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Effects of supplementation with leaves of *Calliandra calothyrsus* and *Leucaena leucocephala* on goat production performance during dry and rainy seasons in the western highlands of cameroon

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ABSTRACT

A study of the effect of supplementary feeding of *Calliandra calothyrsus* and *Leucaena leucocephala* on goat production was conducted at Dschang University Research farm on 24 West African Dwarf goats aged between 2 and 3 years during the dry and rainy seasons. Two bucks were introduced to the herd for two consecutive months for breeding purposes after which the herd was divided in two groups. One group was subjected to supplementary feeding with equal quantity (800 g/goat/day) of *C. calothyrsus* and *L. leucocephala* leaves. The other group served as the control. Change in body weight of does and kids were monitored from onset of supplement till three months *post-partum*. Results revealed a reduced incidence of abortion and an increase in body weight in the groups receiving supplement. During the three months *post-partum* period the body weight decreased as compared to that recorded at parturition but the supplemented goats continued to have 11 to 15% more body weight than their respective control during the dry season whereas during the rainy season the difference between supplemented and non supplemented goats were not so pronounced. The average birth weight of the kids in the supplemented group (1.35 ±0.08 kg) was significantly ($p<0.05$) higher than in the control group (1.12 ±0.10 kg) during the dry season whereas the difference was not significant during the rainy season. At weaning age, the average kid weight in the supplemented group was significantly ($p<0.05$) higher than that in the control during both the dry (5.95±0.45 Vs 3.56±0.45 kg) and rainy (6.22± 0.33 Vs 4.64±0.19 kg) seasons. This indicates the effect of the scope and importance of the supplementation for goats particularly during the dry season.

Key words: West African Dwarf goat, *Calliandra calothyrsus, Leucaena leucocephala*, supplementation, growth, reproduction.

RESUME

L'étude de l'effet de la supplémentation aux feuilles de *Calliandra calothyrsus* et *Leucaena leucocephala* sur la productivité de la chèvre a été conduite à la Ferme d'Application et de Recherche de l'Université de Dschang sur 24 chèvres naines de Guinée agées de 2 à 3 ans pendant la saison sèche et la saison des pluies. Deux boucs fertiles ont été introduits dans le lot pendant deux mois pour les croisements. A la fin de la période, les animaux ont été divisés en deux lots. Un lot a été soumis à la supplémentation avec les feuilles de *Calliandra calothyrsus* et *Leucaena leucocephala* (800 g/animal/jour) dans les proportions 1:1. Le second lot a servi de témoin. Le poids des chèvres et des chevreaux a été évalué du début de la supplémentation au sevrage (3 mois *post partum*). Les résultats ont montré une réduction du taux d'avortement et une augmentation du poids chez les animaux du lot recevant le supplément. Pendant les trois mois *post partum*, le poids des chèvres a régressé par rapport à celui observé lors de la mise bas. Cependant les chèvres du lot supplémenté ont continué à peser en moyenne 11 à 15% de plus que les chèvres du lot témoin pendant la saison sèche alors que, pendant la saison des pluies, la différence entre le poids des chèvres du lot supplémenté et celui des chèvres du lot témoin n'était pas si prononcé. Le poids moyen à la mise bas des chevreaux du lot supplémenté (1,35 ± 0,08 kg) était significativement ($P<0,05$) plus élevé que celui du lot témoin (1,12 ± 0,10 kg) pendant la saison sèche alors que pendant la saison des pluies, aucune différence significative n'a été observée. Au sevrage, le poids moyen des chevreaux dans le lot supplémenté était significativement ($P<0,05$) plus élevé que celui du lot témoin à la fois pendant la saison sèche (5,95 ± 0,45 kg contre 3,56 ± 0,45 kg) et pendant la saison des pluies (6,22 ± 0,33 kg contre 4,64 ± 0,19 kg). Ceci indique l'effet et l'importance de la supplémentation pour ces animaux principalement pendant la saison sèche.

Mots clés: Chèvre naine de Guinée, *Calliandra calothyrsus, Leucaena leucocephala*, supplémentation, croissance, reproduction.

INTRODUCTION

The West African Dwarf Goat (WADG) is an integral component of Cameroonian livestock that contributes substantially to the national economy. The production potential of the WADG is however, very low [1], mainly because of lack of proper nutrition. Insufficient quantity, and low quality of the consumed forage restrict growth rate and reproduction in several ruminant species [2, 3, 4, 5]. Nitrogen content is generally low and fibre content is high both in grass and crop residues which form the basis of animal diet in most African countries, particularly during the dry season. Supplementation of these roughages is a promising approach towards alleviating nutrient deficiencies in ruminant livestock. Different kinds of supplementary feeding have been advocated to boost goat production [6, 7]. Among these, the use of leguminous tree leaves viz. *Calliandra* and *Leucaena* are of great interest because of their high biomass [8, 9], high potential for soil fertility [8, 10, 9], and as forage [11, 12, 13, 14]. The fodder trees, high in protein compared to grasses [15], remain green

longer into the dry season and have a nutritive value that varies little from one season to another.

Studies have revealed that leguminous trees with good fodder value like *Leucaena* and *Calliandra* have a vast potential for growth in sub-Saharan Africa including Cameroon [1]. However there is very little information viz the feeding of Multipurpose Leguminous Tree (MPLT) leaves on production of WADG in the Central Africa and particularly in Cameroon. The present study was, therefore, undertaken to evaluate the effects of the supplementary feeding of *Calliandra calothyrsus* and *Leucaena leucocephala* leaves on the growth and reproduction of West African Dwarf Goat.

MATERIALS AND METHODS

Study area

The study was carried out at the Animal Experimental Farm of Dschang University during the months of July 2001 to July 2003. The area falls within the sudano-guinean zone (latitude 5°26' N, longitude 10°26 E). The annual temperature varies between 16 and 27°C while the relative humidity is 40-97%. There are two main seasons: the rainy season (April to October) and the dry season (November to March). The altitude is 1400 m above sea level while the mean annual rainfall is about 2000 mm.

Animals

The first experimental phase started in July 2001. Twenty-four West African Dwarf Goats (WADG) aged between 2 to 3 years and weighing 17.1 ± 2.1 kg were used throughout the study period. The goats were purchased from the local market and were considered fertile because they had kidded at least once. They were housed in pens (5-7 goats/pen) and dewormed using Levamisol. After one month of adaptation to the natural pasture, two bucks were introduced into the herd for two consecutive months. At the end of this period, the animals were mixed and grazed on natural pasture until December when the bucks were again introduced into the herd for another 2 months. The second phase ended in July 2003.

Feeding

The goats were fed with *Trypsacum laxum ad libitum* and allowed to graze daily on a mixed pasture comprising *Brachiaria ruziziensis* and *Pennisetum purpureum* between 9 AM and 5 PM. Immediately after withdrawal of bucks, the goats were divided into two equal groups. The diet of the first group (average body weight was 16.6 ± 3.2 kg) was supplemented using the leaves of *Calliandra calothyrsus* and *Leucaena leucocephala*. The leaves were harvested in the morning, mixed in equal proportions by weight and distributed in the pens every evening. The quantity of supplements administered (800 g/goat) was based on results from preliminary studies, which indicated that optimum growth of WADG would be attained when 400 g each of these leaves were fed to the animals [16]. Feed Supplementation in the first group began immediately after the goats were divided and continued until three months postpartum. The second group (average body weight was 16.9 ± 2.8 kg) received no feed supplementation thus serving as the control.

Kidding was on the pasture or in the pens and the kids were left with their mothers throughout the study period. No additional feed, assistance or treatment of any kind was administered during this time.

Data collection

Representative samples comprising an entire plant of *Brachiaria ruziziensis* (minus the roots) and the leaves of *Pennisetum purpureum*, *Trypsacum laxum*, *Leucaena leucocephala* and *Calliandra calothyrsus* were collected monthly for chemical analysis. Dry matter, total nitrogen, ash [17], and fibers [18] were analysed as per established procedures. The protein content in the samples was obtained by multiplying a constant factor (6.25) to the respective nitrogen values [17].

Data collection for reproductive performances began immediately after the goats were divided into two groups. Collection of data for kid growth and postpartum growth of goat coincided with the dry season during the first experimental phase and with the rainy season during the second phase. The quantity of feed supplement consumed daily was estimated as the difference between the quantity given the previous evening and that leftover the following morning. The weight of the kids was recorded every two weeks from birth to three months of age using an electronic balance. The number of births, abortions and any mortality in the different groups were recorded.

Statistical analysis

The chemical composition of grasses and legumes, body weight gain of kids and postpartum weight of goat, in dry and rainy seasons were analysed using a one-way analysis of variance and significant means separated using Duncan's multiple range test [19].

RESULTS

Chemical composition of forages

Irrespective of the season, the protein contents in the leguminous leaves were much higher than in the grasses (Table 1). The lowest protein content was recorded during the dry season in *B. ruziziensis* (5.39 ± 3.22) while the highest value was found during the rainy season in *L. leucocephala* (28.02 ± 2.74). Although there was an increase in protein content during the rainy season for all the forages, the increase was highly significant ($P<0.01$) in *B. ruziziensis* where the value was three times higher than in the dry season.

Cellulose, hemi-cellulose and ash levels were higher in the grasses than in the leguminous leaves during both seasons. Cellulose and cell wall constituents were

significantly higher in the dry season in *B. ruziziensis* (P<0.01) and *C. calothyrsus* (P<0.05) only. During the dry season, the cell wall constituents (NDF) and lignocellulose (ADF) were significantly higher in *B. ruziziensis, L. leucocephala and C. calothyrsus* than during the rainy season.

Table 1: Concentrations of different nutrients in various forage crops under study in the dry and the rainy seasons

Fodder species	Season (months)	Contents (% Dry Matter)					
		Protein	Cellulose	Hemi-cellulose	Cell walls constituents	ADF	Ash
B. ruziziensis	Dry (n=4)	5.39±3.22	30.52±1.54**	27.44±1.09	75.99±1.14**	48.55±1.15**	10.53±1.32
	Rainy (n=8)	15.61±2.46**	23.00±4.71	36.42±3.62**	70.46±3.57	34.16±2.45	12.95±0.77**
P. purpureum	Dry (n=4)	10.35±1.14	31.87±8.55	30.88±7.53	79.36±2.84	48.47±7.65	12.13±2.76
	Rainy (n=8)	13.83±2.60*	31.23±3.41	30.73±5.60	76.71±3.92	45.97±4.45	13.05±2.21
T. laxum	Dry (n=4)	12.82±0.31	35.97±0.54	30.60±2.78	80.26±2.69	49.66±0.86	10.71±0.65*
	Rainy (n=8)	13.69±1.41	36.35±3.53	30.62±3.55	79.31±2.23	48.69±4.07	9.72±1.12
L. leucocephala	Dry (n=4)	24.88±1.27	12.55±1.92	23.57±5.06	53.67±5.09*	30.09±1.18*	7.48±0.36*
	Rainy (n=8)	28.02±2.74*	11.77±3.09	20.57±5.81	44.46±8.90	23.89±6.20	6.55±1.17
C. calothyrsus	Dry (n=4)	20.67±1.20	21.23±1.50*	16.58±1.88	57.20±3.28**	40.61±4.47*	6.00±1.30
	Rainy (n=8)	23.42±2.56*	16.93±4.64	14.97±6.04	47.64±5.55	32.67±9.70	5.37±0.81

ADF: Acid Detergent Fibre

*: Value significantly higher than in the other season (P<0.05).

**: Value significantly higher than in the other season (P<0.01).

Ingestion rate and reproductive performance

Each goat consumed between 700 – 800 g of the foliage supplement daily during the entire study period (Table 2), which represented almost the entire quantity of the supplement provided.

Information on the reproductive performances of goats as affected by the various feeding regimes is presented in Table 3. Throughout the study period, incidences of abortion were much higher in the control (6) than in the supplemented group (1). Furthermore, the group receiving supplementary feed produced more kids (24) than the control (20). More goats aborted in the dry season (5) than in the rainy season (2). In both seasons, the average birth weight of the kid from the supplemented group was higher than that from their respective control group although the difference between the two groups was not significant (P>0.05) during the rainy season.

Table 2: Quantity offered per goat (g/day), average consumption (g/day) and ingestion rate (%) of the supplements in different season.

Supplements	Season	
	Dry	Rainy
Quantity offer per goat (g/day)	800	800
Average consumption (g/day)	788.29 ± 16.90	763.95 ± 40.26
Ingestion rate (%)	98.03 ± 2.11[a]	95.49 ± 5.03[a]

a: not significantly different (P>0.05).

Table 3: Reproductive performance of goats in different seasons and on different feed regimes.

	Season	No. of pregnant goats	No. of abortions	Total number of kids
Control	Dry	11	4	8
	Rainy	11	2	12
Supplemented	Dry	10	1	10
	Rainy	11	0	14

Live weight gain

Throughout the dry season, body weight gained by the kids in the supplemented group was significantly higher (P<0.05) than that gained by the kids in the control group (Table 4). In the rainy season, differences in weight gain of kids between the 2 groups were not significant during the

first six weeks of age but weight gain became significantly higher for the kids from the supplemented group as from eight weeks of age. The kids belonging to the group receiving supplement gained 67.1% more weight than those in the control groups during the dry season while the gain was only 34.1% in the rainy season. Total weight gained during the study period was higher in kids from the supplemented group during the rainy season (4.97 kg) which was twice than that weight gained by the kids in the control group during the dry season (2.44 kg).

During the three months post-kidding period, the goats in the supplemented group gained 11-15% more body weight than their respective controls in the dry period. During the rainy season however, the post-partum body weight differences between the supplemented and the non-supplemented goats were not important (Fig. 1).

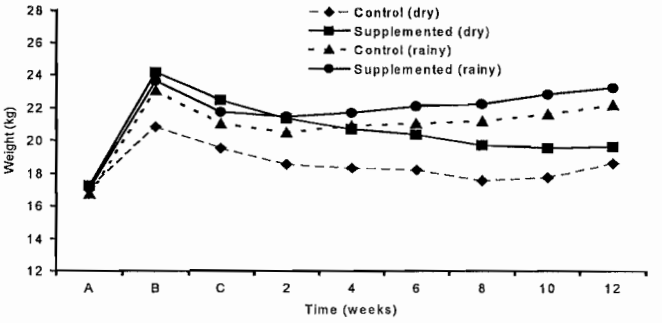

Figure 1: Change of body weight in Cameroon West African dwarf goats in the dry and rainy seasons with different feeding regimes.
(A: at beginning; B: before kidding; C: at kidding)

Table 4: Average body weight (kg) of kids from African dwarf goat on various feeding regimes during different seasons.

Season	Groups	Weight at Kidding	Age (Weeks)					
			2	4	6	8	10	12
Dry	Control (n= 8)	1.12±0.10	1.89±0.19	2.34±0.25	2.68±0.27	2.81±0.31	3.10±0.32	3.56±0.46
	Supplemented (n= 10)	1.35±0.08*	2.61±0.13*	3.72±0.23*	4.54±0.30*	5.04±0.40*	5.34±0.41*	5.95±0.45*
Rainy	Control (n= 12)	1.13±0.06	2.04±0.13	2.75±0.17	3.31±0.23	3.66±0.21	4.12±0.21	4.64±0.19
	Supplemented (n= 14)	1.25±0.07^{ns}	2.14±0.14^{ns}	2.89±0.20^{ns}	3.68±0.25^{ns}	4.39±0.27*	5.25±0.30*	6.22±0.33*

**: Significantly different at P<0.05 during dry season*
ns: Not significantly different at P>0.05 during rainy season

DISCUSSION

The overall protein concentration increased significantly during rainy season in *Brachiaria*, *Pennisetum* ($p<0.01$), *Leucaena* and *Calliandra* ($p<0.05$). Norton and Ahn [20], Jones [21], Norton [22] and Mecha and Adegbola [12] have reported similar observations. This explains the higher weight gain observed in the control during the rainy season in comparison to the control in the dry season. Cellulose and hemicellulose contents in feed form significant sources of energy in the ruminants [12, 23]. Apart from *Brachiaria* and *Calliandra*, the results obtained in this study show that these constituents and therefore the energy value do not change much with the seasons. A similar observation was made by Garcia *et al.* [24].

The high consumption of the supplement provided was an indication of the high level of acceptability of *C.*

calothyrsus and *L. leucocephala* by the West African Dwarf Goat. A similar observation was reported by Phiri *et al.* [25].

A substantially higher proportion of goats (91.7%) became pregnant during rainy season as compared to those (87.5%) recorded during the dry season. Poor nutritive value of the pasture during dry season [26, 27] which render females as well as males relatively subfertile [28] might have caused this phenomenon. During both seasons, 33% abortion rate were recorded in the unsupplemented groups as compared to a 5% rate in the supplemented groups. Malnutrition has been reported as a primary cause of abortion and still birth [29, 30, 31]. The supplementary feeding with the MPLT foliage appeared to have drastically lowered the abortion rate. While 24 supplemented goats yielded 24 kids, only 20 kids were obtained from the unsupplemented goats during both seasons.

Supplementation with multipurpose leguminous tree browse particularly helped in improving the reproductive performance and the overall yield of kids per animal. The same observation was reported by Amoah and Gelaye [32] and Kabuga and Akowuah [33] and was related to the good quality of forage available during the rainy season.

Differences in kids' weight gain between the groups were much more pronounced during the dry season where the total weight gained during the entire study period in the supplemented group (4.60 kg) was almost twice than that gained with the control animals (2.44 kg), as a result of the high nutritive quality of the supplement provided. In this study, the protein level in the MPLT leaves was 84-140% higher than in the grasses, justifying their usage as feed supplements in ruminant nutrition during periods of forage scarcity [21, 20, 23, 1].

All the goats receiving supplements gained more weight than their respective controls. During this period the high nutritive value of the supplement led to a more efficient conversion of the poorer quality grass in the pasture into important animal product (body mass). During the rainy season the weight difference of the supplemented (53%) and unsupplemented (50%) groups were not important. This was because, in this period the nutritive value (especially protein) of the grass in the pasture was high. Animals feeding solely on natural pasture had a well balanced diet. Consequently, the effect of the supplementation was not evident. Similarly, the goats receiving supplements gained much more weight than the control during the dry period but the difference in weight gain was not much during the rainy season.

After parturition, metabolic requirements increase with respect to the lactation process and this can induce a decrease in the body weight if the nutritional level is not well balanced [34, 35]. The relatively high difference in body weight observed in the dry season between the supplemented group and their respective control is an indication of the quality and quantity of forage consumed by goats during this period. The body weight losses, which are generally drastic in malnourished lactating females negatively influence the resumption of oestrus and ovarian activity [28]. Weight loss was not acute in this study because the dry season was not so severe. During the rainy season the quality of forage was rather excellent. As a result, supplementation did not produce any major difference between the supplemented group and the control. In a similar study, Mbayahaga *et al.* [36] also observed a body weight loss of 11.1 ± 6.8% on Burundian goats after parturition during the dry season. A much lower loss in body weight (4.0 ± 1.7%) was reported in the dry season by Ndlovu [37] after parturition on Zimbabwean goats.

The beneficial effects of supplementary feeding with multipurpose leguminous tree browses on goat production in Cameroon have been demonstrated in this study. It helps in substantially reducing the incidence of abortion and increases the overall yield of kids per animal. During the post kidding period, the goats receiving supplements continued to have 11 to 15% more body weight than their respective unsupplemented control during the dry season while in the rainy season body weight among the two groups were similar. This indicates the effect of the scope and importance of the supplementation for those animals particularly during the dry season.

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