

Nutritional Potential of Acacia (*Acacia Nilotica* (L.) Del.) Pods for Growing Red Sokoto Goats

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Abstract: An experiment to evaluate the potentials of *Acacia nilotica* pods as replacement for cotton seed cake (CSC) on nutrients digestibility, haematological parameters and growth performance of Red Sokoto goats was conducted. The aim was to explore the possibility of reducing the high cost of feeding goats by using alternative source of protein instead of the highly demanded and costly conventional sources of protein like CSC. Twenty five Red Sokoto goats (bucks) having average age of 10 months, and average weight of 10.3 ± 0.1 kg were blocked to balance for weight in a Completely Randomized Block Design (CRBD) experiment, and assigned to 5 treatments having 5 animals per treatment. They were fed graded levels of sun-dried *Acacia* pods as replacement for CSC, and dried sweet potato forage as basal diet. The proximate analysis of the diets compounded with graded levels of sun-dried *Acacia* pods with other feed ingredients showed that zero inclusion of *Acacia* pods (control), had the highest percentage of crude protein (CP) 17.56%. The percentages of CP decreased in the diets as the level of *Acacia* pods inclusion increased. The control diet also had the highest percentage of dry matter (DM) 94.41%, while the least value of DM was recorded in 100% *Acacia* pods level (93.21%). The levels of metabolizable energy (ME) in the diets ranged from 2322 to 2549 ME (Kcal/kg). While the crude fibre (CF) in the diets ranged from 10.72 to 14.26%. There were no significant ($P > 0.05$) differences in daily feed intake (DFI) and final body weight (FBW) in Red Sokoto goats fed graded levels of sun-dried *Acacia* pods. There were significant ($P < 0.05$) differences in weight gain (WG), daily weight gain (DWG), feed conversion ratio (FCR) and cost per weight gain (CPWG) across the treatments. Goats fed 25% level of sun-dried *Acacia* pods performed better than the other animals in the other treatments in terms of WG, DWG, FBW and had the cheapest cost per weight gain in Naira (₦/kg). There were significant ($P < 0.05$) differences in the digestibility of most of the feed nutrients and in water intake (WI) in the treatments. Also there were significant ($P < 0.05$) differences in all the blood parameters (Packed Cell Volume (PCV), Haemoglobin (Hb), Total Plasma Protein (TPP), Plasma Urea Nitrogen (PUN), and Creatinine (Cr)) measured in this experiment. It was therefore, concluded that 25% of sun-dried *Acacia* pods can be used to replace CSC in the diets of Red Sokoto goats without having any adverse effect on nutrients digestibility, blood parameters and their performance. *Acacia* pods can also be used to significantly reduce the high cost expended in feeding goats with conventional sources of protein and to increase availability of animal protein, as well as increase the profit margin of goat farmers.

I. Introduction

The most difficult constraint in small ruminant production in the tropics is the inadequacy and poor quality of the available energy and protein feed stuffs, particularly during the dry season (Njoya, *et al.*, 2005; Olafadehan, *et al.*, 2009).

The above situation according to Ademosun (1985) and Topps (1992) calls for search for cheaper and locally available alternative feed stuffs which should be nutritionally viable, non-toxic and of little or no dietary value in human diets. *Acacia* species (including *Acacia nilotica* pods) meet all the above requirements, except that it requires one form of processing or the other to reduce the amount of anti-nutritional factors (tannins) in them (Mokoboki, *et al.*, 2005).

Acacia nilotica has great potential for feeding livestock, especially during period of drought and feed scarcity (Tanner, *et al.*, 1990; Sawe, *et al.*, 1998). However, notwithstanding its availability in Nigeria, especially in the northern states and its great potential for feeding livestock; its use for feeding livestock is still very low. In Nigeria, it is mainly used for leather tanning, and to a lesser extent for medicinal purposes and for the control of erosion in desert prone areas.

Tannin in *Acacia* species can be greatly reduced by subjecting them to processing in various ways, by soaking pods in polyethylene glycol (PEG), boiling pods in water, adding charcoal to pods, crushing and soaking pods in wood ash (NaOH) or ammonia solutions (NH₃) or by sun-drying (Poage, *et al.*, 2000; Mlambo *et al.*, 2001; Rubanza, *et al.*, 2003; Sikosana, *et al.*, 2006). Most of the above methods of processing *Acacia* pods are either too technical, expensive or harmful to man and livestock, particularly when used wrongfully. In this experiment, *Acacia* pods processed by sun-drying for 7 days (a relatively safer, cheaper and less harmful

method) were used in the diets of Red Sokoto goats to replace CSC at different graded levels; to evaluate its effect on the digestibility of nutrients, blood parameters and growth performance of Red Sokoto goats.

II. Materials And Methods

Experimental Site

The experiment was conducted in the experimental unit of the Small Ruminant Research Programme of the National Animal Production Research Institute, Ahmadu Bello University, Shika, Zaria. Shika is located in the northern guinea savannah on latitude 11° 12'N and longitude 7° 33'E, at altitude of 610m above sea level. Annual rainfall is about 1100 to 1200mm, while mean temperature is about 24.4°C (14.5 to 39.3°C), with the lowest temperature occurring during early dry season (November - January). Higher temperatures are experienced during the late dry season, from February to April (Google Earth, 2012).

Proximate and Chemical Analysis of Feeds

Samples of feeds formulated with sun-dried *Acacia nilotica* pods to replace CSC at 0-100% levels were collected and chemically analyzed to determine their DM, CP, CF, Ether extract (EE) and Ash contents using AOAC (2000) method. Hemicellulose (HC), Acid detergent fibre (ADF) and Neutral detergent fibres (NDF) were determined by the method of Van Soest and Robertson (1998). While urine sample were analyzed for their nitrogen contents using Archer and Robb (1925) method.

Animals Management, Feeds and Feeding

Twenty five Red Sokoto goats (bucks) of average age of 10 months and weighing on average 10.3±1.0kg were used for this experiment. The animals were bought from local markets within Zaria and Makarfi, in Kaduna State, Nigeria. The animals were given prophylactic treatments against endo-parasites, ecto-parasites and bacterial infections 7 days before commencement of experiment. They were dewormed with Albendazole® to control endo-parasites at 3ml/10kg body weight (BW) repeated after 2 weeks, Ivomectin (Ivomec®) to control ecto-parasites at 0.5ml/25kg BW given subcutaneously and long-acting antibiotics (Tridox®) oxy-tetracycline injection to control bacteria at 1.0ml/10kg BW given intramuscularly and repeated after 3 days.

The animals were blocked according to their weight and assigned to 5 treatments each having 5 animals. The animals were individually penned and offered the experimental diets made up of sun-dried *Acacia* pods with other feed ingredients: maize offal, CSC, bone meal, salt and sun-dried sweet potato forage as basal diet. Each animal received a total of 4% of their body weight as daily feed allowance. Out of this total, 40% and 60% were provided by the experimental diets and dried sweet potato forage respectively. The experimental diets were given at 08.00 hours, while the sun-dried sweet potato forage was given 3 hours later. The left-over feed from each animal was measured the following day before feeding them. Water was also provided free-choice to animals, and the feeding trial lasted for 90 days.

Measurements

Data on feed intake, water intake, weekly live weight of animals, blood samples, urine production and samples of feeds offered and faecal output were collected and recorded for chemical and statistical analysis.

Design/Analysis Of Data

The experiment was a Completely Randomized Block Design (CRBD). Data generated from the experiment were analyzed using the General Linear Model (GLM) analysis of variance procedure of Statistical Analytical System (SAS, 2005). Treatment means that were significantly different were separated using Duncan's Multiple Range Test (DMRT).

III. Results And Discussion

The chemical composition of diets containing different levels of sun-dried *Acacia* pods as replacement for cotton seed cake are presented in Table 1.

Table 1: Chemical Composition of Diets Containing different levels of Sun-dried *Acacia nilotica* Pods as Replacement for Cotton Seed Cake (Expt. II)

Parameters (%)	Treatments (Levels of <i>A. nilotica</i>) %				
	0	25	50	75	100
Dry Matter	94.41	94.21	93.62	93.69	93.21
Ash	6.97	6.08	4.53	4.90	4.24
Crude Protein	17.56	17.50	15.38	14.50	14.38
Crude Fibre	10.72	13.13	14.26	13.71	14.13
Ether Extract	18.28	18.29	13.48	10.68	13.92
NDF	45.98	29.48	28.20	41.57	28.64

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ADF	10.66	12.01	16.68	11.47	14.11
HC	35.32	17.47	11.52	30.10	14.53
*ME (Kcal/kg)	2536	2322	2430	2549	2428

*ME=0.0152(DCP) + 0.0342 (DEE) + 0.0128 (DCF) + 0.0159 (DNFE).

According to: Alderman G. (1978).

The above result showed that zero inclusion of sun-dried Acacia pods gave better results in terms of total DM, 94.41%, CP, 17.56% and had the least percentage of CF, 10.72%. Also 25% inclusion of acacia pods gave good results in terms of total DM, CP and CF 94.21%, 17.50% and 13.13% respectively. In addition, the percentage of hemicelluloses (HC) 17.47% in 25% Acacia pods inclusion level was lower than the value of 35.32% recorded in zero percent Acacia pods inclusion. The CP values of the feeds 14.38% to 17.56% fall within the range of 12 to 30% reported by Norton (1998) for most tropical legumes and the range of 10 to 15% reported by Sikosana *et al.*, (2002) for most browse plants. Similarly, Leng (1990) reported that the minimum CP content for rumen functions is 7-8%.

The performance of Red Sokoto goats fed diets containing different levels of sun-dried *Acacia nilotica* pods to replace cotton seed cake are presented in Table 2.

Table 2: Performance of Red Sokoto Goats Fed Diets Containing Different Sun-Dried *Acacia nilotica* Pods to Replace Cotton Seed Cake

Parameters	Treatments (% Levels of <i>Acacia nilotica</i> replacement of CSC)					SEM	LOS
	0	25	50	75	100		
Initial Body Weight (kg)	10.30	10.40	10.30	10.30	10.40	1.20	NS
Final Body Weight (kg)	16.30	16.62	15.62	14.14	14.94	1.92	NS
Daily Intake of Exp. diet (g)	256.93	262.16	249.97	228.94	225.30	29.87	NS
Daily Sweet Potato Intake (g)	342.80	339.71	331.34	316.22	330.42	31.50	NS
Daily Feed Intake (g)	599.73	601.87	581.31	545.16	555.72	59.82	NS
Weight Gain (kg)	6.00 ^a	6.22 ^a	5.32 ^{ab}	3.84 ^b	4.54 ^b	0.86	*
Daily Weight Gain (g)	66.67 ^a	69.11 ^a	59.11 ^{ab}	42.67 ^b	50.44 ^{ab}	9.61	*
Feed Conversion Ratio	8.99 ^c	8.70 ^c	9.83 ^{bc}	12.77 ^a	11.01 ^b	0.84	*
Cost/Weight Gain (₦/kg)	0.61 ^{ab}	0.55 ^a	0.59 ^a	0.71 ^b	0.56 ^a	0.04	*

a, b, c means in the same row bearing different superscripts are significantly different (P<0.05) level, * = significant at P<0.05; and NS = not significant at P>0.05.

There were no significant differences in many of the parameters measured. However, daily intake of experimental diets declined as the level of Acacia pods inclusion increased from 262.16g in 25% Acacia pods level to 225.30g in 100% Acacia pods level. The above result agrees with the finding of Makaranga (2002) who reported reduction in DM intake and CP intake in sheep fed browse diets containing tannins. However, Araya *et al.*, (2003) reported that DM intake, percent in-vitro dry and organic matter digestibilities and body weight gains increased with an increase in the amount of *A. tortilis* pods in the rations of goats, up to 75% level before declining. The total daily feed intake (TDFI) across the treatments did not vary significantly, but the highest TDFI of 601.87g recorded in 25% Acacia pods level was below the values of 768.40g and 790g for goats fed *A. fleckii* and *A. tortilis* respectively as supplements (Aganga *et al.*, 1998). The above differences may be attributed to nutritional differences common in species of Acacia and on the methods of processing used.

Weight gain (WG) differed significantly across the treatments, and the highest WG of 6.22kg recorded in 25% Acacia pods inclusion was similar to the value of 6.23kg reported by Yahaya (2011) when varied levels of *A. seyal del.* Was fed to sheep as supplement.

The nutrients digestibilities and nitrogen balance in Red Sokoto goats fed different levels of sun-dried *Acacia nilotica* pods as replacement for cotton seed cake are presented in Table 3.

Table 4.10: Nutrients Digestibilities and Nitrogen Balance in Red Sokoto Goats Fed different levels of Sun- dried *Acacia Nilotica* Pods as replacement for Cotton Seed Cake.

Parameters (%)	Treatments (% Levels of <i>A. nilotica</i> replacement of CSC)					SEM	LOS
	0	25	50	75	100		
DM	55.50 ^{ab}	55.55 ^a	55.47 ^{ab}	55.38 ^b	55.39 ^b	0.033	*
CP	51.94 ^a	50.69 ^b	51.57 ^{ab}	50.57 ^b	51.88 ^{ab}	0.293	*
Ash	57.63 ^a	55.63 ^b	56.79 ^{ab}	51.18 ^d	53.49 ^c	0.709	*
EE	28.52 ^a	23.56 ^c	25.80 ^b	25.89 ^b	24.83 ^c	0.849	*
CF	22.52 ^b	24.01 ^a	22.30 ^b	23.18 ^{ab}	21.90 ^b	0.371	*
NDF	33.47 ^{ab}	34.18 ^a	33.05 ^b	33.77 ^{ab}	33.32 ^b	0.194	*
ADF	29.20 ^a	30.24 ^a	28.75 ^{ab}	28.39 ^b	28.74 ^{ab}	0.321	*
HC	30.36 ^c	27.60 ^d	30.11 ^c	37.64 ^a	32.05 ^b	1.700	*
Water Intake (ml/d)	6922.5 ^a	6300.0 ^{ab}	5247.5 ^b	6481.3 ^{ab}	5366.3 ^b	454.6	*
<u>Nitrogen balance</u>							

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N Intake (g/day)	234.67 ^a	211.09 ^{ab}	206.86 ^{ab}	182.60 ^b	176.03 ^b	21.67	*
Faecal N (g/day)	78.71 ^a	75.29 ^a	73.43 ^a	53.43 ^b	51.01 ^b	7.78	*
Urinary N (g/day)	31.06 ^{ab}	22.76 ^{ab}	28.60 ^{ab}	36.11 ^a	14.32 ^b	10.39	*
N-Retained (g/day)	124.90	113.04	104.83	93.06	110.70	22.02	NS
% of Intake retained	53.22	53.55	50.68	50.96	62.89	8.05	NS

a, b, c means bearing superscripts in a row differ significantly, SEM = Standard Error of Means, LOS = Level of Significance at P<0.05, NS = Not significant.

The result of nutrient digestibilities and nitrogen retention showed significant differences in most of the parameters measured except nitrogen retention and percentage of intake retained. Water intake (WI) was highest in zero inclusion of Acacia pods 6922.5 (ml/d), this may have been because of the oily and fibrous nature of CSC, as well as the high level of hemicelluloses (35.32%) in diets containing zero percent Acacia pods.

Nitrogen intake (NI) in grammes per day differed significantly across the treatments and followed a defined pattern. It decreased as the level of Acacia pods inclusion increased from 0-100%. The above agrees with the finding of Salem *et al.*, (2006), they reported that ingestion of tannin containing food by ruminants may reduce digestibility of nutrients (particularly protein) and will affect voluntary intake of nutrients.

Faecal nitrogen (FN) also differed significantly across the treatments; it decreased as the level of Acacia pods inclusion increased from 0-100%. This result did not agree with the findings of Van Soest (1994) and Karda *et al.*, (2001); they reported that increasing levels of tannin in diets of animals will also lead to increase in FN excretion because of low digestibility of nitrogen and the formation of tannin protein complexes.

Urinary Nitrogen (UN) differed significantly across the treatment from 14.32-36.11%. This result did not agree with the findings of Van Soest (1994), and Kaitho *et al.*, (1998), they reported that animals on high tannin diets retained more nitrogen by reducing nitrogen excretion through urine. However, in this study nitrogen excretion through urine was high for animals that received 25% to 75% Acacia pods in their diets. Reduction of nitrogen excretion in the urine as reported by Van Soest (1994) and Kaitho *et al.*, (1998) was only remarkable at 100% inclusion of Acacia pods in the diet.

Percent nitrogen retention (NR) did not differ significantly amongst the experimental animals; nitrogen retention decreased as the level of Acacia pods inclusion increased up to 75% and rose again at 100% Acacia pods level. The above did not agree with the findings of Van Soest (1994), Umunna *et al.*, (1995) and Kaitho *et al.*, (1998); they reported that high level of tannin may cause low apparent digestibility of nitrogen, but this may not always lead to decrease nitrogen retention as tannin in the diet increases, because of decreased urinary nitrogen excretion. A possible explanation for the poor NR in this experiment may be the high levels of UN recorded at 25-75% Acacia pods inclusion levels.

The results of Haematological parameters of Red Sokoto goats fed graded levels of sun-dried Acacia pods as replacement for cotton seed cake at different hours of sampling are presented in a trend analysis in Figures 1-5.

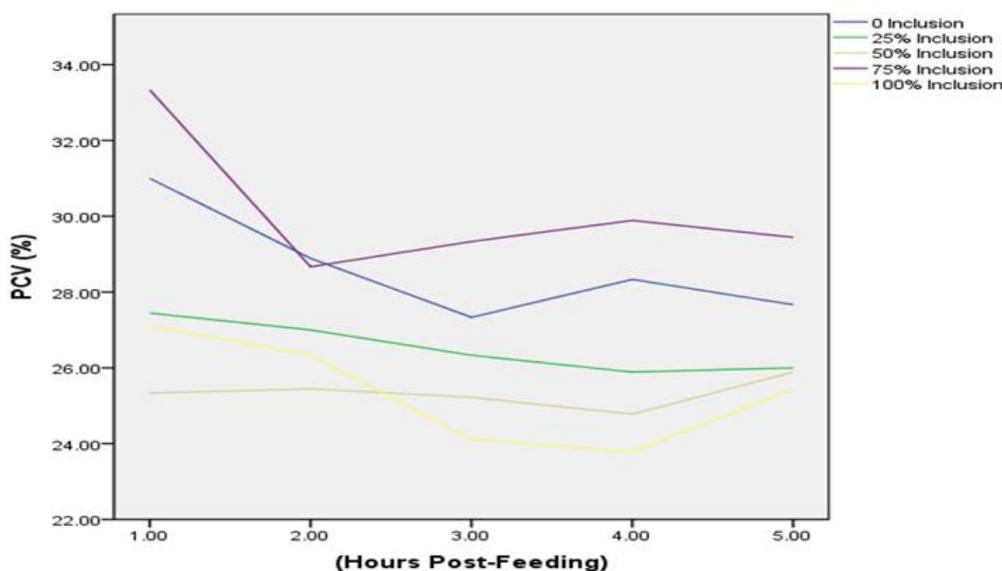


Fig 1: Trend of PCV (%) of Red Sokoto Goats fed graded levels of *Acacia nilotica* pods at different hours of collection.

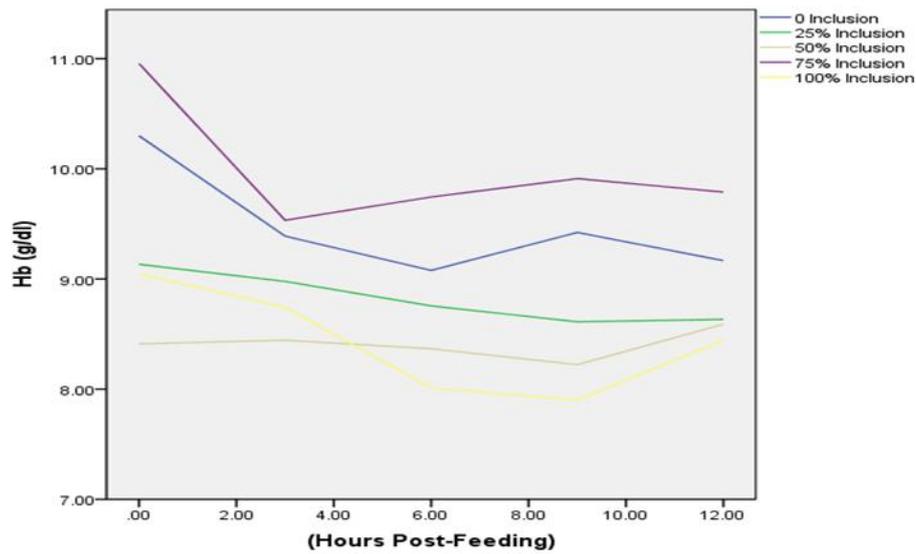


Fig 2: Trend of Hb (g/dl) of Red Sokoto Goats fed graded levels of *Acacia nilotica* pods at different hours of collection.

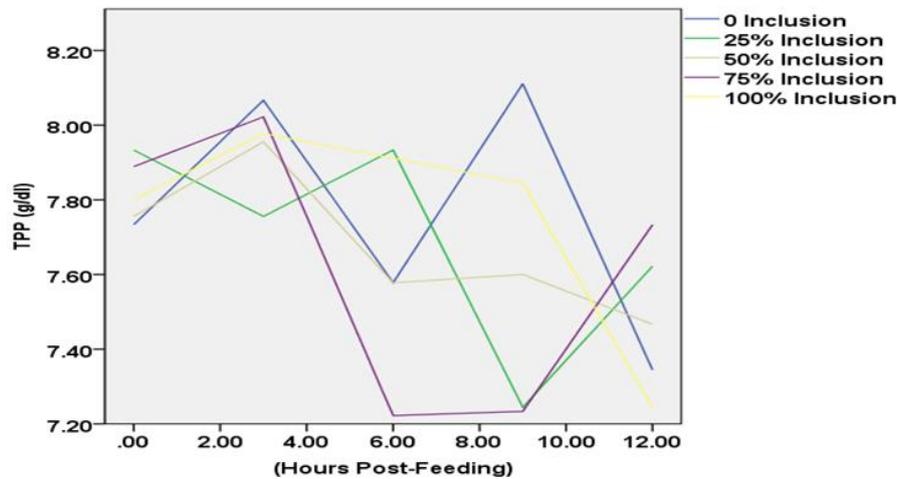


Fig 3: Trend of TPP (g/dl) of Red Sokoto Goats fed graded levels of *Acacia nilotica* pods at different hours of collection.

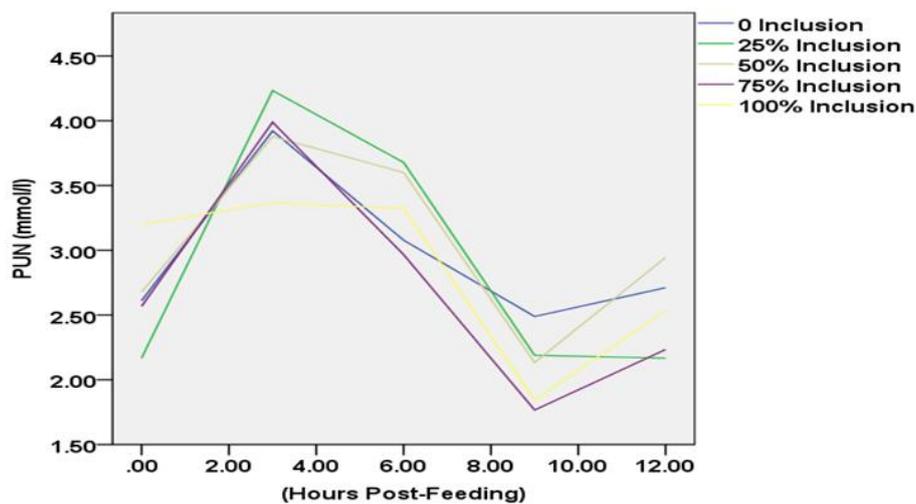


Fig 4: Trend of PUN (Mmol/l) of Red Sokoto Goats fed graded levels of *Acacia nilotica* pods at different hours of collection.

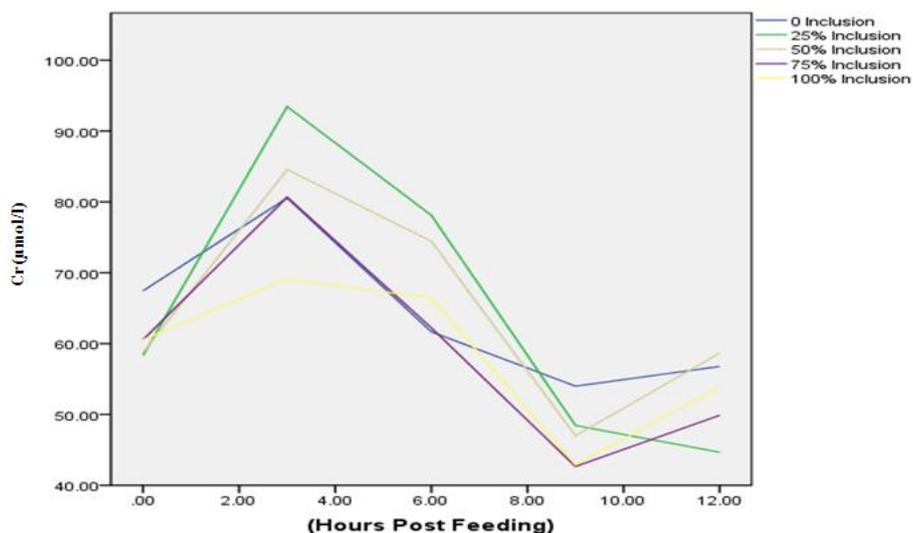


Fig 5: Trend of Cr (μmol/l) of Red Sokoto Goats fed graded levels of *Acacia nilotica* pods at different hours of collection.

The results showed significant differences in all the parameters measured. The range of PCV, Hb and TPP, 23.53 to 33.20%, 7.79 to 11.03g/dl and 6.48 to 8.58g/dl fall within the range of PCV (24 to 45%), Hb (8 to 15g/dl) recommended for goats by Ganti (1983). Also the level of TPP recorded in this study was within the range of 6.4 to 7.0g/dl recommended for the caprine species by Kaneko (1989). However, the range of PUN, 1.84 to 4.45 mmol/l and Cr, 41.93 to 87.87μmol/l were below the range of 2.5 to 6.5 mmol/l of PUN recommended for goats by Mehrez (1976); and the range of Cr, 88.40 to 159.00μmol/l recommended for goats by Kaneko *et al.*, (1997).

While the low levels of PUN recorded in this experiment agrees with the finding of Reed *et al.*, (1990) who reported that high levels of tannins in the diets affect the level of PUN in the blood negatively; the levels of Cr recorded in this experiment may be described as good, this agrees with the finding of Wisloff *et al.*, (2003), they reported that high levels of Cr in the blood may be caused by poor filtration in the kidneys due to muscle catabolism when the kidneys are either weak or diseased.

IV. Conclusion

From the above results and findings, the following conclusions are made:

- Sun-dried *Acacia nilotica* pods can be used as alternative source of protein in the feeding of Red Sokoto goats.
- Cost of production in Red Sokoto goats can be greatly reduced by replacing CSC in their diets with 25% sun-dried *Acacia nilotica* pods

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