

# CHEMICAL COMPOSITION, ACCEPTABILITY OF THREE *TEPHROSIA* SPECIES AND USE OF *TEPHROSIA PURPEREA* AS SUPPLEMENT FOR GRAZING ANIMALS IN THE WESTERN HIGHLANDS OF CAMEROON

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## ABSTRACT

*The study was carried out to investigate the suitability of utilizing Tephrosia species in the feeding of small ruminant livestock. It involved the laboratory assessment of nutritive and anti-nutritive components of three Tephrosia species. Forage acceptability of the species using cafeteria method with eight adult goats and effect of feeding the most preferred specie to grazing goats. The species studied were T. candida (Roxb) D. C., T. purpurea (L) Pers, and T. vogelii (Hemsley) A gray. These values are within the ranges considered adequate for goats. The concentration of tannins, saponins, oxalic acid and phytic acid were low. Differences in the relative preference index (%) were significantly different with an average of 80.4 for T. purpurea, 67.7 for T. vogelii and 19.9 for T. candida. Total body weight of grazing animal supplemented with T. purpurea was significantly higher than those without supplement by 2.19kg. The results showed that these Tephrosia species have good level of nutrients save level of anti-nutritional factors and therefore can be used as supplement to animals grazing on poor paddocks.*

**Keywords:** *Browse, chemical composition, forage acceptability, goats, grazing, supplementation.*

## INTRODUCTION

Much of the feeds and the feedstuffs that are available for ruminants during the dry season are of low quality and have been described to be fibrous resulting in low digestibility and poor livestock productivity (Richard et al., 1994). In Cameroon, the usual practice is to supplement the livestock diets with protein rich ingredients such

as groundnut cake (GNC), soya-bean meal (SBM) and cotton seed cake (CSC). These ingredients are becoming scarce and expensive because of various competitive uses for them. A cheaper alternative of enhancing utilization of low quality grass is by supplementation with Multipurpose Trees and Shrubs (MPTS). *Gliricidia sepium* and *Leucaena leucocephala* appeared to be the most commonly used. At this level of acceptance, these plants still have some problems associated with their use. *Gliricidia Sepium* have limited acceptance among ruminants as it contains an offensive odour (Coumarin). *Leucaena leucocephala* on the other hand contains mimosine, an antinutritional factor that prevents the ad libitum use of the plant by ruminants.

According to Brewbaker (1986), *Tephrosia* spp belongs to the subfamily Papilionoideae and Tribe Tephroseae and has a large number of genera like, *candida*, *linearis*, *bracteolata*, *purpurea* etc dispersed through the tropics occurring also in South Africa Sub-tropical Australia, North America. The shrub has potentials of comparing well with other MPTS and can be an excellent source of nutrients to ruminants. They are notably dispersed throughout the tropics, subtropical Australia and North America. However, little information is available on the utilization of this plant as browse in ruminant feeding. Hence the study was to investigate the chemical composition of three *Tephrosia* species, their acceptability to goats and potential use as supplement to grazing goats.

## MATERIALS AND METHODS

**Experimental Site:** The experiments were conducted at the Institute of Agricultural Research for Development (IRAD), Mankon Station, Bamenda in the Western Highlands of Cameroon (WHC). The station lies at an altitude of 1300m above sea level. The annual average rainfall ranges from 1500 to 2000mm with some places exceeding 3000mm. The WHC is characterized by ferralitic soils derived from basic rocks, the texture ranges from sandy clay to clay. They are classified as haplic ferralsols in association with rhodic ferralsols (Yerima and Ranst, 2005). The soils are acidic (pH 5 - 6).

**Experiment 1: Assessment of acceptability of three *Tephrosia* spp. by goats:** The three *Tephrosia* spp. under investigation were *T. candida*, *T. purpurea* and *T. vogelii*. They were established in IRAD Mankon Bamenda. Eight West African dwarf adult goats were used in a cafeteria feed preference study that lasted two weeks. The animals were housed in-group pen, which had been constructed to achieve proper ventilation. The housing had a floor which was covered with wood shavings for easy cleaning and disposal of animal faeces and urine. During the first week animals were fed with all three *Tephrosia* spp. to enable them adapt to the feed. In the second week 2kg each of the three species was harvested fresh daily and introduced to the animals in three different wooden troughs. Each animal had free access to each of the browse species in the feeding trough. The positions of the feeding troughs were changed each day to avoid any conditioning and learning. The amount consumed was monitored for six hours each day and the quantity consumed recorded by subtracting the amount

consumed from among offered/provided. After six hours, final refusals were weighed and Guatemala grass (*Tripsacum laxum*) was offered to the animals. A daily relative preference index was calculated for each species by dividing consumption values for each browse species by the amount of feed offered and multiplying the result by 100 in order to express it as a percentage.

$$\% \text{ Preference Index} = \frac{\text{Feed on offer} - \text{Feed remaining}}{\text{Feed on offer}} \times 100$$

Browse species were ranked based on mean preference index.

**Chemical Analysis:** Dry edible forages samples consisting of leaves together with stems of less than 6mm diameter (Tarawali et al., 1995) were ground using a Willey mill (to pass through a 1- mm sieve) and the following analyses carried out: Tannin content was determined according to the method of Price et al. (1978). Saponin, crude protein (CP), crude fibre (CF), ether extract (EE), dry matter (DM) and ash contents were analyzed using methods described by the AOAC (1990). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were analyzed as reported (Goering and Van Soest, 1970). Hemicellulose was estimated as the difference between NDF and ADF. Oxalic acid was analyzed using the method of Fassett (1966). The analysis of phytic acid was done according to the method of Mega (1982). Crude protein was calculated as N x 6.25 and available P (in mg/kg) was determined by the Bray1P method (Bray and Kurtz, 1945). Mineral element was determined by atomic absorption spectrophotometer (AAS) model 490 Gallen Kamp London.

**Experiment 2: Feed Intake and Growth Rate of Goats Supplemented with *T. purpurea*:** Eight young growing West African Dwarf (WAD) goats (four bucks and four does) aged between 4 and 6 months with an average initial live-weight of 12.6 kg were included in a growth (performance) trial using *T. purpurea* as source of protein supplement. The use of *T. purpurea* was based on its preference in the acceptability trial. The animals were de-wormed before the start of the trial. The experimental site and housing was as in experiment 1. The animals were allowed 14 days for adaptation to the feed before the beginning of data collection. At 0900 hours the eight animals were tethered in a 1ha paddock dominated by *Brachiaria ruziziensis*.

For each goat 400g of freshly harvested *T. purpurea* was placed in a bowl and individually fed to four of the goats. The remaining four goats were not fed *T. purpurea* through out the study. Collection of feed remaining was carried out at 2.00 pm, then, all the animals were left free in the paddock. Feed offered and feed remaining from each animal was weighed. Intake was calculated as the difference between feed offered and feed remaining. Each goat was weighed at the beginning of the experiment and at the end of each week thereafter. Before weighing, the animals received no feed or water overnight from 21h00 to 09h00. Average daily weight gain (g/day) was calculated as differences between final and initial body weights divided by number of days of feeding. Fresh drinking water was available ad libitum as well as salt licks. The trial lasted for 105 days. ie (15 weeks). A t-test was used to compare grazing with *T. purpurea* as supplement and grazing without *T. purpurea*.

## RESULTS AND DISCUSSION

**Table 1:** Chemical composition of edible forage of *Tephrosia* species

Component	Species		
	T. candida	T. purpurea	T. vogelii
	%	%	%
Proximate composition			
Dry matter (DM)	29.00	33.00	31.00
Crude protein (CP)	22.11	24.10	22.50
Crude fibre (CF)	12.35	14.62	13.92
Ether extract (EE)	4.26	3.39	3.58
Ash	9.79	11.85	11.28
Nitrogen free extract (NFE)	46.72	44.70	43.87
Cell wall components			
Neutral detergent fibre (NDF)	63.19	61.39	59.74
Acid detergent fibre (ADF)	44.58	38.68	39.63
Hemicellulose (NDF - ADF)	18.61	22.71	20.11
Minerals			
Calcium (Ca)	1.58	1.53	1.10
Potassium (K)	0.97	1.57	1.90
Phosphorus (P)	0.22	0.31	0.28
Magnesium (Mg)	0.37	0.44	0.32
Anti-nutritional factors			
Tannins	0.175	0.438	0.329
Saponins	0.199	0.057	0.426
Oxalates	0.585	0.495	0.360
Phytates	0.206	0.125	0.165

**Table 2:** Forage preference of goats when fed three *Tephrosia* species

Species	Leftover herbage (g) <sup>1</sup>	Preference Index (%) <sup>2</sup>	Preference ranking
T. candida	1577.27	19.77c	3
T. vogelii	645.45	67.73b	2
T.purpurea	390.00	80.45a	1

<sup>1</sup>Data from leftover herbage averaged over 14-day feeding periods

<sup>2</sup>Values with the same letters are not significantly different ( $P < 0.05$ )

**Table 3:** Total live weight gains of grazing goats fed with or without *T. purpurea* supplement

Diet	Live weight gain (kg/head)
Grazing + <i>T. purpurea</i>	3.60
1Grazing	2.19
t-value	17.10 *
1 Grazing mainly <i>Brachiaria ruziziensis</i>	* Significant ( $P < 0.05$ )

**Chemical composition of edible forage of *Tephrosia* spp.:** Table 1 shows chemical composition of edible forage in experiment one. The dry matter (DM) content varied from 29% in *T. candida*, and 33% in *T. purpurea*. Crude protein (CP) content values were from 22.11% in *T. candida* to 24.10% in *T. purpurea* with Crude fibre from 12.35% in *T. candida* to 14.62 in *T. purpurea*. Ether extract (EE) was from 3.39% for *T. purpurea* to 4.26% *T. candida* while the ash content varied from 9.79% in *T. candida*, 11.28% for *T. vogelii* and 11.85% in *T. purpurea*.

The neutral detergent fibre (NDF) which is a measure of the plant cell wall material was 59.74% in *T. vogelii* to 63.19% in *T. candida* with acid detergent fibre (ADF) measuring 38.68% in *T. purpurea* to 44.58% in *T. candida*. The hemicellulose fraction was from 18.61% in *T. candida* to 22.71% *T. purpurea*. In respect of mineral

content, calcium was between 1.10% in *T. vogelii* and 1.58% for *T. candida*. Potassium (K) was 0.97% in *T. candida*, 1.57% in *T. purpurea* and 1.90% in *T. vogelii* while phosphorus (P) was 0.22% (*T. candida*), 0.28% (*T. vogelii*) and 0.31% (*T. purpurea*).

The anti-nutritional factor contents ranged as follows: Tannins from 0.175% in *T. candida*, 0.329% for *T. vogelii* to 0.438% for *T. purpurea*; saponins measured 0.057% for *T. purpurea*, 0.199% for *T. candida* and 0.426% for *T. vogelii* while oxalic acid content was 0.360% for *T. vogelii*, 0.495% for *T. purpurea* and 0.585 for *T. candida* and phytic acid was 0.125% in *T. purpurea*, 0.165% in *T. vogelii* and 0.206% in *T. candida*.

**Acceptability of three *Tephrosia* species by goats and the use of *T. purpurea* as supplement for grazing animals:** *Tephrosia purpurea* was the most preferred species by goats and *T. candida* the least. Table 2 shows the leftover feed herbage, relative preference index and the preference ranking of the species. The relative preference index of *T. purpurea* was four times that of *T. candida* and that of *T. vogelii* was three times that of *T. candida*. These differences were significant with *T. purpurea* exhibiting a significantly superior preference index to *T. vogelii* as well. Total live weight gains of grazing animals fed *Tephrosia purpurea* as supplement were significantly higher than the gains of animals which did not receive *T. purpurea* supplement (Table 3).

*Tephrosia purpurea* had the highest DM content at the same age among the three legumes under study implying higher rates of accumulation of DM by *T. purpurea* than the other two species. Dry matter content of *T. purpurea* and *T. vogelii* in the present study falls within the range of values of different species catalogued by Topps (1992) which were between 31.93 and 41.80%. The CP values viz 22.11% (*T. candida*), 24.10% (*T. purpurea*) and 22.50% (*T. vogelii*) were all above the minimum ruminant crude protein content requirement in tropical forage of between 7 and 8% below which voluntary intake falls (Norton, 1994). The differences among species may be ascribed to genotypic variation. The values also compare favourably with those recorded by Aletor and Omodara (1994) for forage legumes, which were between 25.27 and 25.44%. Among other determinants of protein or feed utilization in ruminants is the fibre content. The crude fibre contents of the three species were lower than the values reported by Babayemi et al (2004) for *T. candida* in Ibadan Nigeria. Concerning the cell wall constituents, the neutral detergent fibre (NDF) was highest in *T. candida* than the other two species. The difference between NDF and ADF is hemicellulose, which is degradable by rumen microbes. The higher the hemicellulose fraction, the higher is the feed value (Humphreys, 1991).

Thus, *T. purpurea* with the highest level of hemicellulose is likely to be the most preferred by ruminants as turned out to be the case in the cafeteria study. Ether extract and ash contents for the three *Tephrosia* spp. were similar and consistent with reported values for leguminous browse in Tropical West Africa (Le Houerou, 1980). The NFE values for the three *Tephrosia* species in this study were comparable to the values reported by Anugwa et al. (2000). Regarding minerals, the calcium contents in the three species were similar to those of other species of *Tephrosia* viz. *T. emeroide*

(1.73%), *T. uniflora* (1.73%) and *T. villosa* (1.50%) reported by Ogungbesan (2004). The potassium content of each of the three *Tephrosia* spp. in the present study was above the daily ruminant requirement of 0.50 - 0.80% DM. However, the values for *T. candida* and *T. purpurea* were lower than those of *Leucaena leucocephala* (1.86%) and *Sesbania grandiflora* (1.73%) but closer to that of *Gliricidia sepium* (0.96%) (Topps, 1992). The values for phosphorus content also meet the daily requirement of 0.16 - 0.37% and the highest was recorded in *T. purpurea* (0.31%) followed by *T. vogelii* (0.28%) and *T. candida* (0.22%).

The values were similar to the range of 0.28 - 0.30% of *Sesbania grandiflora* but higher than those of *Cajanus cajan* (0.16 - 0.26%) and *Leucaena leucocephala* (0.11 - 0.29%) (Topps, 1992). The magnesium contents were within the range of 0.04 to 1.00% DM requirement (NRC, 1981) but the values were lower than those of *Cajanus cajan* (0.16 - 0.26%) a leguminous browse as reported by Topps (1992). Among the anti-nutritional factors, the tannin content of the three *Tephrosia* spp. in the present study were considerably lower than the value of 2.05% reported for *Gliricidia sepium* (Ahn et al., 1989). A threshold concentration of tannin of 5% had been reported above which there is rejection of browse (Ologhobo, 1989). The saponin content too was also low as in other leguminous browse species. Oduguwa et al. (1998) reported values of 3.24% and 3.47%, for *Parkia biglobosa* and *Azelia africana*, respectively.

***Phytate and oxalate contents were low in the three Tephrosia spp. investigated:***

The reason for the differences in relative preference among the three *Tephrosia* spp. to goats is not clear, and could not be determined in this limited study because palatability or preference is a complex phenomenon determined by animal, plant and environmental variables (Molyneux and Ralphs, 1992). However, high preference or acceptability of *T. purpurea* may be partly attributed to its higher content of hemicellulose as previously noted because this chemical constituent is degradable and digestible these leading to higher rate of passage from the rumen leading to increased intake rates (Ogungbesan, 2004). *T. vogelii* was ranked second and *T. candida* was the least preferred a ranking that matches their ranking in respect of hemicellulose content. There are no reports on utilization of the *Tephrosia* species in the present study as a dietary supplement for livestock in Nigeria. The available reports on the species have been more of preliminary studies on composition, intake and digestibility (Adeloye, 1994; Ayoade et al., 1998).

## CONCLUSION

This study was conducted to evaluate the chemical composition of three *Tephrosia* species, their acceptability to goats and potential use as supplement to grazing goats. It was observed that the relative poor performance of grazing goats not given *T. purpurea* may be attributed to relatively low nitrogen or protein levels in their feed consisting mainly of grass dominated by *Brachiaria ruziziensis*. However, goats

receiving *T. purpurea* as supplement recorded higher liveweight gains suggesting that *T. purpurea* had beneficial effects on the animals. Legume supplementation has in fact been found to improve animal performance. Reports (NRC, 1995; Dzwela et al., 1997) indicate that animals on native pasture alone may even lose weight. However, goats grazing without supplement in the present study did not lose weight. The weight gains of the animals supplemented with *T. purpurea* were comparable to the reported values of 36.44 to 41.14g/day/animal (Ndemanisho et al., 1998) for goats raised on concentrate diets. As concentrate is expensive and not within the reach of resource poor farmers, *T. purpurea* would be a good substitute.

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