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ARTICLE

Utilization of *Senna obtusifolia* as a Potential Non-Conventional Feedstuff In Sheep

***OGUNSAN[1], E.A., TUKUR[2], H.M., MAIGANDI[2], S.A., MAKINDE[1], A.A., MALAMI[2], B.S., OGO[1], N.I.**

[1]National Veterinary Research Institute, Vom. Plateau State, Nigeria.[2] Faculty of Agriculture, Usmanu Danfodiyo University, Sokoto, Nigeria
*Correspondence: adekanbioguns@yahoo.com. P.O.Box 203, Vom, Plateau State, Nigeria.

SUMMARY

Experiment was conducted to determine the effects of including *Senna obtusifolia (SO)* plant at 0, 10, 20 and 30% levels in the diet of sheep. The best performance was found at the 20% level and this was traced to better digestibility of nutrients. Cost of feed per Kilogram liveweight gain was also best at 20% inclusion level. Although blood parameters differed significantly between treatments, they were mostly within acceptable physiological limits, and there were no adverse effects in feeding the plant to the animals.

KEYWORDS: *Senna obtusifolia*, feedstuff, digestibility, anti-nutrition, liveweight, sheep.

INTRODUCTION

Senna species, including *Senna obtusifolia, Senna fistula, Senna occidentalis and Senna acutifolia* among others are annual or perennial leguminous herbs (Stedmans, 1973). *Senna obtusifolia* is a short-day plant, but the exact light requirements for flower initiation differ by provenance; it is self-pollinating and interspecific crosses have not yielded viable seed. (Aliyu, 2006). The leaves are used as a poultice to treat skin infections, sores, ulcers and insect bites (Aliyu, 2006). Over forty phytochemicals have been identified including obtusifolin, majority of which are found in the seed. Some distinct activities or properties of the chemicals include anti-allergic, analgesic, antianemic, antiasthmatic, antirheumatic, antialopecic among others (Aliyu, 2006). Whereas their dry leaves are browsed by ruminants, a good number of them are noted for their medicinal properties. For example aqueous extract of the dry leaves of *Senna acutifolia* and *Senna fistula* are good laxatives and carminatives, a property that can be employed to relieve constipation in man and animals. *Senna cinnamonum* is the source of aromatic stomachic, an agent that can be used to improve appetite and aid digestion (Stedmans, 1973).

Sheep are selective grazers, preferring short grasses, legumes and a wide variety of low-growing herbs. Adu and Lakpini (1983) reported that average daily intake of dry matter is 1.14, 0.93 and 1.27 kg per 100kg liveweight for Merino, Blackhead and Persian breeds respectively. The daily dry matter requirement of Yankassa sheep has been estimated at 67g/day/kg liveweight while the requirement for its lambs is said to be 54.6g/day/kg liveweight (Adu and Lakpini 1983).

Nutrition is one of the most important factors that determines the performance of sheep (Gatenby, 1986), thus, special attention needs to be given to the type of feed provided for sheep as this must meet the requirements for energy, protein, vitamins, minerals and other micro-nutrients necessary for growth, development and reproduction (Church, 1978, Ngawa and Tawah, 1991). This paper described the use of this non-conventional feedstuff in the diet of sheep; bearing in mind that in Nigeria, conventional diets are either expensive or difficult to come by.

MATERIALS AND METHODS

Experimental diet

Senna obtusifolia (SO) was obtained from, Sokoto, Tureta, Gusau and Zamfara grazing reserves in Sokoto and Zamfara states of Nigeria. The plant specimens were collected when they were young, fresh and green. After cutting, they were air dried on concrete floor in a ventilated room for 6 days during which they were turned over twice daily. On the seventh day, they were sun-dried on concrete floor for three days; thereafter pounded using local mortar and stored in jute sacs. Random samples of these prepared plants specimen were taken and analysed for proximate components. Other feed ingredients used to formulate experimental diet include wheat offal, yellow maize, groundnut cake, blood meal and bone meal. They were obtained from Sokoto central market and used to prepare diets containing 0, (control) 10, 20 and 30% inclusion levels of *Senna obtusifolia*.

Experimental animals

Ten four to five months old Yankassa sheep weighing approximately 14 kg were used in the experiment. Three animals were assigned to each dietary treatment and one served as control. The animals were housed in metabolism cages and fed experimental diets for an initial seven days adjustment period, which was followed by experimental period of 56 days. Feed and water were given *ad libitum* and animals were weighed weekly.

Digestibility trial

Four weeks after the commencement of the experiment, a digestibility trial was introduced which lasted for ten days. During this trial, daily feed intake and feacal output were measured. 100g of feacal samples were obtained from each animal and put in clean polythene bags and transferred into a refrigerator. At the expiration of the 10 days digestion trial, the feacal samples were analysed for proximate composition using the methods of AOAC (1990). The proximate composition in the feaces subtracted from the intake gives an approximate measure of digested feed.

Blood analysis

Blood samples were collected through the jugular vein of the experimental animals on the day they were put into the metabolism cages, and thereafter, samples were collected fortnightly. Heamoglobin was analysed using Dippelfarstab haemoglobinometer, total protein by biuret method; and bilirubin, serum glutamic-oxaloacetic transaminse (SGOT) and serum glutamic-pyruvic transaminase (SGPT) were assessed using Corning colorimeter. Alkaline phosphatase and urea were determined using diacetyl monoxine extraction procedure (Tietz,1987); creatinine, sodium and potassium were analysed on Seac Fp 20 flame photometer while bicarbonate ion was determined by the tetrimetric method (Tietz,1987).

RESULTS

Chemical composition of experimental diets

Chemical composition of experimental diets is shown on table I. The crude protein content of the experimental diets were similar while fibre contents increased with increasing levels of *SO*. The metabolizable energy (ME) value for the 30% *SO* diet was slightly higher than those of the other treatments.

Table I: Chemical composition of the experimental diets

Item	*S. obtusifolia*	Treatment (% inclusion level of *SO*			
		1(0)	2(10)	3(20)	4(30)
Dry matter	96.91	92.39	92.52	92.56	92.35
Crude protein	15.22	18.00	17.98	17.87	17.99
Crude fibre	21.73	6.78	8.27	9.64	10.70
Crude fat	3.73	4.82	4.32	4.49	4.75
N.F.E.	44.74	65.81	63.99	61.80	59.80
Total ash	12.80	4.59	5.54	6.20	6.76
Calcium	2.89	0.12	0.41	0.69	0.97
Phosphorus	0.69	0.21	0.65	0.72	0.75
ME (kcal/kg)	2476.8	2412.3	2407.3	2476.9	2610.8

Table II: Performance characteristics of sheep fed different levels of *Senna obtusifolia*

	Treatments (% inclusion levels of *SO*)			
Parameters	1(0)	2(10)	3(20)	4(30)
Initial weight (kg)	14.0 1.0	14.0 1.0	14.2 0.4	13.8 0.6
Final weight (kg)	22.3 1.6	21.8 0.8	24.7 1.0	20.2 0.5
Final weight gain (kg)	8.3^{b}	7.8^{c}	10.5^{a}	6.4^{d}
Daily weight gain (g)	148.8^{b}	139.8^{c}	187.5^{a}	114.6^{d}
Daily feed intake (g)	827.9^{b}	767.6^{c}	867.3^{a}	693.5^{d}
Daily protein intake (g)	149.0^{b}	138.2^{c}	156.1^{a}	124.8^{d}
Feed conversion ratio	5.6^{b}	5.5^{b}	4.6^{c}	6.1^{a}
Protein efficiency ratio	1.0	1.0	1.2	0.9
Cost of feed (x/kg)	25.97	23.85	21.48	20.25
Cost of feed consumed (x/kg)	21.4^{a}	18.3^{b}	18.6^{b}	14.0^{c}
Cost of feed/kg live weight gain(x)	143.8^{a}	130.9^{b}	99.4^{d}	122.5^{c}

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

Table III: Nutrients digestibility in sheep fed graded levels of *Senna obtusifolia*

	Treatments (% inclusion levels of SO)			
Parameter	1(0)	2(10)	3(20)	4(30)
Dry Mater (DM)	67.59^{c}	55.98^{d}	73.97^{a}	71.95^{b}
Crude Protein (CP)	78.64^{b}	64.21^{c}	78.33^{b}	80.20^{a}
Crude Fibre (CF)	79.98^{a}	63.78^{d}	78.15^{b}	66.43^{c}
Crude Fat (EE)	71.40^{d}	82.58^{b}	91.24^{a}	74.21^{c}
Nitrogen Fee Extract	60.54^{d}	69.46^{c}	80.77^{b}	82.70^{a}
Total Ash (TA)	421.81^{a}	30.80^{c}	25.88^{d}	29.34^{c}
Calcium (CA)	65.65^{a}	36.75^{b}	66.46^{a}	64.63^{a}
Phosphorus (P)	63.36^{b}	56.28^{c}	68.54^{a}	48.96^{d}

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

Table IV: Blood chemistry of sheep fed graded levels of *Senna obtusifolia*

	Treatments (% inclusion of SO levels)			
	1(0)	2(10)	3(20)	4(30)
Haemoglobin (g/100 ml)	13.3[a]	10.2[c]	13.6[a]	12.2[b]
Total bilirubin (mg/100 ml)	0.9[a]	0.4[c]	0.5[b]	0.4[c]
Conjugate bilirubin (mg/100 ml)	0.1[b]	0.1[b]	0.3[a]	0.1[b]
Total protein (g/d)	8.0[a]	6.0[b]	5.7c	6.1[b]
Albumin (g/dl)	2.4[c]	3.2[b]	3.2[b]	3.5[a]
SGOT (IU/L)	9.0[c]	11.0[a]	3.0[d]	10.0[b]
SGPT (IU/L)	22.3[a]	19.0[b]	7.0[d]	16.0[c]
ALP (King Armstrong unit)	156.7[b]	80.0[d]	134.0[c]	165.6[a]
Urea (mg/100 ml)	7.8[a]	4.5[d]	5.5[c]	7.3[b]
Creatinine (mg/100 ml)	0.9[c]	0.9[c]	1.1[b]	1.3[a]
Na^+ (mmol/L)	144.0	137.0	139.0	142.0
K^+ (mmol/L)	6.6[a]	3.9[c]	4.1[b]	4.5[b]
Cl^- (mmol/L)	111.0	101.0	107.0	109.0
HCO_3^- (mmol/L)	16.6[c]	25.0[b]	25.0[b]	26.0[a]

Means on the same row with different superscripts (a, b, c, d) are significantly different (P<0.05)
SGOT: Serum glutamaic oxaloacetic transaminase
SGPT: Serum glutamic pyruvic transaminase
ALP: Alkaline phosphatase

Feed intake and liveweight gain

Table II described the pattern of feed intake in relation to liveweight gain (g) in sheep fed graded levels of *SO*. The liveweight gain (g/d) was higher (P<0.05) for the 20% *SO* diet (187) followed by the control diet (149).

Similarly, the daily weight gain (g) recorded for the 10% *SO* diet (140) was higher than that recorded for the 30% *SO* diet (115). Feed and protein intakes followed a similar pattern while the feed conversion ratio was best at 20% inclusion of *SO*. Protein efficiency ratio did not differ significantly between the treatments. Cost of feed (x/kg) decreased from x26/kg for the control diet to x20/kg for the 30% *SO* diet. Cost of feed consumed followed a similar pattern with a significant decrease (P<0.05) from x21/day for the control diet to x14/day for the 30% *SO* diet. Cost of feed per kg liveweight gain however decreased from x144 for the control diet to x99 for the 20% *SO* diet, and then rose to x122 for the 30% *SO* diet (P<0.05).

Nutrients digestibility

The digestibility of various nutrients of *SO* is depicted in table III. Dry matter digestibility was higher (P<0.05) for the 20% diet followed by the 30% level, while crude protein digestibility was higher at the 30% inclusion level compared to the control and 20% levels, which are similar. Nitrogen free extract digestibility increased significantly (P<0.05) with increasing levels of *SO,* while ash digestibility decreased up to the 20% inclusion level and thereafter increased.

Blood chemistry

As shown in table IV, haemoglobin was significantly higher in the control and 20% *SO* diets compared to the other treatments (P<0.05). Total and conjugate bilirubin were higher in control and 20% level as compared to other treatments. ALP increased significantly from 80 KAU for the 10% *SO* diet to 166 KAU for the 30% *SO* diet, while urea was higher at the control level compared to other treatments. Creatinine had the highest value (1.3 mg/100) at the 30% inclusion, while the control and 10% inclusion had similar values. Na^+ and Cl^- however did not show any significant change across the treatments.

DISCUSSION

The highest liveweight gain was recorded for animals fed the 20% *SO* diet followed by the control diet and the 10% diet in that order. Daily feed intake and protein efficiency ratio remained constant across the treatments. The decrease in feed intake at the highest level of inclusion (30%) could be attributed to energy content of the diet. Onwuka and Akinsoyinu (1989) reported metabolizable energy (ME) requirement for sheep and goats to be 0.98 and 3.88 Mcal/day/kg $^{0.734}$ for maintenance and liveweight gain respectively. The 30% inclusion of *SO* contained the highest energy level (2,611 kcal of ME) compared to the other treatments (2,407 to 2,477 kcal/kg). It has been well documented that in animals, feed intake is regulated by the energy content of the feed. Thus the higher the metabolizable energy content, the lower the feed intake (Goranzon *et al.*, 1983). Another factor that could be responsible for the reduced intake of the high *SO* containing diet is palatability. Various species *of Senna* are known to contain organic chemicals which are antinutritional. For example, *Senna acutifolia* and *Senna augustifolia* contain sennosides A and B, which are anthraquinone glycosides. These are said to be the laxative agents in the two *Senna* species (Stedmans, 1973). The Chinese *Senna* is the source of *Senna* oil, which contains not less than 80% of the total aldehydes in *SO*. These substances when taken at high levels could cause reduced feed intake. This could be as a result of gastrointestinal upset which makes nutrients (especially protein) less available for digestion, leading to reduced weight gain (Stedmans, 1973).

The best performance was obtained at the 20% inclusion level which was mainly due to better digestibility of nutrients and points to better utilization of the test plant by sheep at the 20% inclusion as compared to 30% inclusion where ME (kcal/kg) of 2611 was higher than 2477 of 20% and control diets. This is expected, because ruminant have better physiological adaption to utilize high fibre diets. Furthermore, anti-nutritional factors have far more deleterious effects on monogastric animals than ruminants. Vaithiyanathan and Kumar (1993) reported that tannin and phytates form complexes with dietary proteins, thereby inhibiting protein metabolism and utilization in monogastric animals. However, enzymes produced by bacteria in the reticulum and rumen of ruminants are capable of destroying some of the anti-nutritional substances present in ingested feeds (Mc Donald *et al*., 1973). This could explain why in sheep, there was improvement in performance (and even better than the control) at the 20% inclusion level of *SO*.

Increase in blood protein is most often associated with increase in the quantity of albumin, while a decrease in albumin is often accompanied by a relative hypoproteinemia (Stockham and Scott, 2002). This is in line with our observations, because while amongst the treatment group total protein was higher ($P<0.05$) in the 30% *SO* containing diet compared to the control, albumin level of 3.5 g/dL was the highest across the treatments. The total bilirubin decreased from 0.9mg/100ml with the control diet to 0.4mg/100 ml with 10 and 30% *SO* diets. While an increase is due to extravascular haemolytic disorders, decrease is seen in obstructive colistasis, and this was not observed in this study (Stockham and Scott, 2002). Na^+ and Cl^- values increased significantly between the 10 and 30% levels but fell below control values. These increases may be due to continuous ingestion of common salt contained in the salt lick used in the preparation of the diets and offered to the sheep *ad libitum*. However, the highest values at 30% of 142 and 109 mmol/L were still below the control values of 144 and 111 mmol/L, meaning that the hypernatremia and hyperchloremia observed are transient and may not be clinically significant.

Cost of feed per kg liveweight gain (x) decreased with increasing levels of *SO* in the diets. The least cost of feed per kg liveweight gain (x) of 99 was recorded at the 20% inclusion level of *SO*. In order to maximize profit from investment in sheep production, the use of *SO* in formulating ration for both commercial and small holdings should be restricted to 20% inclusion. This 20% inclusion level of *SO* supplementation is therefore the most economical, and is hereby recommended.

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