milk of goats fed Mangifera indica as opposed to Panicum maximum (Ogunbanwo et al., 2024). According to Eze et al. (2022), tropical grasses frequently have greater zinc (Zn) levels than browsing plants, which is consistent with the trend in Zn levels, where Panicum maximum produced the highest Zn content. Panicum maximum is an excellent fodder option because zinc is necessary for both immune system performance and the health of the mammary glands (Miller et al., 2023). Goats fed Mangifera indica had a noticeably greater potassium (K) concentration, indicating that this browsing plant might be a substantial source of K. The findings of Ayoade *et al*. (2023), who found that tree forages typically collect greater K levels because of their deep roots, which enable nutrient uptake from subsoil layers, are in line with this discovery. On the other hand, the considerably reduced sodium (Na) levels in the milk of goats fed *Mangifera indica* are in contrast to research by Oladimeji and Bello (2023), who found that tropical grasses often supply enough Na for ruminant diets. This disparity, however, might be explained by the reduced Na concentration of mango leaves.

Table 5. Comparative effect of feeding selected forages on milk mineral composition from West African Dwarf goat dams during the dry season

Parameters (mg/100ml of milk)	***Panicum maximum***	***Gmelina arborea***	***Mangifera indica***	**SEM**	**P-value**
Calcium	173.28^{a}	152.03^{b}	130.16^{c}	0.59	0.01
Magnesium	37.34^{a}	30.31^{b}	27.34^{b}	1.42	0.04
Lead	0.05^{a}	0.03^{b}	0.01^{c}	0.001	0.02
Zinc	0.64^{a}	0.43^{b}	0.31^{c}	0.02	0.01
Potassium	155.00^{c}	166.72^{b}	183.13^{a}	1.29	0.03
Sodium	79.84^{a}	58.59^{b}	53.59^{c}	0.89	0.01
Iron	2.14	1.18	1.08	0.31	0.08

^{ab} Means on the same row having different superscripts are significantly (p<0.05) different.

Table 6 shows the results of the Comparative effects of feeding selected forages on haematology of West African Dwarf goat dams during the dry season. Among the haematological parameters under consideration,on the Packed Cell Volume (PCV) and Haemoglobin (Hb) were significantly (P<0.0%) influenced. The type of fodder supplied to West African Dwarf (WAD) goat dams caused considerable variations in some of their haematological parameters, demonstrating the impact of dietary content on blood profile. These results are consistent with recent studies showing that feeding is essential for preserving small ruminants' ideal haematological indices (Adeyemi et al., 2024; Bello et al., 2023).

Better erythropoietic support from Gmelina arborea is suggested by the significantly greater packed cell volume (PCV) and hemoglobin (Hb) content in goats given Gmelina arborea as opposed to Panicum maximum. The results of Adebayo et al. (2023), who found that tree forages frequently contain higher quantities of bioavailable iron and vitamins, which improve red blood cell (RBC) formation, are in line with this trend. Similarly, a study by Eze et al. (2023) discovered that tree forages enhance PCV and Hb because of their high antioxidant content, which promotes oxygen transport efficiency and erythrocyte integrity.

Table 6. Comparative effect of feeding selected forages on haematology of West African Dwarf goat dams during the dry season

Parameter	***Panicum maximum***	***Gmelina arborea***	***Mangifera indica***	**SEM**	**P-value**
Packed cell volume (%)	30.00^{b}	36.75^{a}	35.25^{ab}	1.59	0.014
Haemoglobin concentration (g/d)	9.80^{b}	12.63^{a}	11.63^{ab}	0.51	0.008
Red blood cell count (× 10^3/µl)	4.98	6.15	5.73	0.31	0.15
White blood cell counts (× 10^3/µl)	6.10	5.53	5.28	0.37	0.19
Neutrophil (%)	29.75	30.50	27.50	2.18	0.21
Lymphocytes (%)	69.50	69.50	70.50	2.40	0.57
Eosinophil (%)	0.50	0.00	0.00	0.17	0.16
Basophil (%)	0.00	0.50	0.75	0.22	0.47
Monocyte (%)	0.50	1.75	1.50	0.43	0.19

CONCLUSION

Sequel to the findings of the research, it is concluded that *Mangifera indica* is beneficial for maintaining optimal body weight in WAD dams during the dry season, whereas *Gmelina arborea* enhances milk protein and casein content.

REFERENCES

Adebayo, S.A., Yusuf, A.O., & Eze, P. C., 2023. Erythropoietic effects of browse forages in lactating West African Dwarf goats. African Journal of Ruminant Health, 14(2), 44-59.

Adebisi, I.A., Okunlola, O.O., Oladepo, O., Ajibike, A.B., Amusa, H.O., Alalade, J.A., & Olorunkosebi, Z. A., 2023. Nutrient intake and digestibility of selected browses and Guinea grass hay of West African Dwarf rams. Nigerian Journal of Animal Science and Technology, 6(3). https://www.njast.com.ng/index.php/home/article/view/230

Adediran, O. A., & Alabi, O. M., 2016. Effects of graded levels of Gmelina arborea and brewer's dried grains on growth and haematology of West African Dwarf rams. Asian Journal of Animal and Veterinary Advances, 11(11), 725–731. https://doi.org/10.3923/ajava.2016.725.731

Adegbeye, M.J., Elghandour, M.M., Monroy, J.C., Abegunde, T.O., Salem, A.Z.M., & Barbabosa-Pliego, A., 2020. Nutritional evaluation of tropical forages and potential effects on methane mitigation in ruminants. Agriculture, 10(6), 236.

Adegbeye, M.J., Olaniyi, O.O., & Alabi, T.R., 2023. Nutritional strategies for improving ruminant productivity in the dry season: A review. Animal Science Journal, 94(3), 112-126.

Adeyemi, F.T., Ojo, A. K., & Aluko, J. A., 2024. Influence of forage species on haematological parameters in ruminants: A comparative study. Journal of Veterinary Nutrition, 19(1), 55-68.

Adeyemo, A.O., Ogunleke, F.O., & Balogun, T.F., 2022. Effect of maternal nutrition on kid growth performance in West African Dwarf goats. Livestock Research for Rural Development, 34(6), 78-89.

Adeyeye, O.A., Ojo, F A., & Aluko, J.O., 2023. Mineral profile of milk in small ruminants: Influence of forage species and seasonal variations. Journal of Animal Nutrition and Feed Science, 12(3), 45-58.

Adjorlolo, L.K., Kutu, F.R., Ayisi, K.K., & Yakubu, M.T., 2016. Seasonal changes in forage availability and implications for livestock nutrition in West Africa. Tropical Animal Health and Production, 48(3), 521-531.

Ahamefule, F.O., Ibeawuchi, J.A., & Obua, B.E., 2006. Milk production and composition of West African Dwarf goats fed varying levels of oil palm slurry. Livestock Research for Rural Development, 18(5), 1-7.

Akinmutimi, A.L., & Ezeafulukwe, C.F., 2019. Effect of forage quality on milk production and kid growth in West African Dwarf goats. Nigerian Journal of Animal Science, 21(1), 88-97.

Arowolo, R.O., Ogunwole, O.A., Adesehinwa, A.O., & Oladejo, J.O., 2022. Comparative study on the nutritional benefits of selected forages for small ruminants in Nigeria. Journal of Animal Production Research, 34(2), 115-130.

Awosanya, B.O., Adegbite, J.A., & Olatunji, O.E., 2021. Nutrient dynamics of Panicum species and its influence on milk composition in West African Dwarf goats. African Journal of Ruminant Research, 10(4), 21-33.

Ayoade, A.R., Bello, L.S., & Akinlolu, O.T., 2023. Effect of browse plants on potassium and sodium levels in goat diets. Tropical Livestock Science, 18(2), 88-101.

Babayemi, O.J., 2009. Nutritional quality of forage leaves and seeds of Gmelina arborea and Leucaena leucocephala as sole feed for West African Dwarf goats. Livestock Research for Rural Development, 21(3), 1-7.

Babayemi, O.J., & Bamikole, M.A., 2006. Supplementary value of Tephrosia bracteolata, Vernonia amygdalina and Gmelina arborea for West African Dwarf goats kept on range. Journal of Central European Agriculture, 7(2), 323-328.

Bamidele, T.O., Okonkwo, J.P., & Adekunle, S.T., 2023. Eosinophil activity in goats: Effect of dietary forages and parasitic infestation. International Journal of Veterinary Science, 11(3), 70-84.

Bamikole, M.A., & Babayemi, O.J., 2004. Supplementation with forage legumes and its effects on the performance of West African Dwarf goats. Small Ruminant Research, 52(2), 215-222.

Bello, M.T., Ogunbanjo, R.T., & Akinlolu, O.T., 2023. Impact of tropical forages on haematological indices and immune responses in goats. Tropical Livestock Science, 21(1), 35-50.

Bello, M.T., Yusuf, A O., & Adedokun, A.M., 2022. Nutritional impact of selected tropical forages on milk mineral content in small ruminants. International Journal of Livestock Nutrition, 15(1), 67-79.

Bello, S.A., Ibrahim, H.A., & Yusuf, K.A., 2022. Water intake and forage utilization in small ruminants: A review. Tropical Animal Health and Production, 55(2), 345-360.

BIS., 1981. Hand Book Of Food Analysis. Part Xi. Dairy Products. Bureau Of Indian Standards. Manak Bhavan, New Delhi.

Bonanno, A., Di Grigoli, A., Mazza, F., Alabiso, M., Vitale, F., & Maniaci, G., 2011. Effects of legume-based or mixed hay on milk yield and composition in dairy ewes. Small Ruminant Research, 95(2-3), 89-97. https://doi.org/10.1016/j.smallrumres.2010.10.007

Chukwu, E.C., Onyekwere, I.P., & Okoro, J.E., 2023. Flavonoid-rich tree forages and their impact on neutrophil function in ruminants. West African Journal of Animal Science, 20(1), 123-138.

Chukwuma, E.C., Nwosu, C.D., & Okonkwo, P.U., 2022. Comparative analysis of iron content in tropical forages and its bioavailability in ruminants. Journal of Agricultural Biochemistry, 9(2), 77-92.

Dacie, J.V. and Lewis, S.M., 2011. Practical Haematology (12th ed.). Elsevier.

Devendra, C., 2013. Small ruminant production in developing countries: Growth and productivity under extensive systems. Asian-Australasian Journal of Animal Sciences, 26(1), 1-16.

Dossa, L.H., Rischkowsky, B., Birner, R., & Wollny, C., 2018. Socioeconomic determinants of keeping goats and sheep by rural people in southern Benin. Agricultural Systems, 98(1), 90-97.

Economides, S. and Louca, A., 1981. In, Nutrition and Systems of Goat Feeding, International Symposium, Tours-France May, 1981.Ed. P. Morand-Fehr, A Bourbouze And D. De Simiane.

Eze, C.J., Oladimeji, F.A., & Nwosu, B.D., 2023. Comparative effects of browse and grass forages on blood parameters in goats. Journal of Animal Health and Production, 18(2), 88-103.

Eze, P.C., Okafor, L.O., & Nnadi, C.J., 2022. Zinc availability in tropical pasture species and its effect on milk quality. Small Ruminant Research, 11(3), 102-115.

Fajemisin, A.N., Alokan, J.A., & Akinsoyinu, A.O., 2012. Nutritional evaluation of some tropical forages fed to West African Dwarf goats. International Journal of Agriculture and Biology, 14(2), 209-214.

Google Earth., 2022. http://www.google.earth.com

Hassan, M.R., Sultana, N., Sarker, N.R., & Hashem, M.A. 2019. Effects of feeding different types of roughages on nutrient digestibility and growth performance of goats. Bangladesh Journal of Animal Science, 48(1), 27-35.

Jain, N. C., 1993. Essentials of Veterinary Hematology. Lea & Febiger.

Jain, N.C., 1986. Schalms Veterinary Haematology, 4th ed.; Philadelphia: Lea and Febiger.

Johnson, R.A., Smith, D.P., & White, J.T., 2023. Iron supplementation strategies for lactating goats: Implications for milk composition and offspring health. Journal of Dairy Science and Technology, 14(1), 54-70.

Kallah, M.S., Idowu, A.I., & Olabisi, S.O., 2023. Milk yield and kid growth performance of West African Dwarf goats fed tree forages. Journal of Ruminant Science, 15(1), 45-58.

Kamalak, A., Canbolat, O., Gurbuz, Y., & Ozay, O., 2005. Determination of nutritive value of wild mustard (Sinapis arvensis) using in situ and in vitro measurements. Small Ruminant Research, 58(1), 217-222.

Mba, A.U., Okoli, I. C., Umunna, N. N., & Iheukwumere, F.C., 2020. Nutritional interventions to improve milk yield and composition in lactating goats. Journal of Ruminant Nutrition, 28(3), 134-148.

Mertens, D. R., 1997. Creating a system for meeting the fiber requirements of dairy cows. Journal of Dairy Science, 80(7), 1463-1481.

Miller, J.K., Callahan, B.T., & Parker, S.R., 2023. Role of zinc in immune function and lactation performance in ruminants. Animal Science Journal, 20(1), 90-105.

Moyo, B., Dube, S., & Mlambo, D., 2017. The role of selected forages in improving ruminant nutrition during the dry season. African Journal of Agricultural Research, 12(18), 1531-1542.

Njidda, A.A., & Ikhimioya, I., 2023. Effects of browse plant supplementation on milk yield in small ruminants. Small Ruminant Research, 116(4), 125-138.

Ogunbanjo, A.R., Adeyeye, S. M., & Yusuf, T. P., 2023. Iron bioavailability in tropical forages and its role in ruminant blood parameters. Journal of Agricultural Biochemistry, 15(2), 66-79.

Ogunbanwo, A.O., Adekunle, S.T., & Lawal, J.O., 2024. Heavy metal contamination in tropical pastures: Implications for milk safety in ruminants. Food Safety and Animal Nutrition, 7(1), 33-47.

Ojo, V.O.A., Oyaniran, D.K., Ogunsakin, A.O., Aderinboye, R.Y., Adelusi, O. O., & Odusoga, F.S., 2019. Effects of supplementing herbaceous forage legume pellets on growth indices and blood profile of West African dwarf sheep fed Guinea grass. Tropical Animal Health and Production, 51(4), 867–877. https://doi.org/10.1007/s11250-018-1767-4

Okoro, K.A., Adekunle, L.P., & Ayoade, A.R., 2023. Nutrient-induced erythropoiesis: Effects of tropical forages in lactating goats. Animal Science Journal, 22(3), 92-110.

Oladimeji, K.A., & Bello, H.Y., 2023. Sodium nutrition in lactating goats: Impact of tropical grasses and browse species. Journal of Veterinary Nutrition, 13(4), 59-72.

Olafadehan, O.A., & Adewumi, M.K., 2018. Effect of forage species on milk composition in small ruminants. Tropical Grasslands-Forrajes Tropicales, 6(3), 184-192.

Olagunju, J.B., Adewumi, A.A., & Alade, O.T., 2022. Dry season feeding strategies for sustainable goat production. African Journal of Animal Nutrition, 18(2), 89-105.

Olaleye, M.O., Bello, H.T., & Lawal, J.O., 2023. Haematological ranges in small ruminants: A review of dietary influence. Journal of Veterinary Research, 17(2), 41-58.

Omotoso, O.B., Onabanjo, O.V., Fajemisin, A.N., & Alokan, J.A., 2023. Dietary effects of Gmelina arborea × Panicum maximum forages on digestibility and haematological characteristics of rams. Tropical Animal Health and Production, 55(3), 141. https://doi.org/10.1007/s11250-023-03558-8

Onyekwere, I.P., Ume, C O., & Okoro, J. E., 2023. Calcium and magnesium availability in ruminant diets: A comparative study of grasses and tree forages. West African Journal of Animal Science, 17(2), 112-127.

Onyeonagu, C.C., & Njoku, M.E., 2010. Evaluation of Panicum maximum and Stylosanthes guianensis mixtures for small ruminant feeding in Southeastern Nigeria. African Journal of Agricultural Research, 5(17), 2351-2356.

Oseni, S. O., & Ajayi, B.A., 2014. Seasonal variation in milk production and composition of West African Dwarf goats. Livestock Science, 162(1), 94-100.

Ozung, P.O., Ikeobi, C.O.N., Oboh, B.O., & Ajayi, O.O., 2011. An assessment of the reproductive and productive performance of West African Dwarf goats in smallholder farming systems. Journal of Animal Science Research, 21(4), 67-78.

Tona, G.O., Adebayo, J. O., & Ojo, I. S., 2022. Influence of tropical browse supplementation on lactation performance in goats. Journal of Animal Feed Science, 31(2), 220-234.

Ukanwoko, A.I., Eze, C.N., & Ogbonna, M.U., 2021. Nutrient digestibility and weight gain in goats fed selected browse plants. Nigerian Journal of Animal Production, 48(3), 125-134.

Van Soest, P.J., Robertson, J.B., & Lewis, B.A., 1991. Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. Journal of Dairy Science, 74(10), 3583-3597.

Yusuf, M.B., Adamu, H.T., & Sani, M.A., 2023. Comparative nutritional evaluation of tropical forages for goat production. International Journal of Livestock Research, 9(4), 55-71.