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NUTRIENT COMPOSITION AND FEED VALUE OF THE FRESH LEAVES AND SUCCULENT STEMS OF FICUS THONNINGII FOR GROWING RABBITS

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ABSTRACT

Four groups of weaner rabbits were each offered one of the following diets: grower concentrate diet, *ad libitum*, a sole diet of the fresh leaves and succulent stems (FLSS) of *Ficus thonningii*, *ad libitum*, both concentrate diet and FLSS of ficus, *ad libitum*, or FLSS of ficus, *ad libitum*, plus 50% of the concentrate intake of rabbits fed only concentrate. The ficus forage was found to contain 56% DM, 11% CP, 24% CF, 3667 kcal/kg GE and 8.22 mg HCN/kg among other secondary plant metabolites. Arginine, methionine and lysine content of ficus FLSS were found to be higher than for most other plant proteins (4.08, 0.82, 3.60g/100g protein respectively). Rabbits fed only concentrate gained weight faster than the other rabbits, but production cost was lower for rabbits fed both FLSS and concentrate. Rabbits fed only ficus FLSS lost weight at the rate of 9g/day and all died before the end of the 4th week of the study. It was concluded that, whereas FLSS of ficus was not a suitable sole feed for young rabbits, it can be advantageous if fed in combination with concentrate feed.

Keywords: Concentrate, fresh leaves, *Ficus thonningii*, rabbits, sole feed

INTRODUCTION

Population and income growth are fueling an ongoing trend towards greater per capita consumption of animal protein in developing countries like Nigeria, Ghana, and others (World Livestock, 2011). Sustainable livestock production requires an environmentally friendly approach that reduces the level of pollution generated by production of livestock *per se*, and utilize agro-waste which often become pollutants when not properly disposed of, availability and cost of feed dictates how many animals can be reared and how fast they can mature for consumption. High cost of animal products is attributed to feed cost (FAO, 1985), which is a limiting factor. Conventional feed ingredients are costly in the developing world, where they often double as human food staples, hence the necessity to search for alternative feed sources. The target materials are those that are either unsuitable for human consumption, or that have very low human preference, and therefore very cheap.

Rabbit production, using unconventional feed sources, is a viable means of correcting the shortage animal protein in tropical Africa, owing to rabbits' high fecundity and efficiency in converting low quality plant material into high quality animal protein. Rabbits can thrive, even solely, on a wide range of fresh or preserved grasses, shrubs and tree leaves, making their feeding very cheap (Ayoade *et al.*, 1985, Cheeke, 1987).

Feed forage could be scarce during the tropical dry season, and important feature of rabbit housing in hot climates is maximum ventilation and provision of shade to protect the house or cages from direct sunlight. This is because rabbits, being of temperate origin, easily suffer from heat stress when raised in tropical regions like Nigeria. The question, thus, arises, as to whether a plant species such as *Ficus thonningii*, which has dense evergreen foliage, and is widely used as shade and ornamental plants, could provide both forage and shade to rabbit

production units. Rabbits being of temperate origin, easily suffer from heat stress when raised in tropical regions like Nigeria.

The aim of this study is therefore, to determine the nutrient and anti-nutrient composition of the fresh leaves and succulent stems (FLSS) of Ficus and the effect of feeding it on the performance of weaner rabbits.

MATERIALS AND METHODS

The concentrate feed was formulated to contain eighteen percent crude protein and 2700 kcal/kg energy (Table 1). The soybean used in the diet was heat treated according to the procedure described by Shaahu *et al.* (2014). The fresh leaves and succulent stems were harvested from *Ficus thonningii* trees around Makurdi town. Makurdi is the capital of Benue State with Latitude 7° 43' North and Longitude 8^{o} 3' East and ambient temperature ranges from 17.3oC – 24.5oC minimum and 29.8oC -35.6oC maximum. The forage was harvested in the morning, washed and left to wilt overnight before being fed to the rabbits.

Samples of *Ficus* forage, and the concentrate diet were analyzed in duplicate for proximate components and gross energy. The gross energy of *Ficus* forage and concentrate diet were determined using a Gallenkamp ballistic bomb calorimeter (A.O.A.C., 2002). Amino acid and tannin content of *Ficus* forage, was determined using the A.O.A.C. (2002) methods. Other anti-nutritional factor content of *Ficus* forage were determined using the following methods: Saponin, and trypsin inhibitor according to Kakade *et al*. (1974), oxalate and alkaloid according to Henry (1993), cyanide, phytate and haemagglutinin was according to Bradbury *et al.* (1999), Maga (1983), and Liener (1955) respectively.

Twenty crossbred weaned rabbits weighing between 646 – 675 g, obtained from the University of Agriculture Makurdi, were allocated to four groups, balancing for live weight and sex and randomly allocated to four treatments. Each rabbit was individually housed in a cage made from wood and wire mesh, measuring 50cm x 30cm x 40cm (length, width and height respectively) raised 50cm above the floor in an open sided dwarf walled building screened with wire gauze . The cages were equipped with metal feeders and concrete drinkers. Before rabbits were introduced, the cages were thoroughly cleaned, using detergent and disinfectant, and dried. The rabbits were allowed an acclimatization period of seven days before commencement of the experiment.

The diets fed, which represented the experimental treatments, were as follows.

Treatment 1 (T1) concentrate only, *ad libitum*.

Treatment 2 (T2) FLSS only, *ad libitum,*

Treatment 3 (T3) both the concentrate diet and the FLSS, fed separately and both ad-libitum.Treatment 4 (T4) FLSS *ad libitum* in addition to 50% of the daily concentrate feed intake of rabbits in T1.

Each rabbit was given 0.02ml of *ivermectin* (each ml contains 10mg of ivermectin and 1ml solvent), subcutaneously, at the start of the experiment and as a prophylactic treatment, coccidiostat (*Embazin-forte*©) was administered in drinking water. Data collected was subjected to analysis of variance (ANOVA) for Completely Randomized Design (CRD) and where significant differences were indicated among treatment means, they were separated by Duncan's multiple range test using the Statistical Package for Scientific Solutions, 21st version (SPSS 21, 2016) software.

Table 1: Ingredient and Nutrient Composition of Concentrate Diet fed to rabbits.

Ingredient (%)	**Quantity (kg)**	**Calculated Nutrient Content (%)**	
Maize	31.98	Crude protein	18.00
Full Fat Soybean	35.22	Crude fiber	13.42
Rice Offal	29.00	Calcium	0.92
Bone Meal	2.00	Phosphorus	0.82
Palm oil	1.00	Lysine	0.98
Salt	0.30	Methionine	0.48
Premix	0.25	ME (kcal/kg)	2712.10
Methionine	0.25		
Total	**100.00**		

Premix (Agrimix Broiler starter) Manufactured by AGRITED NIG.LTD. Suppling the following per kg of diet: vit.A-10,000 iu, vitD3. 3000 iu, E-30 iu, Vit k-0.0023g. Thiamine(B1)-0.0017g. Riboflavin(B2)-0.005g. Pyridoxin(B6)-0.0031g,Vit B12-0.016mg,Biotin-006mg,Niacin-0.031g,Pantothemic acid-0.008g,Folic acid-0.008g Manganese-0.085g,Zinc-0.05g,Iron-0.025g,Copper-0.006g,Iodine-0.001g,Selenium-0.12mg,Cobal33t-0.22mg, B.H.T.-0.06g,Ethoxyquin-0.065g,Choline Chloride-0.02g.

RESULTS

Chemical composition of Fresh leaves and succulent stems of *Ficus thonningii*

Results obtained from proximate and anti-nutritional factor analysis and the essential amino acid profile of the leaves and succulent stems of Ficus thonningii are presented in Table 2. The fresh leaves and succulent stems was found to have 55.65% dry matter, 23.85% crude fiber, 10.75% crude protein, 16.48% ether extract, and 16.48% ash, Nitrogen free extractives content was 36.29%, while gross energy was calculated to be 3667 kcal/kg.

No trypsin inhibitor and haemaglutinin were detected in the leaves and succulent stems of Ficus thonnigii, but high amounts of hydrogen cyanide and alkaloids were found. The amounts of lysine, leucine, phenylalanine and arginine, which are limiting amino acids for rabbits, were also relatively high.

Performance Indices

The result of the effect of treatment on performance is presented in Table 3. There were significant ($P<0.05$) differences in feed intake among treatments. Rabbits fed both Ficus forage and concentrate feed, treatments 3 and 4, had similar feed intake, and this was significantly ($P<0.05$) higher than for those fed only concentrate (Treatment 1). Those fed only forage, (T2), consumed the lowest amount of feed.

Rabbits fed concentrate alone (T1 diet) gained significantly ($P<0.05$) more weight than those on T3 and T4, which were fed both concentrate and forage. Weight gains of these two later treatments were similar. The rabbits fed only Ficus forage, (T2) lost weight steadily at the rate

of about 9 g/day, and they all died before the end of the fourth week of the trial, while there were no mortalities at all in the other treatments.

Table 2: Chemical Composition of Fresh Leaves and Succulent Stems of Ficus thonningii

Proximate Fractions (%)	**Fresh Leaves and Succulent Stems of *Ficus thonningii***
Moisture	44.26
Dry Matter	55.74
Crude Protein	10.75
Crude Fibre	23.85
Ether Extract	4.66
Ash	16.48
Gross energy (kcal/kg)	3667
Anti-Nutritional Factors	
Tannin (%)	0.092
Alkaloids (%)	3.51
Saponin (%)	1.41
Oxalates (%)	0.90
Phytate (%)	1.50
HCN (mg/kg)	8.22
Trypsin inhibitor (TIU/mg)	0.00
Haemaglutinin (HU/mg)	0.00
Amino acids (g/100g protein)	
Lysine	3.60
Histidine	1.82
Arginine	4.08
Threonine	2.33
Cysteine	0.79
Valine	3.72
Methionine	0.82
Isoleucine	3.14
Leucine	6.80
Phenylalanine	4.06

Table 3: Effect of the Experimental Diets on the Performance of Growing Rabbits

	T1	T2*	T3			T4			SEM
			Conc.	Ficus	Total	Conc.	Ficus	Total	
FW (g)	2115.00	550.83		1561.67			1686.67		145.20
DDMI(g)	80.66[b]	31.27[c]	71.18	41.16	112.34[a]	40.34	61.27	101.60[a]	6.81
TWG(Kg)	1.45[a]	-0.95[c]		1.14[b]			1.01[b]		1.29
ADG(g)	15.96[a]	-9.16[c]		12.55[b]			11.12[b]		2.24
FCR	5.27[a]	-13.95[c]		9.22[b]			9.42[b]		2.19
Mortality (%)	0	100		0			0		-

abc= means in the same row with different superscript are significantly (P<0.05). SEM= stanard error of means, FW= Final weight, DDMI= Daily drymatter intake, ADG= Average Daily gain, FCR= Feed conversion ratio, TWG= Total weight gain, *= analysis was done based on final weight of rabbits before

The amount of feed required by the rabbits fed only concentrate was significantly ($p<0.05$) lower than that of rabbits fed both concentrate and forage, to gain a unit of body weight. Rabbits fed only forage lost weight, and, consequently, had a negative feed conversation ratio.

DISCUSSION

Nutrient and Anti-Nutrient Composition of Ficus Forage.

Anti – nutritional factor (ANF) composition

The *Ficus thonningii* forage used in the study was found to contain anti-nutritional factors such as tannin, alkaloids, saponin, oxalates, phytate, HCN, trypsin inhibitor and haemaglutinin

(Table 2). In contrast to other Ficus species such as Ficus aspenfolia and Ficus syncomoms (Niles, 2009, Nkafanuya et al., 2010), the HCN content is high, but no trypsin inhibitor and haemaglutinin activity was detected. This implies amongst the Ficus genus, Ficus thonningii may be a better feed for livestock, since HCN has proved easier to remove from plant material than most other anti-nutrients. Simple procedures such as peeling, maceration and grinding removes substantial amounts of HCN contained in many fresh plant tissues (Carew, 1981, Kumar, 1991).

Amino acid profile

The nutritional value of dietary proteins depends on their amino acid composition and how effectively the proteins are digested and the amino acids are absorbed and utilized by the animal receiving the diet. Arginine, methionine and lysine are very often found to be limiting amino acids in rabbit nutrition (Gama and Fisher, 1970, Cheeke, 1971). Thus the values obtained for arginine, lysine and methionine in Ficus thonningii forage makes it a very good feed for rabbits. The percentage of arginine, methionine and lysine is comparable to that of Tridax procumbens (Igba, 2002), a material that has been long established as suitable for rabbit production (Cheeke, 1971, Aduku and Olukosi, 1990 and Igba, 2002).

Performance

The pattern of feed intake observed in this study where rabbits fed both forage and concentrate feed (T3 and T4) consumed higher amounts of dry matter than those fed only concentrate or

forage (T1 and T2, respectively) is a long established pattern (Cheeke, 1974, Pote et al., 1980, Aduku *et al*., 1986. This same pattern was also observed by Iyeghe-Erakpotobor (2012) while feeding Stylo and groundnut haulms supplemented with concentrate to growing rabbits.

Weight gains for rabbits fed either concentrate feed alone, or concentrate feed in combination with *ad lib*. forage (T1, T3 and T4) were not similar ($P<0.05$), which does not agrees with the findings of Iyeghe-Erakpotobor *et al.* (2006) who reported non-significant ($P>0.05$) differences in daily weight gain for all the treatments when concentrate, grass and legume combinations was fed to rabbits.

Results from the study showed that rabbits fed T3 and T4 performed higher than those fed T1, with no significant difference, however rabbits fed T2 alone lost weight.

The feed conversion results did not agree with findings of Adeyemo *et al*. (2013), Iyeghe-Erakpotobor *et al.* (2006) but agrees with that of Fielding (1991) that rabbits utilize feed better when fed forage in combination with concentrate feed than forages fed alone especially for growing rabbits. Iyeghe-Erakpotobor (2012) fed Stylo and groundnut haulms in combination with concentrate and found out that the feed conversion ratio was similar for all treatments but significantly higher for rabbits fed stylo and groundnut haulms combined with concentrate than with forage or concentrate alone.

Aduku and Olukosi (1990) used cowpea and groundnut husks commonly found in tropical and sub-tropical countries at 50% in diets combined with wheat bran and discovered higher feed conversion efficiency than when fed on wheat bran control diet alone. These findings conclude that feeding concentrates with forage feed gives better feed conversion efficiency.

Mortality

Mortality among rabbits fed only ficus forage (T2), within the first 4 weeks of the study, was 100%, and 0.00% for all other treatments.

The natural diet of rabbits consists of leaves, shoots, fruits and nuts. Rabbits are known to survive, and even thrive on sole forage diets (Cheeke, 1987; Aduku *et al.,* 1986; Carew et al, 1989). It is noteworthy, therefore, that rabbits in T2 lost weight steadily and eventually all died in about 4 weeks. Rabbits fed diets T3 and T4, ate substantial amounts of ficus forage, but in combination with concentrate feed, sustained no mortality at all and performed quite well. Chemical analysis reveal substantial amounts of HCN in the ficus forage fed (Table 3). The lethal dose of hydrogen cyanide for laboratory rats and other monogastric animals has been variously put at between 0.5 and 4.0 mg/kg of HCN/kg of body weight (Montgomery, 1969, Carew, 1981). This amount of HCN, however, has to be ingested as a single dose within about a minute, and this would be the amount of HCN present in about 500 g of the Ficus forage fed. Going by the live weights of the rabbits at the beginning of this study, it would have taken an animal at least 2 days to eat 500g of forage. When ingested over such an interval of time, the amount of HCN ingested would be far below the lethal dose. Ingestion of HCN, per se, is, therefore, unlikely to be the cause of death of the rabbits.

The effects of HCN ingested from the forage fed would have taken the form of chronic cyanide intoxication, the classical forms of which were described (Ekpechi, 1973; Oh, 1976; Okoh, 1987 and Carew, 1981). This is expressed as deficiency of sulphur amino acids because of the abstraction of sulphur to produce SCN in the Rhodanese pathway of cyanide detoxication.

It can be concluded that, where readily available, the tender leaves and stems of Ficus thonningii could be fed to growing rabbits, in combination with concentrate feed.

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