NUTRIENT COMPOSITION OF SELECTED TROPICAL FORAGES AND THEIR EFFECT ON ACCEPTABILITY IN RABBIT FEEDING

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ABSTRACT

Rabbits' ability to use forages is an important factor in rabbit nutrition. Tridax procumbens, Euphobia heterophylla, Alternanthera brasiliana, Aspilia africana, and Tithonia diversifolia are common forages for rabbits. Previous authors have reported the nutrient composition of these plants, but there is scanty information on how the available nutrient affects the consumption preference of these plants. This study was designed to ascertain the effect of nutrients present in these plants on their preferences. A total of 30 weaner rabbits (New Zealand White) were used in the experiment. The rabbits were separated into groups A and B, fifteen rabbits were in each group. Animals in Group A were offered fresh forages, while those in Group B were offered dry forages in a cafeteria arrangement. With the aid of cameras installed in the pens, the behaviours of experimental animals were recorded to help study the frequency of visitation to the various forages. Results of this study showed that E. heterophylla was the most visited, while A. africana was the least visited. The crude protein (CP) in the forages ranged from 4.70 – 5.62% with T. diversifolia and E. heterophylla having the significantly (p<0.05) highest and lowest values, respectively. A. africana recorded significantly highest (p<0.05) values for NDF, ADF and ADL followed by T. procumbens. Hemicellulose of E. heterophylla was significant (p<0.05). It was concluded that of the selected forages, E. heterophylla was the most preferred while the least was A. africana.

Keywords: Rabbits, Forages, Visitation. Preference, Nutrients

INTRODUCTION

There is competition in the use of conventional feed ingredients like maize, sorghum, and wheat among others, for human consumption and as feed ingredients in the livestock industry which has made feeding more expensive in the industry. This competition can be reduced by raising rabbits on forages (Safwat *et al.*, 2014) since rabbits can make good use of forages as a result of the presence of a caecum in their digestive system, which allows them to carry out caecotrophy; a process similar to chewing the cud in ruminant animals. Several authors (Togun *et al.,* 2008; Adeyemo *et al.*, 2014; Okpakpor *et al.*, 2021) have reported that rabbits are capable of making use of forages as feed in replacement

of conventional feed ingredients or in combination with concentrates.

Recently, Livestock production has been faced with the challenge of producing large volumes of high-quality animal products at low prices. To achieve this, it is important to use low-cost feed materials which can help reduce the cost of feeding while improving productivity (Steinfeld and Mack,1995). Since rabbits can make use of a range of forages alongside household wastes as feed there is a need for better documentation of such forages. Forages commonly used as feed by small-scale rabbit farmers are those plants that are better referred to as weeds (Okpakpor *et al*., 2022) because they grow in unwanted places and are not planted by the farmers. In a review by Mailafia *et al*. (2010) on the problem and prospect of rabbit production in Nigeria, the authors suggested the need for more studies to be carried out on the nutritional values of tropical forages used in feeding rabbits. Available literature only considers the proximate composition of such plants and not much information is available on how the nutrient composition influences the consumption of such forage. The nutrients, and fibre fraction present in plants may be capable of affecting the palatability of the plants and their preferences hence the need for this study.

MATERIALS AND METHODS

Study Site and Forages: The study was carried out at the Rabbit Unit, Teaching and Research Farm of Federal College of Agriculture, Akure, between April 05 – 19, 2022. *Tridax procumbens* L. (Asterales**:** Asteraceae), *Euphobia heterophylla* L. (Malpighiales**:** Euphorbiaceae), *Alternanthera brasiliana* (L.) Kuntze (Caryophyllales: Amaranthaceae), *Aspilia africana* C. D. Adams (Asterales: Asteraceae) and *Tithonia diversifolia* (Hemsl.) A. Gray (Asterales: Asteraceae) was collected from the Teaching and Research Farm. The selected forages were identified (Utteridge and Bramley, 2015) and authenticated by an agronomist at the Federal University of Technology, Akure and registered in the University's herbarium under the following herbarium codes; *T. procumbens* (0345), *E. heterophylla* (0346), *A. brasiliana* (0347), *A. africana* (0348) and *T. diversifolia* (0344).

Experimental Design and Feeding Trials: A total of 30 unsexed New Zealand White weaner rabbits of about six weeks of age were used in the experiment. The rabbits were separated into two major groups (A and B) of 15 rabbits in each group. Each major groups were subdivided into five smaller groups (representing each forage type) of three rabbits each in a completely randomised design (CRD). Animals in Group A were offered fresh forages, while those in Group B were offered dry forages. The forages were presented in wooden feeding troughs that were properly demarcated into five sections and each selected forage was placed into each section. The feeding troughs were braced with galvanized sheets to prevent the rabbits from eating through the wood. Selected forages were offered to experimental animals in a cafeteria arrangement to study the most preferred forage.

Behaviour of Rabbits During Feeding: With the aid of a V380 Realtek bulb type 360° view panoramic cameras which were installed in the pen, the behaviour of experimental animals during days 1 – 2, 7 – 8 and 13 – 14 were recorded. The entire pen was powered using a 3.5 KVA power generator. The recording was made for the first two hours on the selected days. The video footage collected helped to study the frequency of visitation to the various forages. The experiment lasted for 14 days.

Nutrient Composition of Forages: Nutrient compositions (moisture, crude protein (CP), crude fibre (CF), ether extract (EE), nitrogen-free extracts (NFE), neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) and hemicellulose) in the forages were determined using the methods described in Van Soest *et al.* (1991) and AOAC (2005).

Anti-Nutrient Composition of Forages: Anti-nutrient compositions (saponin, alkaloid, phytate, oxalate and tannin) in the forages were determined using the methods described in Trease and Evans (1989) and Harborne (1998).

Data Analysis: The data obtained from the assay of proximate composition and anti-nutrient parameters in the forages were subjected to statistical analysis. Descriptive statistics for their central tendencies were used to summarize the data. Analysis of Variance (ANOVA), was performed to evaluate significant differences in proximate composition and anti-nutrient parameters between forages, where there was a significant difference, the Duncan Multiple Range Test was used to separate the means at $p<0.05$. The results were presented in tables, and figures to facilitate data interpretation. All statistical analyses were conducted using Statistical Package for Social Sciences (SPSS) version 21.

RESULTS

The relationship between fresh forage consumed and the frequency of visiting by rabbits (Figures 1 and 2) indicated that the most visited forage was also the most consumed, while the least visited forage was the least consumed.

Figure 1: Pictural extract from the video coverage showing the rabbits in a pen with the forages presented. ***Key:*** *A- Tridax procumbens, B- Euphobia heterophylla, C- Alternanthera brasiliana, D- Aspilia africana, E- Tithonia diversifolia*

Forage B (*E. heterophylla*) was the most visited and the most consumed of the selected forages, while forage D (*A. africana*) was the least visited and least consumed in both the fresh and dry forms.

The result of the nutrient composition of the five selected tropical forages used for feeding rabbits indicated that the nutrient composition of the various plants differed significantly ($p<0.05$) from each other (Table 1).

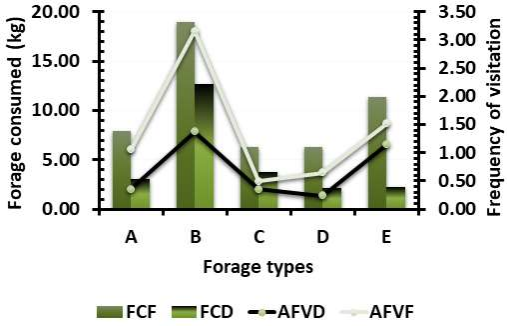

Figure 2: Relationship between forage consumed and visiting frequency by weaner rabbits. ***Key:*** *A- Tridax procumbens, B- Euphobia heterophylla, C- Alternanthera brasiliana, D- Aspilia africana, E - Tithonia diversifolia, FCF - Forage Consumed Fresh, FCD - Forage Consumed Dry, AFVF - Average Frequency of Visiting Fresh Forage, AFVD - Average Frequency of Visiting Dry Forage*

The crude protein (CP) content of the forages ranged from 4.70 ± 0.02% to 5.62 ± 0.01% with *T. diversifolia* and *E. heterophylla* having the significantly ($p<0.05$) highest and lowest values respectively. The crude fibre content of the forage ranges between 2.66 and 8.11%. *A. africana* recorded significantly highest ($p<0.05$) values for NDF, ADF and ADL followed by *T. procumbens*, while varied levels of significance ($p<0.05$) between other plants studied were recorded. The hemicellulose content of *E. heterophylla* was significantly higher ($p<0.05$) while that of *A. africana* was the lowest.

From the result in Table 2, no significant difference ($p>0.05$) was observed across the various treatments for tannin content. *A. africana* had the statistically highest ($p<0.05$) value for saponin while *A. brasiliana* had the significantly lowest ($p<0.05$) value. The values obtained for phytate in this study range from 10.70 to 29.25 mg/g.

DISCUSSION

The video footage from this study revealed that the rabbits scratch their faces with the forelimbs as a result of the itching sensation experienced after visits to *A. africana*. This could be a result of the presence of trichomes (tiny hairy appendages present on the leaves and stems of plants).

Table 1: Nutrient composition of five selected forages used for feeding rabbits

Parameters (%)	*Tridax procumbens*	*Euphobia heterophylla*	*Alternanthera brasiliana*	*Aspilia africana*	*Tithonia diversifolia*
Moisture	78.28 ± 0.14^{b}	80.50 ± 0.28^{d}	79.72 ± 0.01^{c}	76.27 ± 0.02^{a}	81.14 ± 0.01^{e}
Crude Protein	4.90 ± 0.03^{b}	4.70 ± 0.02^{a}	5.52 ± 0.01^{d}	5.62 ± 0.03^{e}	5.46 ± 0.01^{c}
Crude Fibre	8.11 ± 0.01^{e}	5.81 ± 0.00^{d}	2.66 ± 0.01^{a}	3.58 ± 0.01^{c}	2.78 ± 0.01^{b}
Ether extract	1.93 ± 0.03^{b}	1.18 ± 0.01^{a}	2.05 ± 0.01^{c}	1.18 ± 0.01^{a}	1.14 ± 0.02^{a}
NFE	4.82 ± 0.11^{a}	6.13 ± 0.01^{b}	7.49 ± 0.01^{c}	10.92 ± 0.08^{e}	8.05 ± 0.01^{d}
NDF	12.80 ± 0.02^{c}	12.41 ± 0.12^{b}	7.69 ± 0.01^{a}	23.00 ± 0.04^{e}	13.74 ± 0.74^{d}
ADF	7.83 ± 0.12^{d}	5.81 ± 0.24^{b}	5.15 ± 0.02^{a}	22.29 ± 0.00^{e}	7.40 ± 0.12^{c}
ADL	2.80 ± 0.12^{c}	2.60 ± 0.24^{b}	2.01 ± 0.43^{a}	3.40 ± 0.13^{d}	2.00 ± 0.09^{a}
Hemicellulose	4.97 ± 0.07^{c}	6.59 ± 0.18^{e}	2.54 ± 0.01^{b}	0.71 ± 0.04^{a}	6.40 ± 43^{d}

^{abcde} *means on the same row with different letter subscripts are significantly different (p<0.05), NFE- Nitrogen free extracts, NDF- Neutral detergent fibre, ADF- Acid detergent fibre, ADL- Acid detergent lignin*

Table 2: Anti-nutrient composition of five selected forages used in feeding rabbits

Parameters (mg/g)	*Tridax procumbens*	*Euphobia heterophylla*	*Alternanthera brasiliana*	*Aspilia africana*	*Tithonia diversifolia*
Saponin	1.87 ± 0.01^{b}	2.45 ± 0.01^{d}	1.47 ± 0.01^{a}	3.37 ± 0.01^{e}	2.16 ± 0.01^{c}
Alkaloid	4.96 ± 0.01^{a}	5.53 ± 0.01^{c}	5.04 ± 0.02^{b}	5.94 ± 0.01^{e}	5.71 ± 0.01^{d}
Phytate	24.31 ± 0.01^{d}	14.43 ± 0.01^{b}	29.25 ± 0.00^{e}	10.70 ± 0.02^{a}	22.22 ± 0.03^{c}
Oxalate	1.63 ± 0.01^{a}	2.61 ± 0.00^{d}	2.65 ± 0.01^{e}	2.53 ± 0.01^{c}	1.81 ± 0.01^{b}
Tannin	0.03 ± 0.00	0.02 ± 0.00	0.02 ± 0.01	0.02 ± 0.01	0.02 ± 0.00

^{abcde} *means on the same row with different superscripts are significantly different (p<0.05)*

Trichomes are capable of causing itching and burning rashes in humans and other animals that can last up to 12 hours (Melissa, 2023). No visit was recorded to *A. brasiliana* in the first hour of observation. *A. brasiliana* is an herbaceous tropical weed with purple leaves and stems which can make it unattractive to rabbits. Although rabbits do not seem to pay much attention to colours they are more adaptable to green colour (Andreea, 2019). Rabbits are often referred to as protanopic animals because they possess a form of colour blindness where they confuse red and green colour and have a loss of sensitivity to red light (Keil, 2018). The result of this study also showed the rabbits recorded a high frequency of visitation to the forages mostly consumed. Salem *et al.* (2011) reported that rabbits will always visit a spot where they find a preferred feed until such feed is no longer available.

Feeding rabbits solely on any of the selected forages should be discouraged among farmers as the plants do not contain a high quantity of CP and crude fibre to meet the nutrient requirement of the animal. The CP content of the selected forages in this study ranged from 4.70 ± 0.02% (*E. heterophylla*) to 5.62 ± 0.01% (*A. africana*). The selected plants had lower crude protein content than that (12 to 15%) required for growing rabbits, dry does and herd buck (Hofman *et al.,* 2020). When the selected plants are used solely as feed for rabbits, it is important to supplement such feed with protein nutrients to help the rabbit meet with required nutrients. The result obtained for *E. heterophylla* (4.70 ± 0.02% CP) in this study fell within the range reported by Omale and Friday (2010) for fresh and dried samples of the same plant. Chandran (2017) reported 5.00% CP for *A. brasiliana,* while Ikewuchi *et al.* (2009) reported a lower value (3.44% CP) for fresh samples of *T. procumbens.* The hemicellulose content of *E. heterophylla* was significantly higher (p<0.05) than those from all other plants. Gidenne and Lebas (2002) reported that hemicellulose is more digestible in the tract of rabbits than cellulose. The high level of digestibility of hemicellulose in rabbits could be because it is more rapidly hydrolyzed and fermented than cellulose. It is important to note that several other factors could affect the nutrient composition of forages harvested to feed livestock. Some of such factors include maturity

stage at harvest, leaf-to-stem ratio, plant species and cultivars (OSU, 2023). Phytate levels in all the forages studied were high. They could have negative effects on the bioavailability of essential dietary minerals like calcium, iron and zinc to form insoluble complexes that may not be absorbed or utilized causing deficiency of iron and zinc in the rabbits (Kim *et al.,* 2020). Hence the need to consider methods that could help reduce the phytate content of these plants before offering them to the rabbits.

Conclusion: Out of all the selected forages, the rabbits preferred *E. heterophylla,* while the least preferred forage was *A. africana.* Feeding rabbits solely on any of the selected forages should be discouraged as those forages do not contain a high quantity of CP and crude fibre to meet the requirements of rabbits.

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