

EFFECTS OF WILD PURSLANE (*Portulaca oleracea* L.) SUPPLEMENTATION ON NUTRIENTS DIGESTIBILITY, RUMEN METABOLITES AND NITROGEN BALANCE IN YANKASA RAMS

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ABSTRACT

Over dependence on low digestibility feeds is a major challenge in the productivity of small ruminants in developing countries, especially during the dry season when feed scarcity often prevents animals from meeting their maintenance requirements. Poor nutrition remains the key factor limiting small ruminants production in Nigeria. This study evaluated nutrient digestibility, rumen metabolites, and nitrogen balance of Yankasa rams fed Guinea grass supplemented with wild purslane (*Portulaca oleracea* L.). Twenty Yankasa rams with an average weight of 15.7 kg were used in a 90-day trial. The animals were sourced from a local market in Adamawa State, adapted for seven days, and allotted to four treatment groups in a Randomized Complete Block Design. The dietary treatments consisted of Guinea grass supplemented with wild purslane at 0, 100, 200, and 300 g for T₁, T₂, T₃, and T₄, respectively. Results showed that rams on T₄ had significantly ($P < 0.01$) higher dry matter, acid detergent fiber, and neutral detergent fiber digestibility. Fecal nitrogen content and nitrogen losses were also significantly ($P < 0.05$) higher in T₄. Rumen ammonia nitrogen (NH₃-N) differed significantly ($P < 0.05$), with higher values observed in T₄, whereas total volatile fatty acids (TVFAs) were significantly ($P < 0.05$) higher in the control group (T₁). Rams fed T₃ recorded significantly ($P < 0.05$) higher total rumen nitrogen. It was concluded that Wild purslane can be used as supplementary forage to Guinea grass, with 200 g supplementation providing improved nutrient digestibility without adversely affecting rumen fermentation. Therefore, supplementation at 200 g is recommended.

Keywords: Nutrients, Digestibility, Rumen metabolites, Nitrogen balance, Wild purslane

INTRODUCTION

One of the major factors limiting the productivity of small ruminants in developing countries is over dependence on low digestibility feeds which during the dry season cannot meet even the maintenance requirements of these animals. Poor nutrition is one of the major factors limiting the productivity of small ruminants in Nigeria and other countries within the arid and semi-arid region of Sub-Saharan West Africa (Urbanus, 2014). During the dry season, fodder quality is often poor, especially in terms of crude protein (CP) concentration (Muhammed *et al.*, 2024). Consequently, the intake of both energy and protein from pasture by the animals decreases considerably during the dry season (Nyako, 2010). The major problem has been that, while there has been increasing demand for meat, milk and eggs, there has been no corresponding increase in the amount of feedstuff required to feed animals which are expected to produce meat, milk and eggs.

Feed accounts for 60 – 70 % of total cost of livestock production and its inadequacy in quality and quantity could lead to a situation of low nutritional status, poor

weight gain, poor reproductive ability, poor production, poor health condition and poor conversion ratio (Fajemisin *et al.*, 2015). Nyako (2010) pointed out that there has been a growing trend in many regions throughout the world to identify potentially important feed sources among shrubs and tree leaves and to explore possibilities of including them in ruminant diets. Panicum maximum is a palatable species with high dry matter yield and ease of establishment and is widely cultivated as pastures for producing good quality hay (Muraina *et al.*, 2016; Akinola, 2018; Ewetola, 2018). Purslane (*Portulaca oleracea* L.) is a common weed that grows wild all over the world and is one of the most widespread weed species in summer crops which may reach 40 cm in height (Okafor & Ezejindu, 2014).

Wild Purslane (*Portulaca oleracea* L.) leaves and stem contain a significant amount of antioxidants and phytochemicals that can boost the immune system of the rams, making them more resistant to diseases and infections (Akshay *et al.*, 2017). Because forages increase microbial activity and the pH of the rumen, they are a natural and primary source of diet for

ruminants. Purslane is identified as an excellent source of omega-3 fatty acids, antioxidant, vitamins and essential amino acids (Trupti *et al.*, 2018). Therefore, there is a need for research on the effects of Wild purslane supplementation on digestibility, rumen metabolites and nitrogen balance in Yankasa rams.

MATERIALS AND METHODS

Experimental Site

This study was conducted at the Teaching and Research Farm of the Department of Animal Science and Range Management, Modibbo Adama University, Yola Adamawa State. Yola is located in the Northeastern part of Nigeria. It is situated within the Savannah Region and lies between the range of latitude 9°21'13"N, and longitude 12°30'11"E and altitude of 152 m above sea level (Bulus, 2014).

Experimental Animals and their Management

Twenty (20) Yankasa rams with an average live weight of 15.7 kg were used for this study which lasted for 90 days. The animals were sourced from the local market of in Adamawa State. They were dewormed and chemoprophylaxis was administered to them prior to the experiment as according to the procedure of Ibiam *et al.* (2025). The animals were allotted to four (4) dietary treatment groups with five rams per treatment as replicates in a Randomized Complete Block Design (RCBD). They were fed individually twice daily at 8:00 to 8:30 a.m. and 3:30 to 4:00 p.m., housed with adequate ventilation and offered with water ad libitum. The experimental diets consist of Guinea grass supplemented with different levels of Wild purslane as; T₁ – 0 g Wild purslane (control), T₂ – 100 g Wild Purslane, T₃ – 200 g Wild Purslane and T₄ – 300 g Wild Purslane. However, 200 g of maize bran was given to each ram per day.

Nutrient Digestibility Study

At the end of the feeding trial, three rams were randomly selected from each treatment group and housed in metabolic crates for easy collection of faecal and urine samples as described by Aruwayo *et al.* (2025). The samples of feces collected were oven-dried to a constant weight, grounded with pestle and mortar and stored in a plastic container for analysis.

Chemical Analysis

The feed and fecal samples were subjected to Van soest analysis to determine the proximate composition using the procedures outline by Association of Official Agricultural Chemist (AOAC, 2020). Acid detergent fibre (ADF) and neutral detergent fibre (NDF) were determined using the methods of Van Soest method (1967).

Rumen Liquor Collection

Rumen fluid was collected from each ram at the end of the experiment at 0 and 4 h post feeding. Suction tube was used in the rumen fluid collection. The first few ml were discarded to reduce saliva contamination. The pH of the rumen fluid was determined using digital pH meter immediately after collection in the farm. The samples were then put in a 30 ml bottle and stored in a refrigerator (-4°C) for the analysis of ammonia nitrogen using simple micro Kjeldahl distillation (AOAC, 2005) procedure, and total volatile fatty acids was determined by Gas Chromatography (Cottyn & Bonque, 1968).

Data Analysis

The data collected was subjected Analysis of Variance (ANOVA) using SAS package (SAS, 2022 Version 9.0) according to (Steel and Torries, 1980) in a Randomized Complete Block Design (RCBD) and the Least Significant Difference (LSD) was used to separate the means at P<0.05 level of significance.

RESULTS AND DISCUSSION

The results of nutrient digestibility in Yankasa rams fed Guinea grass supplemented with wild purslane are presented in Table 1. In this study, wild purslane significantly (P<0.05) influenced nutrient digestibility in rams. Animals on T₄ recorded significantly (P<0.01) higher mean digestibility values for dry matter (DM), neutral detergent fiber (NDF), and acid detergent fiber (ADF). The dry matter digestibility values (41.44–56.22 %) obtained in this study are higher than the 49.78–50.86 % reported by Ajiji *et al.* (2013) in Yankasa rams fed *Andropogon gayanus* (Gamba grass) hay supplemented with *Faidherbia albida* pods. The improved nutrient digestibility observed here might be due to the fact that Wild purslane contains appreciable soluble nutrients and secondary metabolites that may stimulate rumen microbial activity leading to improved breakdown of feed particles and this was supported by Ochepo *et al.* (2015). The crude protein digestibility (CPD) values (57.43–61.96 %) fall within the range of 21.18–64.14 % reported by Adamu *et al.* (2013) in Yankasa rams fed varying proportions of *Gmelina arborea* leaves. This may be attributed to better protein quality and availability in wild purslane, which enhances microbial protein synthesis in the rumen. The crude fiber digestibility (CFD) recorded in this study (30.60 – 38.94 %) is higher than the 10.32 – 28.32 % reported by Nyako *et al.* (2015), this variation may be explained by the relatively lower lignin content and higher cell wall degradability of wild purslane. Additionally, the higher enzyme activity in the rumen, likely due to better colonization of fiber by fibrolytic microbes, would have contributed to improved fiber utilization. Similarly, the ether extract digestibility (EED) values (45.86 – 71.96 %) were higher than the 14.12–57.75 % reported by Adamu *et al.* (2013). Overall, the findings of this study indicate positive improvements in nutrient digestibility associated with enhanced enzyme activities. Such improvements may result from increased colonization of feed due to higher

populations of ruminal fibrolytic microbes (Adamu *et al.*, 2013), greater abundance of non-fibrolytic microbes (Abdulhameed *et al.*, 2013), accelerated fiber degradation in the rumen (Fadiyimi *et al.*, 2010), enhanced microbial protein synthesis (Sani *et al.*, 2020), and improved total tract digestibility (Gado *et al.*, 2011).

Table 1: Nutrient Digestibility of Yankasa rams fed Guinea grass supplemented with Wild Purslane (*Portulaca oleracea* L.) leaves and stem

Parameters (%)	Treatments				SEM
	T ₁	T ₂	T ₃	T ₄	
Dry matter (DMD)	41.44 ^b	41.81 ^b	54.38 ^a	56.22 ^a	1.01**
Crude protein (CPD)	57.43 ^c	59.25 ^{bc}	61.01 ^{ab}	61.96 ^{ab}	1.20*
Ash (ASHD)	58.76 ^d	63.65 ^c	65.57 ^{bc}	72.24 ^a	0.82*
Ether extract (EED)	45.86 ^c	47.92 ^{bc}	57.83 ^b	71.96 ^a	0.82*
Crude fibre (CFD)	30.60 ^c	32.87 ^b	37.02 ^a	38.94 ^a	0.27*
NDF	17.22 ^b	18.66 ^b	35.32 ^a	40.28 ^a	1.42**
ADF	21.79 ^a	24.70 ^a	28.79 ^a	30.58 ^a	1.34**
Hemicellulose (Hemi)	42.23 ^c	47.07 ^b	49.92 ^a	50.64 ^a	0.92*

Means within the same row with different superscripts differs significantly; *P<0.05 = Significant different; **P<0.01 = Highly Significant different; SEM = Standard Error Mean; LSD =Least significant difference; DMD = Dry Matter Digestibility; CPD = Crude Protein Digestibility; ASHD = Ash Digestibility; EED = Ether Extract Digestibility; CFD = Crude Fibre Digestibility; NDF= Neutral Detergent Fibre; ADF= Acid Detergent Fibre

Table 2: Nitrogen balance of Yankasa rams fed Guinea grass supplemented with wild purslane (*Portulaca oleracea* L.) leaves and stem

Parameters (%)	Treatments				SEM
	T ₁	T ₂	T ₃	T ₄	
Nitrogen intake (g/d)	2.97	2.97	2.97	2.97	0.00
Faecal nitrogen (g/d)	0.21 ^b	0.22 ^b	0.30 ^a	0.31 ^a	0.01*
Urine nitrogen (g/d)	0.29	0.30	0.30	0.30	0.01*
Nitrogen losses (g/d)	0.50 ^c	0.51 ^b	0.60 ^a	0.61 ^a	0.01*
Nitrogen absorbed (g/d)	2.76 ^a	2.76 ^a	2.67 ^b	2.66 ^b	0.01*
Nitrogen retained/balance (g/d)	2.47 ^a	2.46 ^a	2.37 ^b	2.36 ^b	0.01*
Nitrogen balance as % of (%)	83.27 ^a	82.92 ^a	79.66 ^b	79.44 ^b	0.41*

^{ab} = Means of different superscripts are significantly different, SEM: Standard Error of Means

Results of the nitrogen balance are presented in Table 2. The nitrogen intake of ram did not show any (P>0.05) significant differences across the treatments. Nitrogen intake recorded (2.97 to 2.97 %) is lower than 4.3 to 5.5% reported by Yakubu *et al.* (2017) in Uda lambs fed locust beans pulp litter and urea. The variations observed in nitrogen intake may be caused by the differences in diet composition and that of the breed. The fecal nitrogen content of rams placed on T₄ had significantly (P<0.05) higher mean value than the other treatments but statistically similar with those placed on T₃. The faecal nitrogen and nitrogen loss are higher in animals on treatment four diets. This is showing inability of the animal to utilize the nitrogen consumed. Faecal nitrogen recorded (0.21 to 0.31 %) in this research was higher than the value 0.1 to 0.2 % recorded by Fadiyimu *et al.* (2010) in ram fed diets

with different levels of *Moringa oleifera* as supplement to *Panicum maximum*. The differences observed might be attributed to the fact that Wild purslane contains anti-nutritional factors (e.g., oxalates, tannins) that may reduce protein digestibility, leading to higher nitrogen loss through faeces compared to the more digestible protein in *Moringa oleifera* leaves. The higher faecal nitrogen excretion indicates that the animals are losing more nitrogen, which reduces the efficiency of dietary protein use for growth or maintenance. The nitrogen balance recorded (79.44 to 83.27 %) in this study is lower than 83.41 to 89.43 % which was reported by Abdel-Hameed *et al.* (2013) using untreated and urea treated Groundnut haulms with different protein sources. This is likely because wild purslane and Guinea grass supply protein that is less digestible than groundnut haulms supplemented with urea and other protein sources. Urea rapidly releases ammonia for microbial protein synthesis, improving nitrogen retention. However, Purslane contains oxalates and other secondary metabolites that may interfere with nitrogen metabolism and protein utilization, lowering nitrogen retention efficiency. With regards to that, Yakubu *et al.* (2017) reported a similar trend. The Wild purslane does not influenced (P>0.05) urine nitrogen contents. Moreover, ram on T₄ had significantly higher (P<0.05) mean value of nitrogen losses when compared with rams on the other treatment groups. Rams placed on T₁ were significantly (P<0.05) recorded with higher mean values of nitrogen absorbed, nitrogen retained and nitrogen balance, respectively. Nitrogen retention is a major indicator used to assess the protein nutritional status of ruminant livestock (Abdu *et al.*, 2012). The decrease in nitrogen absorbed and retained as percentage intake in rams with increase of Wild purslane levels was not in agreement with the report of Sarwar *et al.* (2003) that nitrogen retention depends on good digestibility of nutrients and/or utilization. The nitrogen retention recorded (2.36 to 2.47 %) is lower than 5.7 to 6.4 % reported by Ashiru *et al.* (2017). This could be due to differences in forage–concentrate ratios. Diets with higher concentrate levels provide rapidly degradable protein and energy, which may lead to increased microbial activity and subsequent nitrogen loss in faeces and urine (Fadiyimu *et al.*, 2010). Lower nitrogen retention indicates that a smaller proportion of dietary protein is being converted into body tissue, which can negatively affect growth and productivity. The results of the rumen metabolites are presented in Table 3. According to the result of the study, the mean value of rumen NH₃-N differed significantly (P<0.05) in rams placed on T₄. The mean values of NH₃-N among the treatment groups are within the normal range which was reported by (Abdurrazak *et al.*, 2014). Total volatile fatty acids (TVFAs) were significantly (P<0.05) higher in rams fed the control (T₁) diet and this imply that the control diet (T₁) supported more favorable fermentation compared with supplemented diets. The TVFA values obtained in this study (13.88 – 14.34 mmol/l) differed from the ranges of 14.00 – 56.11 mmol/l and 47.8 – 56.4 % molar proportions of TVFAs

reported by Abdullahi (2021) and Woyengo *et al.* (2004), respectively. Variations in values may be attributed to the physical fibrousness, starch content, and carbohydrate solubility of various dietary treatments employed in various researches.

Table 3: Rumen metabolites of Yankasa rams fed Guinea grass supplemented with wild Purslane weed (*Portulaca oleracea* L.)

Parameters	Treatments				SEM
	T ₁	T ₂	T ₃	T ₄	
NH ₃ Nmg/100 ml	31.20 ^b	30.95 ^c	30.40 ^d	31.95 ^a	0.15
TVFAs mg/L	14.34 ^a	13.97 ^b	14.15 ^b	13.88 ^c	0.08
Total Nitrogen %	2.87 ^b	2.68 ^b	2.96 ^a	2.88 ^a	0.03
Rumen Ph	6.53	6.60	6.57	6.52	0.18

Means within the same rows with different superscripts differ significantly (P<0.05); SEM=Standard error of means; NH₃N=Ammonia nitrogen; TVFTs=Total volatile fatty acids

Sequel to that, Dung *et al.* (2011) reported that the proportion of major partials of volatile fatty acid concentration in the rumen depends largely on the type of feed consumed by the animals. Since TVFAs are the primary energy source for ruminants, reduced concentrations could translate into lower growth performance, feed efficiency, or productivity compared with diets that yield higher TVFA levels. Moreover, rams fed T₃ showed a significantly (P<0.05) higher mean value of total nitrogen whereas the rumen pH did not showed any (P>0.05) difference amongst the treatment groups. The rumen pH (6.52 - 6.60) reported in this research is within the normal range of 6.00-7.20, which is ideal for rumen bacteria' optimum development and activity (Jallow and Hsia 2011). The values were comparable to 5.92 - 6.60 reported by Okoruwa *et al.* (2016) on the rumen metabolites of West African Dwarf Sheep and lower than 7.86 - 8.70 reported by Binuomote *et al.* (2022) who examined the rumen parameters of West African Dwarf Sheep fed *Panicum maximum* supplemented with varying concentrations of *Gmelina aborea* leaves.

CONCLUSION

While wild purslane supplementation improved nutrient digestibility, its effects on nitrogen retention and TVFA production suggest that it should be included with caution and possibly in combination with other protein and energy sources to optimize utilization.

Based on the results of this study, it's recommended that;

- i) Wild purslane can be incorporated as a supplementary forage to Guinea grass at moderate levels (200 g) to improve nutrient digestibility without compromising rumen fermentation.
- ii) Excessive inclusion (300 g) should be avoided as it may increase nitrogen losses and reduce nitrogen utilization efficiency.
- iii) Since wild purslane may contain anti-nutritional factors that reduce protein digestibility, treatment methods such as drying, soaking, or combining with high-quality protein sources (e.g., oilseed

meals, leguminous forages) are recommended to improve nitrogen retention.

- iv) To counter reduced TVFA production in purslane diets, supplementation with readily fermentable carbohydrate sources (e.g., cereal grains or molasses) is advised to enhance rumen fermentation and energy supply.
- v) Farmers can use wild purslane as a locally available and cost-effective feed resource to improve forage utilization, but it should not serve as the sole supplement. A balanced diet will yield better growth and productivity.

Conflict of interest: The authors declare no conflict of interest.

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