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Effects of Feeding Cowpea Shaft on the Growth Performance of West African Dwarf Goats

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ABSTRACT

Nutritional constraints remain the foremost limitation to goat production in West Africa, particularly during the dry season when natural pastures are scarce and of poor nutritive quality. This study evaluated the influence of cowpea shaft on growth performance of West African Dwarf (WAD) goats. Twelve growing WAD goats (average initial weight: 4.8 ± 0.5 kg) were randomly allotted to two dietary treatments for eight-week feeding trial in a completely randomized design. Diet T1 consisted of elephant grass (*Pennisetum purpureum*) while Diet T2 consisted of cowpea shaft. Proximate analysis of diets was carried out using AOAC methods. Parameters measured included body weight gain (BWG), average daily feed consumed (ADFC), feed conversion ratio (FCR), specific growth rate (SGR), and survival rate (SVR). The proximate composition showed that cowpea shaft had higher crude protein (13%) compared to elephant grass (10%). Data collected were subjected to one-way ANOVA at $p < 0.05$. Goats fed cowpea shaft (T2) had significantly higher BWG (7.47 ± 1.77 kg) than those fed elephant grass (6.80 ± 0.19 kg). Survival rate was also higher in T2 ($1.55 \pm 0.34\%$) compared with T1 ($1.05 \pm 0.05\%$). Although ADFC was slightly lower in T2, goats attained better growth, reflecting nutrient density of cowpea shaft. Feed conversion ratios were comparable between treatments. The findings demonstrate that cowpea shaft improved growth and survivability of WAD goats, attributable to its superior crude protein content. Cowpea shaft thus represents a protein-rich, and sustainable feedstuff for smallholder goat production. Its incorporation into dry-season feeding systems is recommended to enhance productivity and resilience of WAD goats.

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INTRODUCTION

Goat production is central to the livelihoods of rural households in West Africa, providing meat, milk, manure, cultural assets, and financial security (Akinmoladun *et al.*, 2019; Devendra, 2013). Among goat breeds, the West African Dwarf (WAD) goat is the most widespread and adapted to the humid and sub-humid regions of the subcontinent, valued for its resistance to trypanosomiasis and tolerance to harsh environmental conditions (Oni *et al.*, 2012; Peacock, 2005). Despite its adaptive advantages, the productivity of WAD goats remains low due to feed shortages, diseases, and poor management (Chukwu *et al.*, 2018; Yakubu *et al.*, 2010).

The problem of nutrition is particularly acute during the dry season when forage availability and quality decline sharply, resulting in weight loss, low reproductive performance, and increased mortality (Adjorlolo *et al.*, 2015; Smith *et al.*, 2018). To bridge this gap, crop residues and agro-industrial by-products have been identified as alternative feed resources (Akinfemi *et al.*, 2016; Kassahun *et al.*, 2020). Crop residues are often abundant after harvest and can serve as affordable feed supplements for small ruminants if properly utilized. Cowpea (*Vigna unguiculata*), a leguminous crop widely cultivated across West Africa, provides grains for human consumption while leaving behind substantial residues such as cowpea haulms and cowpea shaft. Cowpea shaft, the by-product of threshing and processing cowpea grain, contains moderate protein and fiber levels, making it suitable for ruminant feeding (Adeyemi *et al.*, 2020; Tarawali *et al.*, 1997). Its utilization could simultaneously improve animal performance and reduce environmental waste. Previous studies have explored the feeding value of cassava peels (Adesehinwa *et al.*, 2004), maize stover (Nsahlai *et al.*, 2017), and groundnut haulms (Okunlola *et al.*, 2019) in small ruminant diets. Leguminous residues such as cowpea haulms have been reported to enhance nutrient intake and growth performance (Osakwe & Steingass, 2014; Tarawali *et al.*, 1997). However, limited empirical data exist on utilization of cowpea shaft specifically, particularly in relation to WAD goats. Given the strategic role of WAD goats in rural economies and the abundance of cowpea shaft in West Africa, evaluating its nutritive value is

both academically significant and practically relevant. The study hypothesized that cowpea shaft had significant impact on growth performance of West African Dwarf Goat. This study therefore aimed to determine the proximate composition of cowpea shaft relative to elephant grass, assess its effects on growth performance indices of WAD goats, and draw practical implications for smallholder goat production.

MATERIALS AND METHODS

Experimental site

The trial was carried out at Olusegun Agagu University of Science and Technology Farms Okitipupa, Ondo State (Southwest Nigeria), located within the derived savannah zone. The region experiences a bimodal rainfall pattern averaging 1,300 mm annually, with temperatures ranging from 26–34 °C. The experiment was conducted during the dry season (November–January) (Toponavi, 2023).

Experimental animals and management

Twelve healthy WAD goats aged 6–8 months (mean initial weight: 6.8 ± 0.5 kg) were sourced from local farmers. On arrival, goats were quarantined for two weeks, dewormed with albendazole (0.5ml/kg), and vaccinated against Peste des Petits Ruminants (PPR). Animals were housed in well-ventilated pens (3m by 5m by 2m), with concrete floors and slatted bedding. Water and mineral licks (Na+Iodine+P+Clay) were provided *ad libitum*.

Experimental design and diets

The goats were randomly assigned into two treatments T1 and T2 in a completely randomized design ($n = 6$ per group). Treatment 1 (T1) consisted of elephant grass (*Pennisetum purpureum*), while Treatment 2 (T2) consisted of cowpea shaft. Feeds were offered at 5% body weight daily, divided into two equal portions (morning and evening). The leftovers were weighed daily to determine actual feed intake.

Proximate analysis

Feed samples were analyzed using standard AOAC (2005) methods to determine dry matter, crude protein, crude fiber, ether extract, and ash contents.

Growth performance parameters

Body weights were recorded weekly using a digital scale (Turbo, Germany). Performance indices measured included: Body weight gain

(BWG) = Final BW – Initial BW, Average daily feed consumed (ADFC) = Total feed consumed ÷ days of trial, Feed conversion ratio (FCR) = Feed intake ÷ BWG, Specific growth rate (SGR) = (ln final BW – ln initial BW) ÷ days × 100, Survival rate (SVR) = (Number of surviving goats ÷ total goats) × 100.

Statistical analysis

Data were subjected to Analysis of Variance (ANOVA) using SAS 9.2 (SAS Institute, Cary, USA). Treatment means were separated by Duncan's Multiple Range Test at 5% level

of significance. The treatment effect was treated as the main factor in the model: $Y_{ij} = \mu + B_i + \varepsilon_{ij}$ Where, Y_{ij} = observed value of performance parameter, μ = overall mean B_i = effect of treatment, ε_{ij} = residual error.

RESULTS AND DISCUSSION

Descriptive statistics: General growth statistics are summarized in Table 1. Across treatments, mean BW was 7.13 kg, BWG was 3.00 kg, FCR was 0.16, SGR was 2.71 and survival rate was 1.30. Survival rate has the highest coefficient of variation while body weight gain has the lowest value.

Table 1: Descriptive statistics of the growth performance

Variables	Mean	Stand Dev	N	Minimum	Maximum	CV
Body weight (BW in Kg)	7.13	1.96	6	4.05	9.55	27.26
Average body weight gain (BWG in Kg)	3.00	0.19	6	0.69	0.90	13.40
Feed conversion ratio (FCR)	0.36	0.07	6	0.13	0.20	20.98
Specific growth rate (SGR in %)	2.71	0.45	6	2.03	3.26	15.02
Survival rate (SVR in %)	1.30	0.46	6	1.05	2.05	33.51

N=Sample size; CV=Coefficient of variation.

Proximate composition

The proximate analysis (Table 2) showed that cowpea shaft (T2) had higher crude protein (13%) and crude fiber (39%) compared to

elephant grass (T1) (10% and 31%, respectively). Ash content was lower in cowpea shaft (7%) than in elephant grass (11%).

Table 2: Comparative proximate analysis of cowpea shaft and elephant grass used.

Component	T1	T2
Moisture	14%	11%
Crude protein	10%	13%
Crude fibre	31%	39%
Ash	11%	7%
Ether extract	3%	2.5%

Growth performance: Treatment-specific performance (Table 3) revealed that goats fed cowpea shaft (T2) achieved significantly higher BWG (7.47 ± 1.77 kg) compared to those on elephant grass (6.80 ± 0.19 kg). ADFC was slightly higher in T1 (0.80 ± 0.11 kg/day) than T2 (0.75 ± 0.11 kg/day), though not significant. FCRs were similar (0.16 for T1, 0.17 for T2). SVR was notably higher in T2 (1.55 ± 0.34) than in T1 (1.05 ± 0.05).

Table 3: Performance of goats fed with cowpea shaft (T2) and elephant grass (T1)

Treatment	BWG (kg)	ADFC (kg)	FCR	SGR (%)	SVR (%)
T1	6.80 ± 0.19^b	0.80 ± 0.11^a	0.16 ± 0.06^a	2.78 ± 0.08^a	1.05 ± 0.05^b
T2	7.47 ± 1.77^a	0.75 ± 0.11^b	0.17 ± 0.07^a	2.65 ± 0.41^b	1.55 ± 0.34^a
Overall mean	7.13 ± 0.84	0.78 ± 0.09	0.16 ± 0.06	2.71 ± 0.21	1.30 ± 0.22

Means with same superscripts are not significantly different at $p < 0.05$. Key: BWG: Body weight gain; ADFC: Average Daily Feed Consumed; FCR: Feed Conversion Ratio; SGR: Specific Growth Rate; SVR: Survival Rate.

DISCUSSION

The superior growth performance of goats on cowpea shaft diets highlights the potential of this residue as a valuable feed resource for WAD goats. The higher crude protein content in cowpea shaft likely contributed to improved BWG, as dietary protein is essential for tissue synthesis, enzymatic function, and metabolic activity (Devendra & Sevilla, 2002; McDonald *et al.*, 2010). Similar findings were reported by Tarawali *et al.* (1997), who observed improved liveweight gains in ruminants fed legume haulms compared with grass forages.

The comparable FCR between treatments suggests that goats utilized both feeds efficiently, but the slightly higher BWG in T2 implies superior nutrient density and biological value of cowpea shaft (Adeyemi *et al.*, 2020; Akinfemi *et al.*, 2016). This aligns with reports by Osakwe and Steingass (2014), who demonstrated improved nutrient digestibility in goats fed cowpea haulms compared to grass diets.

Although ADFC was marginally higher in T1, goats in T2 still gained more weight, confirming that nutrient concentration and quality matter more than sheer feed volume (Kassahun *et al.*, 2020; Smith *et al.*, 2018). Similar trends were reported by Okunlola *et al.*, (2019), where goats fed groundnut haulms achieved greater BWG despite lower feed intake compared with grass-fed controls.

The higher survival rate in T2 reflects better metabolic utilization competence, possibly due to improved protein and mineral nutrition. Adequate protein enhances antibody synthesis and disease resistance (Yakubu *et al.*, 2010; Peacock, 2005). Improved survival is critical for smallholder farmers, where high mortality often undermines productivity and profitability.

From a practical standpoint, the use of cowpea shaft in goat feeding systems reduces dependence on conventional forages and prevents waste of crop residues (Akinmoladun *et al.*, 2019; FAO, 2019). The cowpea shafts were gotten free of charge thus reducing cost of feeding. This strategy also supports climate-smart agriculture by recycling agricultural by-products into productive use. The only limit to the use cowpea shaft is that it is not available

all year round. Cowpea are grown from August to November in the South. The cowpea shaft can only be used for dry season feeding.

CONCLUSION AND RECOMMENDATION

Feeding cowpea shaft improved BWG and survival of WAD goats compared to elephant grass. The higher crude protein content of cowpea shaft was key to enhanced growth and overall performance. Smallholder farmers should incorporate cowpea shaft into goat diets, particularly during the dry season. Extension services should disseminate knowledge on processing and feeding techniques. Further studies should evaluate reproductive performance, long-term productivity and economic returns of feeding cowpea shaft.

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