Incorporation of Dry *Mangifera indica* Kernel in the Concentrate Ration of Growing Lambs

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Keywords

Sheep – Lamb – *Mangifera indica* – Growth – Concentrates – Tannin – Maize – Nigeria.

Summary

Twenty Southeast Dwarf yearling lambs of Nigeria were grouped according to their live weight (20.9 ± 1.7 kg) and offered one of the five concentrate rations as a supplement to the low quality dry season forage of mixed grass/legume hays (mainly three part *Pennisetum purpureum* and one part *Centrosema pubescens*) for 56 days growth period, after which five of the lambs were relocated to metabolism cages for digestibility and nitrogen balance trials. The *Mangifera indica* kernel was substituted for maize offal in diets A, B, C, D and E at 0, 15, 30, 45 and 60%, respectively. The concentrate intakes and growth rates were 951, 961, 1017, 1225 and 1001, and 116, 125, 146, 162 and 116 g/day, respectively.

■ INTRODUCTION

The increasing demand for energy and protein feedstuffs, and the prospect of greater cost are already having their effects on the supply in quantity of finished compounded feeds, and their future use for ruminants is quite uncertain. The problem is further aggravated by the fact that grains, which form the bulk of supplementary feed for ruminants, are staple food for humans and are also needed for industrial raw materials. Thus, the situation warrants exploring the possibilities of using alternatively energy and protein sources for animal feeding. Mango (*Mangifera indica* L.) seed kernels constitute about 15% of the mango weight and may well be used for livestock feed (14). Gohl (8) reported that ruminants can tolerate concentrate with up to 15% *Mangifera* seed kernel without adverse effects, and that the kernels are fairly rich in tannin, which progressively leads to reduced growth rate and less efficient feed utilization in pigs and poultry. The present study was conducted to determine the optimum level of inclusion of *Mangifera* kernel in the diet of growing lambs.

■ MATERIALS AND METHODS

Twenty Southeast Dwarf yearling lambs of Nigeria were divided into five groups according to their initial live weight (20.9 ± 1.7 kg) and assigned to five different experimental diets in a completely randomized block design. Each group was given a basal diet of 0.5 kg/head of mixed grass/legume hays (mainly three parts *Pennisetum purpureum* and one part *Centrosema pubescens),* and a concentrate ration mixture containing maize offal (60%), dried poultry manure (10%), palm kernel cake (20%), molasses (8%), bonemeal (1%) and salt (1%). Ground *M. indica* kernel replaced maize offal at 0, 15, 30, 45 and 60% (w/w) in diets A, B, C, D and E, respectively, and were available *ad libitum.* Before starting the study, the animals were quarantined for 30 days, which followed a 30-day-pretrial adaptation period to the experimental diets. Weighed quantities of

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concentrate rations and hays (called diets) were offered daily, separately at 7h30 and 16h30, respectively, to avoid selective intake of the diets. Refusals were collected and weighed before the next feeding. Each diet was sampled and bulked for 56 days, and chemically analyzed. Fresh water was available *ad libitum* throughout the trial period, and the lambs were weekly weighed. To study the utilization of nutrients and nitrogen balance, five lambs of an average body weight of 24.2 ± 0.7 kg were placed in metabolic cages and fed the five experimental diets in a 5x5 Latin square design, with a 10-day adaptation period, followed by a five day period of collection of feces and urine. The experimental diets and refusals were sampled daily and pooled for a 5-day collection period for chemical analysis. Daily outputs of urine and feces were also recorded and sampled. The urine was stored at 5°C and feces were frozen until required for analysis. The lambs were weighed at the beginning and at the end of each collection period. The diet and feces samples were dried to a constant weight, under laboratory conditions, then ground to pass through a 2-mm screen in a Willy mill. The dry matter, organic matter, crude fiber, nitrogen free-extract, ether extract, protein and ash contents were determined (3). The tannin content of the *M. indica* kernel was determined according to Herman and Enge's method (10), which depends upon the formation of a copper-tannin complex. Urine samples were analyzed for nitrogen. Data were analyzed statistically (9, 19). Duncan's multiple range test was used to determine the significant difference among means (6, 21). The feeding study was carried out at Chief Ekpunobi's Farm at Abakiliki, old Anambra State, and the other studies with the help of Agrofeed Mill Nig., Calabar, Nigeria, in association with N.V. Versele-Laga, Belgium.

■ RESULTS AND DISCUSSION

The chemical composition of the hay, maize offal, *M. indica* kernel and the different concentrate rations administered to the lambs are shown in Table I. Results from the chemical analysis of *M. indica* kernels used in the experimental trial were similar to those reported by Gohl (8), and the higher protein content of 8.13% agreed with that of Ranjhan (18). As the level of inclusion of *M. indica* kernel increased, the ether extract and ash contents of

Table I

Chemical composition of feedstuffs and concentrate rations [% on dry matter (DM) basis]

Feedstuff		Dry matter	Organic matter	Crude fiber	Crude protein	Nitrogen free extract	Ether extract	Ash	Tannin
Hay		96.4	89.1	34.3	10.88	42.2	1.7	7.3	–
Maize offal		85.9	81.1	5.5	8.39	57.6	7.4	4.8	–
Mangifera indica kernel		98.4	93.2	3.0	8.13	73.1	9.0	5.2	10
Concentrate ration	**Level of kernel (%)**								
A	0	94.8	89.54	7.89	11.87	66.77	4.31	5.25	–
B	15	94.28	89.17	7.37	11.76	66.85	4.36	5.69	1.5
C	30	51.72	87.59	6.86	11.81	66.92	5.19	6.13	3.0
D	45	97.93	91.34	6.36	11.84	69.0	7.35	6.58	4.5
E	60	98.37	91.34	5.84	11.71	67.07	7.78	7.02	6.0

Table II

Mean daily intakes and live weight gains of lambs fed diets containing levels of ground *Mangifera indica* kernels for a period of 56 days (N = 4)

	Diets					Mean value	Standard deviation	Coefficient of varieties
	A	B	C	D	E			
Levels of *M. indica* kernel (%)	0	15	30	45	60	–	–	–
Initial weight (kg)	20.1	19.9	20.2	21.1	21.0	20.46	0.55	0.03
Final weight (kg)	20.22	20.03	20.35	21.26	21.12	20.60	0.56	0.03
Live weight gain (g/d)	116	125	146	162	116	133	20.32	0.15
Concentrate ration intake (g DM/d)	951	961	1017	1225	1001	1031	111.83	0.11
Intake of *M. indica* (g DM/d)	0	144	305	551	600	–	–	–
Nitrogen intake (g/d)	18.1[a]	18.1[a]	19.2[a]	23.2[b]	18.8[a]	19.48	2.13	0.11

[a, b] Means on the same row with different superscripts are significantly different ($P < 0.05$)

Table III

Mean intake and digestibility of diet fed to lambs with levels of ground *Mangifera indica* kernels. Observations were collected over a 5 day period, following 10 days of adaptation (N = 5)

	Diets					Mean value	Standard deviation	Coefficient of varieties
	A	B	C	D	E			
Total DMI (g/d)	811	712	724	858	740			
DMI (g/W$^{0.75}$ kg)	85	75.2	75.7	86.7	76.5			
Concentrate intake (g DM/d)	566	467	479	613	495	524	62.85	0.12
Digestibility coefficient (%)								
Dry matter	58.48	57.89	58.98	60.80	59.54	59.13	1.23	0.02
Organic matter	68.97^{a}	67.68^{a}	71.98^{a}	69.95^{a}	63.30^{b}	68.37	10.52	0.15
Crude fiber	60.47^{b}	63.67^{b}	65.46^{b}	77.05^{a}	69.07^{a}	67.144	6.35	0.09
Crude protein	63.42^{a}	66.65^{b}	67.19^{b}	69.62^{c}	63.54^{a}	66.084	2.63	0.04
Nitrogen-free extract	55.31^{c}	65.19^{b}	75.03^{a}	74.91^{a}	60.04^{b}	66.096	8.82	0.13
Ether extract	72.23^{b}	62.13^{a}	82.10^{c}	90.30^{c}	85.1^{c}	75.372	11.70	0.16
Nitrogen balance (g/d)								
Intake	10.77^{a}	8.79^{b}	9.05^{b}	11.66^{a}	9.27^{b}	9.898	1.23	0.12
Feces	1.98^{c}	1.73^{c}	1.27^{d}	2.35^{b}	2.78^{a}	2.022	0.58	0.29
Urine	5.74^{b}	5.08^{b}	5.38^{b}	6.57^{a}	5.07^{b}	5.568	0.62	0.11
Retained	3.05^{a}	1.98^{c}	2.40^{b}	2.69^{b}	1.42^{d}	2.308	0.63	0.27

DMI = dry matter intake

$^{a, b, c, d}$ Means on the same row with different superscripts are significantly different ($P < 0.05$)

the concentrate rations rose correspondingly and the levels of crude fiber decreased. The low protein (10.88%), and high fiber (34.3%) contents of the hay confirmed that the basal diet was mature and of low quality forage. The tannin content of the *M. indica* kernel was high at 10%, compared to that of 7.5% found by Devendra (5). Tannin contents in *M. indica* kernel vary, depending on the variety, maturity and climatic conditions (13); the content in the concentrate rations increased with the increasing levels of *M. indica* (from 1.5% in diet B to 6.0% in diet E). The daily intake of the basal forage diet remained constant at about 0.45 kg/head throughout the trial period. The growth and diet intake trials are summarized in Table II. There were no significant ($P > 0.05$) differences in the diet intake and growth rates between the groups, but the nitrogen intake was significant ($P < 0.05$). The results of the digestibility trials are presented in Table III. They show that all the digestibility components of the various diets were significantly ($P < 0.05$) different, except for the dry matter (DM). On the nitrogen balance trial, the intake and retained nitrogen balances together with those of the urine and feces were significant ($P < 0.05$).

Differences in growth rates noted over the five treatments might be caused by the fact that the diet intake, although generally low at about 951 g DM/day, rose to reach a maximum of 1225 g DM/day in diet D with 45% *M. indica*. The crude fiber, crude protein and nitrogen-free extract digestibility showed a similar pattern in that the intake of digestible nutrients, and in particular that of crude protein which is important for growth, increased as the level of *M. indica* in the concentrate ration rose. The best growth rate of 162 g/day, which was obtained in diet D, was lower than expected (4). Sporndly and Wiktorsson's (20) observations suggested that 25 kg tissue protein would support a live weight gain of 100 g/day in sheep. Poorer than expected growth was noted in sheep fed a diet of forage + concentrate with a crude protein percentage of 14.33 calculated to support a daily gain of about 100 g, but which achieved a gain of 54.29 g/day (1). The difference between the observed and expected growth rate may be explained by the low fiber and high fat contents (6.86 and 5.80%, respectively), the low digestibility of the diets in general, and the fact that high inhibitors, such as tannins, present in *M. indica* tend to bind proteins with indigestible fiber, thereby making it unavailable to the animal (2, 7, 8, 15). The high outputs of fecal nitrogen in diets D and E (2.35 and 2.78 g/day, respectively) agree with this observation, as does the reduction in the overall digestibility of DM and crude proteins in diet E (59.54 and 63.54%) compared to that in D (60.80 and 69.62%, respectively). The reduced diet intake, as observed in diet E, was associated with reduced dry matter digestibility, but might have also been influenced by the diet unfavorable olfactory properties (16, 22). This became more apparent when the level of *M. indica* in the concentrate ration was increased. Other researchers (11, 12) reported that the presence of condensed tannins and other inhibitors deter feed intake in some animals (15).

■ CONCLUSION

Rations that include *M. indica* kernel might support the growth rate in lambs in a way similar to or greater than that which is obtained through feeding them with maize offal. However, the maximum level of inclusion as noted in this study is 45% beyond which the toxic properties of the phonetic compounds present in *M. indica* limit production at a 60% level. While Pritchard et al. (17) investigated whether feeding polyethylene glycol could limit the toxic effects of condensed tannins, inclusion of *M. indica* reduced the cost of rations in this study (diet D was about 38% cheaper than diet A), which makes it an alternative feed to low quality forage rations for sheep and one which cannot compete with food for humans.

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Résumé

Anigbogu N.M., Bienstman P., Van Damme B., Ezeokoli C.D. Incorporation d'amandes de *Mangifera indica* séchées dans les rations concentrées d'agneaux en croissance

Vingt agneaux Nains du sud-est du Nigeria ont été groupés selon leur poids vif (20,9 ± 1,7 kg) et ont reçu une des cinq rations concentrées en complément d'un fourrage de saison sèche de qualité médiocre à base d'un mélange d'herbes et de légumineuses (principalement trois quarts de *Pennisetum purpureum* et un quart de *Centrosema pubescens*) pendant une période de croissance de 56 jours. Ensuite, cinq des agneaux ont été transférés dans des cages à métabolisme pour l'étude de la digestibilité et du bilan azoté. Des amandes de *Mangifera indica* ont remplacé, à raison de 0, 15, 30, 45 et 60 p. 100, les issues de maïs, respectivement dans les rations A, B, C, D et E. Les ingestions de concentrés et les taux de croissance ont été respectivement de 951, 961, 1 017, 1 225 et 1 001, et 116, 125, 146, 162 et 116 g/jour.

Mots-clés : Ovin – Agneau – *Mangifera indica* – Croissance – Aliment concentré pour animaux – Tannin – Maïs – Nigeria.

Resumen

Anigbogu N.M., Bienstman P., Van Damme B., Ezeokoli C.D. Incorporación de grano seco de *Mangifera indica* en la ración de concentrado de los corderos en crecimiento

Veinte corderos enanos sur orientales de un año de Nigeria fueron agrupados según su peso vivo (20,9 ± 1,7 kg) y luego se les ofreció una de las cinco raciones del concentrado como suplemento al forraje de baja calidad de la estación seca de una mezcla de hierba/leguminosas en heno (principalmente tres partes de *Pennisetum purpureum* y una parte de *Centrosema pubescens*) durante el período del crecimiento de 56 días, después del cual cinco de los corderos fueron mantenidos en jaulas metabólicas para ensayos de equilibrio de digestibilidad y de nitrógeno. El grano de *Mangifera indica* se substituyó con restos de maíz en las dietas A, B, C, D y E en 0, 15, 30, 45 y 60%, respectivamente. Las tasas de consumo de concentrado y de crecimiento fueron 951, 961, 1017, 1225 y 1001, y 116, 125, 146, 162 y 116 g/día, respectivamente.

Palabras clave: Ovino – Cordero – *Mangifera indica* – Crecimiento – Pienso concentrado – Tanino – Maíz – Nigeria.