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Evaluating the Performance of Yankasa Rams Fed *Acacia Sayel Del* (Chenchilo) Leaf Meal as a replacement for Cotton Seed Cake

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Target Audience: Livestock farmers, Animal Nutritionist and Feed toxicologist

Abstract

A study was conducted to evaluate the nutritive value of Acacia sayel Del. (Chenchilo) pods as replacement for Cotton Seed Cake (CSC) in diets of Yankasa rams. Twenty Yankasa rams of average weight 15.4 ± 0.15 kg were used in a feeding trial which lasted 120 days. The rams were randomly allotted to five treatment groups: 0, 25, 50, 75 and 100 % inclusion levels of A. sayel pods in a complete randomized design experiment. The rams were fed concentrate at the rate of 2.5% body weight/head/dat. A basal diet of maize stover was offered ad libitum. Rumen fluid and blood samples were collected at the beginning, middle and end of the feeding experiments to determine rumen and hematological parameters. A digestibility trial was conducted at the end of the feeding trial. The results of the study show that A. sayel pods inclusion levels had significant (P≤ 0.05) effect on all the performance characteristics except feed intake. The best results were obtained at 75% level of inclusion (feed conversion ratio of 1.35, weight gain 622.5g and final body weight (21.625kg). Inclusion levels of A. sayel pods had significant (P≤0.05) effect on nutrient digestibility, but had no significant (P≥0.05) effect on nitrogen balance. The inclusion of A. Sayel had no significant effect (P≥ 0.05) on Packed Cell Volume (PCV), heamoglobin, rumen ammonia nitrogen and rumen pH. From the result of this study it was concluded that A. sayel pods can be included in the diet of Yankasa rams up to 75% to replace Cotton Seed Cake. This inclusion level resulted in improved performance in rams in terms of feed efficiency, nutrient digestibility and nitrogen retention.

Keywords: A*cacia sayel*, Yankasa sheep, Nutrient utilization

Description of Problem

One of the major limitations of ruminant livestock production in Nigeria is poor nutrition. Native grasses and crop residues are characterized by low nitrogen, high fibre and poor digestibility (1). Conventional supplements such as cotton seed cake, groundnut cake and meals from animal by-products are expensive and not readily available. Under these circumstances, the most practical supplement may be locally available legume trees and browse plants

(2), which have high protein content and are potential supplements for ruminants.

Among leguminous browse species, *Acacia sayel* Del. (Chenchilo) is regarded as a plant with good fodder value in the northern part of Nigeria and large parts of arid and semi-arid areas of tropical and sub-tropical countries (3). Browse plants are less subjected to seasonal variations in climate, remain green in the dry and wet season and serve as cheap alternative feed that leaf out at the end of the dry season, before the main forage plants appear. This occurs at a time when animal's need for quality feed is highest, and ruminants at this time are grazed on low quality grasses. Livestock reared in arid and semi-arid region have problems in meeting nutritional needs on hay alone and depend on trees to balance their diet in terms of proteins, vitamins and minerals (4).

Leguminous trees produce pods, tender twigs, shoots, flowers and leaves which are rich in protein, mineral and vitamins. Traditional herdsmen and other pastoral group cut the branches and fed the leaves and pods to livestock during the dry season when forages are scarce and of low quality. Unfortunately, some forages that are rated high contain various anti-nutritional factors which may be deleterious to livestock that feed on them.

Acacia sayel is a browse plant that belongs to the family *Mimosoideae*. It is commonly found in Nigeria, Senegal, Cameroon, Egypt and Somalia. In Nigeria, the browse grows in the range commonly around damp valleys bordering Niger Republic. Despite the usage of this browse by agro-pastoralist, scanty information is available on its nutritional value, intake and performance on livestock feeding on it. This study was carried out to determine the chemical composition, nutritional value and the performance of Yankasa sheep fed varying levels of *Acacia sayel* Del pods as replacement for Cotton Seed Cake (CSC).

Materials and Method

Study site

The growth study was conducted at the Small Ruminant Experimental Unit of the National Animal Production Research Institute (NAPRI), Shika (11^{o} 12'N, 7'33'E), in the sub-humid zone of Nigeria, on an elevation of 670m above sea level. Wet season begins in late April/early May and ends in late September/ early October. Mean maximum temperature of 39.5^{o} C occurred in April, while the lowest minimum temperature of 9.7^{o} C was recorded in the month of December.

Collection of Acacia sayel Del

Fresh *Acacia sayel* Del. plant material (fruits, shoots, tender twigs, leaves and flowers) were harvested from Nguru in Yobe State. The harvested material was air dried for 24 hours and trashed to separate the fruits from the leaves. These were then further sun dried. The dried materials were then collected and stored in jute bags until required for use.

Determination of chemical and minerals composition.

Fruits and tender branches of not less than 5cm length of *Acacia sayel* Del.

were separated into their component parts (fruits, leaves and seeds) and analyzed for proximate components, using the procedure described by (5). Acid Detergent Fibre (ADF) and Neutral Detergent Fibre (NDF) were determined (6). The content of calcium, phosphorous, sodium, iron, magnesium and potassium were determined using the flame spectrophometer as described by (7). Samples fruit, seeds and leaves were taken and analyzed for antinutritive factors such as tannin, saponin and cyanogenic glycosides (5). Oxalate (8) and Phytate (9).

Experimental animals and management

A total of twenty growing Yankasa rams with an average weight of 15.4 ± 0.15kg were used for this study. The animals were randomly allotted to five treatment groups with four animals per treatment in a Completely Randomized experimental Design (CRD). The animals were individually penned and given prophylatic treatment consisting of Ivomectin (0.5ml/25kg body weight) against endo and ectoparasites and Terramycin long acting antibiotic (1.0ml/10kg body weight) against bacterial infections, a week before the commencement of the study. The rams were then transferred into individual feeding pens.

Experimental diets and treatment

Acacia sayel Del. pods were included in concentrate diets at 0% (Control), 25%, 50%, 75% and 100% levels as replacements for Cotton Seed Cake. Other ingredients in the concentrate diet include maize offal, salt and bone meal. The animals were fed the experimental diets at 8.00hr in the morning at the rate of 2.5% of body weight/head/day. Maize stover and fresh water were fed *ad libitum*.

Rumen fluid and blood metabolites

Rumen fluid was sampled at 0, 60 and 120 days of the feeding trial, with the aid of a manually operated suction pump. The fluid was immediately strained through cheese cloth and the pH was measured with a digital pH meter. Rumen fluid samples were kept in plastic containers into which Hydrochloric acid was added and stored at -4^0C for analysis of ammonia-nitrogen (10). Total volatile fatty acids were estimated by procedure of (5).

Blood was sampled from the jugular vein with a hypodermic needle into vacutainer tubes at 0, 60 and 120 days. Blood samples were centrifuged immediately and plasma decanted into tubes and stored at a temperature of -4^0C, for plasma urea nitrogen determination (11).

Digestibility and nitrogen balance

Three Yankasa rams were randomly selected from each treatment at the end of the feeding trial used for digestibility study. The rams were housed in an individual metabolism crates. The animals were allowed for 14 days adjustment period, which was followed by 7 days total faecal and urine collection. The daily fecal outputs were dried for initial determination of dry matter (DM). Faeces from animals on each treatment were bulked, thoroughly

mixed and sub-sampled. An aliquot of 5% daily urine output was removed and stored in a refrigeratorat -4^{o}C until required at the end of the digestibility period for analysis of nitrogen..

Data collection

Initial body weights of the rams were taken at the commencement of the experiment and subsequently fortnightly using a hanging scale (Salter Suspended Weigher Model 235). The treatments were adjusted fortnightly, to maintain treatment effect at 2.5% body weight. Feed intake was determined by the difference between the feed offered and the left over feed. Feed Conversion ratio (FCR) was also determined by dividing weight gain by feed intake.

Chemical analysis

Samples of feed offered and faecal outputs were analyzed for proximate composition (5), Acid Detergent Fibre, Neutral Detergent Fibre and hemicelluloses (6) Urine samples were analysed for nitrogen using the procedure of (5).

Statistical analysis

Data collected from the feeding trial, rumen and blood metabolite as well as digestibility trial were all subjected to Analysis of Variance using the General Linear Model procedure of (12). Means were separated using the Duncan Multiple Range Test.

Results and Discussion

Proximate and mineral composition of Acacia sayel Del

The result of the proximate and mineral analysis of *A. sayel* plant parts and other ingredients in the concentrate diets are presented in Table 1.The crude protein content of *Acacia sayel* Del components 17.06 to 22.44% obtained in this study was within the range of 12 to 30% reported by (13) for most tropical legumes. Similar values for West African browse plants was also reported by (14). The values obtained in this study are however, higher than 13.4% reported by (15) for some species of *Acacia* plant

Table 1. Ingredients composition of experimental diet containing level of *Acacia sayel* Del. Pods.

Ingredients (kg)	Level of inclusion (%)				
	0	25	50	75	100
Maize offal	87.96	86.54	84.68	82.01	77.95
Acacia sayel	0	2.87	6.69	11.99	20.05
Cotton seed cake	10.04	8.6	6.69	3.99	0
Bone meal	1.5	1.5	1.5	1.5	1.5
Salt	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100

Organic matter (OM) content ranged from 86.84 to 91.15%. This is lower than 92.10% reported by (16). The fibrous fractions of *A. sayel,* in the form of NDF and ADF (44.04% and 32.02%) were higher than 20.2% and 18% reported (16, 17, 18 and 19).

The calcium (Ca) level in the present study (7g/kg DM) is lower than 12 g/kg DM obtained by (19, 20) in dry season for some Acacia species. The content of Mg, K and Na recorded were higher than 1.3, 4.1 and 0.8 g/kg DM reported by (16). The variations in chemical and mineral compositions indicates species, seasonal and physiological differences which could affect nutritional status and should be considered when utilizing browse plants as livestock feed resource.

The mineral composition of *A. sayel* plant parts were within the optimum mineral requirement for sheep at maintenance level. The values fell within the range recommended by (21). Mc Dowel *et al.* (22) recommended the mineral requirement of adult sheep for maintenance as Ca - 2.5g/kg DM, P - 1.5 g/kg DM, Mg - 2.0g/kg DM and NaCl - 3.0g/kg DM. However, the author recommended that it may be necessary to add 10 – 20% above recommended requirement to ensure optimum performance for animals on pasture.

Anti-nutritive factors in Acacia sayel Del. Plant

The content of anti-nutritive factors in different parts of *A. sayel* presented in Table 2 showed that the seeds had significantly ($P \leq 0.05$) higher tannin, phytate, cyanogenic glycoside and oxalate. This result agrees with the finding of (22), which showed that most tannin and other anti-nutritive factors are located in the testa. Oxalates and phytates can interfere with the absorption of calcium, iron, and other minerals. Levels of these anti-nutrients in *A. sayel* are within tolerable limits (2% of DM) regarded safe for ruminant feeding. The ingredient and chemical composition of the diets is presented in Tables 3 and 4. The crude protein content of the diets increased with increasing levels of *Acacia sayel Del.* Seventy five percent level of *Acacia sayel* inclusion had the highest content of neutral detergent fibre (NDF) and acid detergent fibre (ADF).

Performance of Yankasa rams fed diet containing Acacia sayel Del.

The performance of Yankasa rams fed various levels of *A. sayel* as replacement for cotton seed cake presented in Table 5 showed that there was significant ($P<0.05$) increase in body weight across the treatments. Average daily weight gain (ADG) was highest in rams fed 75% level of *A. sayel* pods. This finding supported the report of *(*23) who stated that when the diet is non-limiting in protein, an advantageous interaction between free, condensed tannins and protein occurs which result in higher intake of nutrients, hence, higher performance.

Table 2: Nutrient composition of experimental diets

Parameters (%)	Levels of inclusion of *Acacia sayel* Del.)				
	0	25	50	75	100
Dry Matter	94.85	95.04	94.21	94.60	95.59
Ash	11.64	14.41	12.62	13.54	14.71
Crude Protein	11.81	12.00	12.06	12.13	12.19
Crude Fiber	25.73	26.07	20.10	21.94	25.60
Ether Extract	7.38	7.70	8.40	9.82	10.02
NDF	59.96	56.14	58.10	61.86	58.06
ADF	36.03	36.03	36.06	38.06	36.16
NFE	43.44	39.82	46.73	42.57	37.48
ME(kcal/kg)	2561	2468	2769	2742	2582

NDF = Neutral detergent fibre; ADP = Acid detergent fibre; NFE = Nitrogen free extracts; ME = Metabolizable energy.SD= standard deviation

A study conducted by (24) showed that sheep given a high level of protein diet (18.8% CP) supplemented with *Quebracho* tannin extract, consumed more feed than those on the control diet. The author suggested that the increased intake in the tannin-supplemented rams could be a mechanism to compensate for dietary or endogenous protein loss.

There was no significant (P>0.05) difference in feed conversion ratio across the treatments. The highest feed conversion ratio was however, obtained from the rams fed 50% *A. sayel*. This can be attributed to the associative digestive effect of a combination of cotton seed cake and *A. sayel that* led to the efficient utilization of the nutrients in the feeds.

Nutrients digestibility and nitrogen balance

The result of digestibility study presented in Table 6 showed that there was no significant difference (P>0.05) in DM digestibility between the control, 75 and 100% A. sayel inclusion in the diets. Also CP digestion between the control, 50, 75 and 100% level of inclusion was not significantly different This indicates that once the deficiency of protein in the rumen is overcomed there may be no advantage in increasing the level of protein availability for the rumen microbes. This support the findings of (23), who fed ruminants with *Brachiaria* hay supplemented with concentrates base of maize bran, CSC and tannin rich browse plant leaf meal.

Table 3: Chemical (%) and mineral composition of *Acacia sayel* Del. plant components and major feed ingredients

Parameter	Leaves	Fruits	Seeds	CSC	MO	MS
DM	91.50	93.68	91.31	93.85	93.97	93.10
CP	17.13	17.06	22.44	20.31	13.16	8.06
Ash	4.66	4.53	3.22	4.13	3.53	5.45
ADF	34.60	32.02	25.92	21.98	18.02	40.20
NDF	41.98	44.04	30.02	48.02	26.94	70.02
EE	6.02	12.16	3.04	4.96	4.18	1.16
HC	7.38	12.02	4.10	26.04	8.92	29.82
OM	86.84	91.15	88.09	89.72	90.44	87.65
Minerals(ppm)						
Ca	7000	6250	4500	1000	1000	3250
K	10600	13200	9400	13400	12600	13400
Mg	5120	4020	4020	5100	4740	5100
Na	6400	8400	4600	8000	8400	8000
Fe	356	311	133	200	267	511
Zn	36	27	18	27	46	37
Mn	17	44	22	11	22	33

ADF = acid detergent fiber, NDF neutral detergent fiber, CP= crude protein, EE = Ether-extract, HC = Hemicelluloses, L = Leaves, F = Fruits, S= Seeds, MS =Maize stover, MO= Maize offal, CSC =Cotton seed cake, SD= Standard deviation

Table 4. Levels of anti-nutritive factors in *Acacia sayel* Del. plant parts

	Structural components				
Anti- nutrients (mg/100g)	Leaves	Fruits	Seeds	SEM	LOS
Tannin	0.23^{b}	0.17^{b}	0.65^{a}	0.90	*
Phytates	0.46^{c}	1.03^{b}	1.83^{a}	0.90	*
Cyanogenic glycosides	0.67^{b}	0.2^{c}	0.88^{a}	0.90	*
Oxalates	0.45^{c}	0.83^{b}	1.03^{a}	0.64	*
Saponin	1.67^{a}	1.46^{b}	1.25^{c}	0.06	*

^{a,b,c} Means with different superscripts within the row differ significantly($P<0.05$)

Table 5: Performance of Yankasa sheep fed varied levels of *Acacia sayel* Del.

	Levels of inclusion						
Parameters	0	25	50	75	100	SEM	LOS
Initial body weight (kg)	15.25	15.4	15.50	15.40	15.43	0.63	NS
Final body weight (kg)	19.625^{ab}	21.433^{a}	18.875^{b}	21.625^{a}	20.750^{a}	0.72	*
Weight gain (g)	437.5^{d}	603.30^{b}	337.5^{e}	622.5^{a}	532.0^{c}	0.68	*
ADWG (g/day)	3.65 ^{d}	5.03^{c}	2.81^{e}	5.18^{a}	4.43^{b}	0.06	*
Daily con. intake(g)	450.25	445.78	436.92	471.40	465.07	3.77	NS
Daily stover intake (g)	365.15^{e}	379.18^{c}	385.96^{b}	370.13^{d}	400.25^{a}	1.85	*
Total daily feed intake (g)	815.41	824.96	822.88	841.53	865.32	4.09	NS
Feed conversion ration	1.86	1.37	2.44	1.35	1.63	0.60	NS

a, b, c Means bearing different superscript in row differ significantly. SEM = Standard error of means

LOS = level of significance; * = P<0.05, NS = Not significant.

Table 6: Nutrient digestibility and nitrogen balance of Yankasa rams fed levels of *Acacia sayel* Del.

Parameters (%)	Level of inclusion						
	0	25	50	75	100	SEM	LOS
Dry Matter	56.22^{a}	41.44^{b}	41.81^{b}	54.38^{a}	50.23^{a}	3.060	*
Crude Protein	57.43^{c}	59.25^{bc}	61.01^{ab}	61.96^{ab}	62.84^{a}	1.037	*
Ash	58.76^{d}	72.24^{a}	63.65^{c}	65.57^{bc}	68.49^{b}	1.114	*
Ether Extract	45.86^{c}	47.92^{bc}	57.83^{b}	71.96^{a}	75.66^{a}	3.104	*
Crude Fiber	38.94^{a}	37.02^{a}	32.87^{b}	30.60^{ab}	28.72^{b}	4.034	*
NDF	40.28^{a}	35.32^{a}	17.22^{b}	18.66^{b}	15.57^{b}	3.409	*
ADF	28.79^{a}	21.79^{a}	30.58^{a}	24.70^{a}	17.47^{b}	5.156	*
Hemi Cellulose	50.64^{a}	49.92^{a}	42.23^{a}	47.07^{a}	21.01^{b}	1.037	*
Nitrogen balance							
N intake (g/day)	120.29^{b}	118.90^{b}	122.03^{b}	138.86^{a}	136.86^{a}	6.106	*
Faecal N (g/day)	50.73	48.45	47.57	52.87	50.69	2.358	NS
Urinary N (g/day)	34.67	38.42	41.48	21.92	30.28	9.545	NS
N-retained (g/day)	34.89^{b}	32.03^{b}	32.97^{b}	64.07^{a}	55.55^{a}	8.128	*
N % of Intake	29.49^{b}	27.49^{b}	26.45^{b}	46.20^{a}	40.90^{a}	6.748	*

a,bc Means bearing different superscript in a row differ significantly. SEM = Standard error of mean

LOS = Level of significance; * = P<0.05, NS = Not significant. NDF= Neutral detergent fiber ADF=Acid detergent fiber

Nitrogen retention in Table 6 increased with inclusion level of the *A. sayel* in the diets. The increase in level of nitrogen retention at 75% *A. Sayel* inclusion agrees with other report which shows nitrogen retention may be a factor responsible for the increase in ruminants fed tannin-rich plants (25, 26).

Haematological parameters

Effect of replacement levels of *Acacia sayel* Del. on haematological parameters is presented in Table 7. Packed Cell Volume (PVC) values obtained in this study (31.89 to 37.0%) are within normal range of 24 – 50% for sheep (27). This showed that the inclusion of *A. sayel* pods in the diets fed to the rams, had no negative effect on the PCV. The content of haemoglobin and White Blood Cells (WBC) showed no significant ($p>0.05$) difference across the treatments. These values ranged from 10.54 to 12.30 g/dl, which is within the normal range of 8 – 15 g/dl and 4 – 12 x 10^9/L, respectively (27).

There was an increase in plasma urea nitrogen with the increase in the level of *A. sayel* pods up to 75% inclusion level. This result agrees with the range of 2.5 – 6.5 mmol/l reported by (28). Mehrez and Orskov (29) also obtained similar values for total proteins.

Rumen metabolites

Result of the rumen metabolite study is presented in Table 8. Rumen ammonia concentration (8.4 mg/L to 10.3 mg/L) across the dietary treatments is within the range reported by (30) to be adequate for efficient rumen function. Orskov and Ryles (31) reported 1 – 5 mg/l as optimum ammonia concentration for microbial growth. Volatile fatty acids (VFA) showed a slight non-significant increase in mean values from 25% to 75% levels of inclusion of *A. sayel* pods. The slight decrease in the TVFI with increase in inclusion level of *A. sayel at 100%* could be associated with decrease in digestibility of the feed material as explained by (32). The range of pH values recorded in this study fell within normal limits for optimum rumen function reported by (33).

Table 7: Effect of replacement levels of Acacia sayel Del. on haematological parameters of Yankasa sheep

Parameters	Levels of inclusion					SEM	LOS
	0	25	50	75	100		
PCV(%)	33.56	36.44	37.0	34.78	31.89	1.442	NS
Hb(g/dL)	11.16	12.11	12.30	11.61	10.54	0.826	NS
WBC(x10^9)	12.16^a	9.83^c	12.71^a	10.57^{bc}	11.19^{ab}	0.898	*
PUN(mmol/L)	5.89	6.11	6.67	6.78	6.11	0.770	NS
TPP(g/dL)	7.80^b	7.56^b	8.52^a	8.54^a	8.16^a	0.544	*

LOS= Level of significant, SEM=Standard error of means, NS= Not significant PCV= Pack cell volume, PUN = Plasma urea nitrogen, WBC = White blood cells, Hb= Hemoglobin, TPP = Total plasma protein

Table 8: Effect of inclusion level of *Acacia sayel* Del. pods on rumen metabolites of Yankasa rams

Parameters (%)	Levels of inclusion						
	0	25	50	75	100	SEM	LOS
NH_3 N (mg/l)	9.43^{ab}	8.42^{b}	9.38^{ab}	10.29^{a}	8.50^{b}	0.58	*
pH	6.79	6.01	6.24	6.21	6.31	0.34	NS
TVFA (µmol)	48.87	41.93	42.37	46.50	39.19	2.86	NS

a,b Means within a row differ significantly. TVFA (µmol) = Total volatile fatty acids (micro mols) SEM = Standard Error of mean; LOS =Level of significance; * = P<0.05, NS = Not significant.

Conclusion and Application

It was concluded that:

1. The use of *Acacia sayel* Del pod as replacement for Cotton Seed Cake in a supplementary diet fed to Yankasa rams had positive effect on performance of the rams.
2. Animals fed with diets containing 75% inclusion level of *Acacia sayel* Del pods had the highest feed efficiency, nutrient digestibility and nitrogen retention.
3. The anti–nutrients levels (tannin, phytates, oxalates, cyanogenic glycosides and saponins) contained in the *Acacia sayel* Del plant were within tolerable values irrespective of the plant components.
4. *Acacia sayel* Del is therefore, recommended in supplementary diet of small ruminants up to 75% without any deleterious effect.

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