

Feeding Wild Sunflower (*Tithonia Diversifolia* Hemsl., A. Gray) to West African Dwarf Goats as a Dry Season Forage Supplement

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Abstract A study was conducted to investigate the nutritional response of West African Dwarf (WAD) goats offered a concentrate diet containing Wild sunflower leaf meal, as a dry season feed supplement. Twenty WAD goats with age range of 5 – 7 months, weighing approximately 6.94 ± 0.37 kg were randomly allotted to a concentrate diet containing graded levels of Wild sunflower leaf meal (WSLM) at 0, 10, 20 and 30% levels of inclusion, offered as supplement to a guinea grass basal diet, in a completely randomized design. The experiment, which lasted 16 weeks, measured the nutritional performance indices of the WAD goats such as Feed intake, Weight gain, Digestibility, Nitrogen utilization and Feed conversion ratio. Results obtained indicate no significant difference in the dry matter intake (DMI), weight gain and dry matter digestibility of the goats on the different diets. However, the crude protein digestibility and nitrogen utilization of goats on 0% and 10% WSFLM inclusion were higher than those on 20% and 30% WSLM diet. It was concluded that wild sunflower leaf meal can serve as a forage supplement to the WAD goats up to 30% level of inclusion without any deleterious effect.

Keywords: digestibility, nitrogen utilization, WAD goat, wild sunflower leaf meal

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1. Introduction

The major constraint to ruminant livestock production in the tropics is the availability of cheap and quality feedstuffs, especially in periods of drought or dry season. The increasingly expensive nature of most feed ingredients has resulted in reduced livestock production activities by the ordinary peasant farmers who constituted the majority of the livestock holder, and this has impacted negatively on the available animal protein for human consumption.

Feed alone has been reported to account for 60-80% of the total cost of any livestock production [1]. Although, grasses abound in the tropics, seasonal changes in their palatability and nutritive values have been a major challenge in ruminant animal production [2]. The desire of most ruminant livestock producers have been towards the search for mostly, cheaper feed ingredients that are readily available for the better part of the tropical season and have no competition with man’s dietary demands. This therefore necessitates the search for alternatives to conventional feed resources that have hitherto been regarded as “weeds” due to their poor or low utilization in the livestock feed industry. Such alternative feed resources include Mimosa [3], Vetiver [4], Tephrosia [5] and *Tithonia* [6]. Although utilization of leaf meals of legumes

such as wild sunflower, mimosa, calopo, gliricidia, as source of protein and/ or energy in livestock nutrition have been investigated, most of these studies have been concentrated on monogastric livestock ([3,6,7,8]).

Wild sunflower (*Tithonia diversifolia*) is a weed of cultivated crops, wasteland and road sides. It could be cultivated by resource poor farmers who could manipulate planting density to achieve maximum yield [9]. The plant is an early colonizer at the start of rains and is capable of growing late into the dry season when most forages are no longer available due to drought [10]. This plant has some attributes to qualify it as a cheaper substitute to conventional resources. It is abundant in nature, it has limited processing demand and it is not in competitive demand for human consumption [11]. Limited information exists on the effect of wild sunflower meal on the growth, digestibility and nitrogen utilization of WAD goats, hence this study. The aim of this study, therefore, was to determine the effect of feeding a concentrate supplement containing Wild sunflower leaf meal (WSFLM) on the nutritional response of West African Dwarf (WAD) goats.

2. Materials and Method

The experiment was carried out at the Sheep and Goat Unit of the Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife. Twenty growing West

African Dwarf (WAD) goats weighing approximately 6.94 ±0.37 kg, with age range between 5 and 7 months were used for this study. Goats were randomly allotted to four treatments in a completely randomized design, with replicates of five goats per treatment. The goats were housed in an open - sided, well-lighted and adequately ventilated building with concrete floor that had been previously disinfected with Sodium hypochlorite. The concrete floor was covered with 5 cm layers of wood shavings to absorb urine and for easy removal of faeces. Provision of fresh feed and water were done daily.

2.1. Processing of Wild Sunflower Leaf Meal

Wild sunflower leaves were harvested prior to flowering in, and around the Teaching and Research Farm. The harvested leaves were spread on a concrete slab and air dried for seven days and then ground in a laboratory mill with 4.0 mm sieve size and stored for later use.

2.2. Experimental Diets

Four concentrate diets were compounded comprising 0, 10, 20 and 30% levels of inclusion of wild sunflower leaf meal (WSLM) and fed to the WAD goats (Table 1). The formulated concentrate diets were fed at 40% of the total feed on offer with the basal ration of guinea grass (*Panicum maximum*) making up the remaining 60%. The concentrate diets were offered to the goats first, before they were allowed access to the guinea grass ration. Feeding was done for a period of 112 days. Goats were transferred to metabolism cages with facilities for separate collection of urine and faeces for digestibility trial, towards the end of the growth studies.

2.3. Digestibility Trial and Nitrogen Utilization

Digestibility trial was carried out at 14th and 16th week of the experimental period. Faeces and urine were collected daily before the morning feeding. Feed and water were offered ad-libitum for the 14 – day period. Ten percent of faecal samples were taken per day and dried in a forced-draught oven at 70°C for 48 hours. At the end of the digestibility trial, daily stored samples of faeces were bulked, thoroughly mixed, ground and sub-sampled for chemical analysis. The volume of urine voided were also measured daily for the 14 – day period. Volatilization of nitrogen from urine was prevented by introducing 0.1N of HCl into the urine container. 10% of the daily urine voided was taken and stored for later analysis. Data on feed intake, fecal and urine output were collected and

used to estimate the digestibility coefficients of nutrients and nitrogen balance according to the method of [12].

2.4. Measurements

Each animal was weighed using hanging scale before the commencement of the study and weekly, throughout the experimental period. Experimental diets were fed to the animals for a period of sixteen weeks. Forages and treatment diets were also weighed daily and the feed left-overs were weighed to estimate daily feed intake.

2.5. Chemical Analysis

All samples of feeds and faeces were dried in an oven at 70°C for 72 hours and sub samples taken and ground using laboratory mortar and pestle. The samples were analyzed for proximate and fibre composition using the method described by AOAC [13]. Crude protein (CP) was analyzed with the aid of a Kjeltec system digester (Tecator Model 1007) and Kjeltec distilling unit (Tecator Model 1002).

2.6. Statistical Analysis

Data obtained were statistically analyzed with the General Linear Model of SAS [14] and the Duncan New Multiple Range Test of the same package was used to test for any significant differences among the treatment means.

3. Results and Discussion

Table 1 shows the chemical composition of wild sunflower leaf meal (WSLM) and *Panicum maximum*. The result suggests that the WSLM may serve as an alternative protein feed source for ruminants [15], especially towards the dry season. The crude protein, crude fibre, ether extract and ash values obtained for the wild sunflower leaf in this study were similar to the values reported by Fasuyi *et al* [16]. Proximate analysis of *Panicum maximum* used in this study was observed to contain 8.10 CP, 26.12 CF, 8.72 ether extract and 9.80 ash all on g/100 g DM basis, which is indicative of the actively growing phase of the grass before lignification sets in, as evident in its relatively low lignin value (2.84 g/100 g DM). The values of the proximate analysis recorded for *Panicum maximum* in this study were higher than those obtained by Alasa *et al* [17]. The difference in values may be as a result of age of the grass and season of harvesting. The values in the present study were similar to the reported values of FAO [18] and Bamikole *et al* [19] where they reported crude protein value of between 7.20 - 8.25% CP for *Panicum maximum*.

Table 1. Chemical composition of wild sunflower leaf meal and *Panicum maximum*

Parameter (g/100g)	Wild sunflower leaf meal	<i>Panicum maximum</i>
Dry matter	85.37	26.26
Crude Protein	21.14	8.10
Crude fibre	18.90	26.21
Ether Extract	4.00	8.72
Ash	14.14	9.80
Nitrogen free extracts	41.82	47.10
ADF	43.25	49.18
NDF	63.20	69.44
Hemicellulose	19.95	20.26
Lignin	3.67	2.84

ADF: Acid detergent fibre

NDF: Neutral detergent fibre

Table 2. Gross composition of the experimental diets

Ingredients	Control	10% WSLM	20% WSLM	30% WSLM
WSLM	-	10.00	20.00	30.00
Maize	45.00	45.00	45.00	45.00
Soya bean	30.00	20.00	10.00	-
Palm Kernel Cake	18.00	18.00	18.00	18.00
Groundnut Cake	4.50	4.50	4.50	4.50
Bone meal	1.50	1.50	1.50	1.50
Salt	0.50	0.50	0.50	0.50
Vitamin	0.50	0.50	0.50	0.50
Total	100	100	100	100

Control: Concentrate diet without wild sunflower leaf meal

WSLM: wild sunflower leaf meal inclusion

The gross composition of the experimental diets is shown in Table 2 while the chemical composition of diets is shown in Table 3. The result of the chemical composition shows that wild sunflower has feed value suitable as livestock feed. All the diets had crude protein values above the 6-8% CP minimum requirement for ruminants [20]. Blending of roughages and concentrate as a complete diet enhanced feed consumption, live weight

gain and feed efficiency in animals [21]. The crude protein levels of the experimental diet was far above the 8% needed to provide the minimum ammonia levels required for microbial activity in the rumen [22]. Minson [23] reported that low cost concentrate diets with more than 8% CP could be a good maintenance ration for ruminant animals during dry season, and as such wild sunflower leaf meal could be useful as dry season feed.

Table 3. Chemical composition of diets fed to the experimental goats

Parameter (g/100g)	Control	10% WSLM	20% WSLM	30% WSLM
Dry matter	90.23	91.04	91.67	91.70
Ash	8.43	7.59	8.76	8.17
Crude Protein	17.20	15.60	15.50	15.46
Ether extract	8.19	7.97	7.37	7.19
Crude fibre	14.50	14.40	14.30	14.28
Nitrogen free extract	51.68	54.44	54.07	54.90
Organic matter	91.57	92.41	91.24	91.83

Control: Concentrate diet without wild sunflower leaf meal

WSLM: wild sunflower leaf meal inclusion

Table 4. Mean nutrient intakes (g/day) by WAD goats fed experimental diets

Intake (g/day)	Control	10% WSLM	20% WSLM	30% WSLM	SEM*	P value
Dry matter						
Concentrate	208	208	206	205	3.59	0.9233
Panicum maximum	103.5	102.5	100.4	100.2	1.26	0.2340
Total	311.5	310.5	306.4	305.2	3.87	0.6949
Crude protein						
Concentrate	35.75 ^a	32.45 ^b	31.93 ^b	31.69 ^b	0.38	0.0001
Panicum maximum	8.36	8.30	8.13	8.12	1.10	0.0622
Total	44.11 ^a	40.75 ^b	40.06 ^b	39.81	1.01	0.0001
Crude fibre						
Concentrate	30.16	29.95	29.46	29.27	0.95	0.9402
Panicum maximum	27.04	26.87	26.74	26.28	0.36	0.9705
Total	57.20	56.82	56.10	55.55	0.74	0.9568
Ash						
Concentrate	18.04	17.53	16.75	15.79	0.30	0.1829
Panicum maximum	10.11	10.05	9.84	9.81	0.12	0.1754
Total	28.15	28.18	26.59	25.60	0.37	0.0665

^{a, b}: Means within row with different superscript are significantly different (P < 0.01)

Control: Concentrate diet without wild sunflower leaf meal;

WSLM: wild sunflower leaf meal inclusion; *: Standard error of mean

Table 4 shows the mean nutrient intake (g/day) of WAD goats fed the experimental diets. The intakes of Panicum maximum forage by the goats were similar across the treatments. Similarly, their total mean daily dry matter intake (DMI g/day) were also similar across the different diets but the values obtained in this study were lower than those reported by Ahamefule and Elendu [24] where intake ranged between 357 g/day and 456 g/day for West African Dwarf (WAD) goats fed cassava leaf-maize offal based diets. The mean total daily Crude Protein Intake (CPI g/day) of goats fed Control diet was higher than those on concentrates with WSLM inclusion. The CP intake ranged from 31.69% to 35.75% CP for goats on 30% WSLM and control diet respectively. This could be attributed to reduced palatability with increasing WSLM content as Matthewman [25] observed that animal's feed intake was greatly affected by the palatability and

digestibility of the feed. The slight reduction in feed intake with increasing level of WSLM in the diet might be due to the bitter taste associated with saponin which was quite abundant in the wild sunflower leaf [26]. Notwithstanding its effect on feed intake, feedstuffs containing saponin have been reported to be capable of reducing methane production [27], which makes the diet containing WSLM a good option in the current phenomenon of climate change. Meanwhile, the levels of saponin Wild sunflower as reported by [10] are within safe limits for ruminant consumption [26]. The mean total crude fibre intake, ether extract intake, organic matter intake and ash intake were not different across the diets.

Table 5 shows the apparent nutrient digestibility of the experimental diets by WAD goats. The nutrient digestibility values of the goats were similar across treatments except for crude protein where the goats on

10% WSLM and the control diet had a better performance (68.11% and 68.53% respectively) than those on 20% and 30% WSLM diets (62.62% and 57.97% respectively). The results obtained in this study was similar to the report of Ngi *et al* [28] who obtained a range of 54.01 – 64.49% CP

digestibility for Maradi × West African Dwarf cross bred goats fed mixtures of dried cassava leaf meal and maize offal, as dietary supplements to rice straw. However, the values obtained for the crude fibre were lower than that reported by Arigbede [29].

Table 5. Apparent nutrient digestibility of the experimental diets by WAD goats

Parameter	Control	10% WSLM	20% WSLM	30% WSLM	SEM*	P value
Dry matter	71.24	70.57	70.66	70.98	2.42	0.7935
Crude protein	68.53 ^a	68.11 ^a	62.62 ^b	57.97 ^b	1.75	0.0164
Crude fibre	62.84	62.04	61.99	61.53	1.75	0.5706
Ether extract	69.81	67.37	65.41	64.62	3.21	0.1616
Ash	71.25	68.99	70.74	69.86	1.93	0.7740

^{a, b}: Means within row with different superscript are significantly different (P < 0.05)

WSLM: wild sunflower leaf meal inclusion

*: Standard error of mean

Table 6. Mean nitrogen utilization of WAD goats fed experimental diets

Parameter (g/day)	Control	10% WSLM	20% WSLM	30% WSLM	SEM*	P
Nitrogen intake	7.59 ^a	6.84 ^a	5.83 ^b	5.76 ^b	0.03	0.0210**
Faecal nitrogen	2.39	2.18	2.16	2.42	0.39	0.6340
Urinary nitrogen	1.10 ^a	1.01 ^a	0.66 ^b	0.36 ^c	0.04	0.0012***
Nitrogen balance	4.10 ^a	3.65 ^a	3.01 ^b	2.98 ^b	0.37	0.0032***
Nitrogen retention (%)	54.02 ^a	53.36 ^a	51.62 ^b	51.74 ^b	2.72	0.0223**

^{a, b, c}: Means within row with different superscript are significantly different *** (P < 0.01); ** (P < 0.05)

WSLM: wild sunflower leaf meal inclusion

*: Standard error of mean

The results for nitrogen utilization of the goats fed experimental diets are presented in Table 6. Faecal nitrogen of the animals was similar, with a range of 2.16 – 2.42 g/day (in 20% WSLM and 30% WSLM respectively). Urine nitrogen was least in goats fed 30% WSLM (0.36 ml/day) and highest (1.10 ml/day) in goats fed the control, although the values recorded for those on 10% WSLM and control are similar. On the overall, Nitrogen retention was better in animals on 10% WSLM and Control diet with values of 53.36 and 54.02% respectively. The reason for the reduced Nitrogen retention in goats on 20% WSLM and 30% WSLM can be attributed to the anti-nutritive components of Wild sunflower [10], as Nitrogen retention decreases with increasing level of inclusion of WSLM. Notwithstanding the variation in the utilization, all the diets indicated protein values that are in excess of the 6 – 8% requirement for ruminant animals [20].

Table 7 shows the performance characteristics of the WAD goats fed the experimental diets. Values for all the parameters measured were similar. Total feed intakes of the animals were similar, ranging from 305.2 – 311.5 g/day, an indication that the goats were well adjusted to

the experimental diets. The initial weight of the animals was well balanced at the start of the experiment, resulting in a mean value of 6.94 ± 0.37 kg across the treatments. The average weight gain and total weight gains of the WAD goats on the different diets were similar ranging from 26.12 g/day to 31.73 g/day and 2.56 kg to 3.11 kg respectively. The daily weight gains in this experiment compared well with the results of Ajayi *et al* [30] who obtained 23.81 – 46.64 g/day for WAD goats fed *Mangifera indica*, *Ficus thionningii* and *Gliricidia sepium* foliages when fed as concentrates supplements to basal diet of guinea grass (*Panicum maximum*). Ngi *et al* [28] reported a daily weight gain of 18.6 g -20.89 g/day for Maradi × West African Dwarf cross bred goats fed mixtures of dried cassava leaf meal and maize offal as dietary supplements to rice straw *ad libitum*. The values obtained for weight gain in this study were however lower than that reported by Oni *et al* [31] who obtained a daily gain of 33.8 – 52.9 g/day for West African Dwarf goats fed different levels of dried cassava leaves (*Manihot esculenta*)- based concentrates with *Panicum maximum*.

Table 7. Performance characteristics of WAD goats fed the experimental diets

Parameter	Control	10% WSLM	20% WSLM	30% WSLM	SEM	PROB
Intake (g/day)						
Concentrate	208.00	208.00	206.00	205.00	3.59	0.9233
P. maximum	103.50	102.50	100.20	100.20	1.26	0.2340
Total Feed Intake (g/day)	311.50	310.50	306.20	305.20	3.87	0.6949
Initial weight (kg)	6.94	6.94	6.94	6.94	1.06	1.0000
Final weight (kg)	9.65	10.05	9.60	9.50	1.53	0.9933
Total weight gain (kg)	2.71	3.11	2.66	2.56	0.02	0.1403
Average daily gain (g)	27.65	31.73	27.14	26.12	5.86	0.9145
Feed conversion ratio	11.27	9.78	11.28	11.68	0.57	0.2322

WSLM: wild sunflower leaf meal inclusion

feed ingredient in the WAD goat's diet with inclusion level of up to 30 % without any deleterious effect.

4. Conclusion

It can be concluded that wild sunflower possesses adequate nutritive value as to support good growth of West African Dwarf goats, especially during the period of drought and the forage can effectively serve as alternative

Statement of Competing Interests

The authors have no competing interests.

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