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Growth and Reproductive Performances of Rabbit Does Fed *Aspilia africana* Leaves in Combination with Other Forages

NseAbasi NsikakAbasi ETIM*, Uduak ANIEFIOK and Ikwo Ibanga WILLIE
Department of Animal Science, Akwa Ibom State University, Obio Akpa Campus, Oruk Anam, Akwa Ibom State, Nigeria.
*Corresponding author, email: etimbobo@yahoo.com

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ABSTRACT

This study investigated if combining *Aspilia africana* with other forages will promote growth without deleterious effect on fertility and reproduction. Eighteen pubertal rabbit does were used for the experiment in Completely Randomized Design of 3 treatment groups, with 6 does per group. Rabbits in each treatment group were fed same concentrate diet (70g/doe/day) and 300g of forages daily, throughout the study. The treatments consisted of (*Calopogonium mucunoides* (150g) and *Ipomea batatas* (150g) without *Aspilia africana*) (T_1; control), *Calopogonium mucunoides* (100g) *Ipomea batatas* (100g) and *Aspilia africana* (100g) (T_2) and *Calopogonium mucunoides* (50g), *Ipomea batatas* leaves (50g) and *Aspilia africana* (200g) (T_3). Results revealed significant differences ($P<0.05$) among the various treatment groups in feed intake. Does in the control group (T_1) had the highest feed intake (216g), followed by T_2 (148g) while T_3 had the lowest feed intake (143g). Various bodyweight parameters, progesterone concentrations and weight of ovaries of does in all the treatment groups were statistically ($P>0.05$) similar. It was observed that feeding *Aspilia africana* with other feed could still yield optimum growth without negatively affecting fertility and reproduction.

1. Introduction

Over the years, rabbit production has gained popularity, especially in Africa with meat production quantities (tonnes) of 7000 in Algeria, 7500 in Sierra- Leone, 3000 in Kenya and 96 in Cameroon as at 2010 (Iyeghe-Erakpotorbor, 2007; Oseni and Lukefahr, 2014).

The white meat from rabbit is highly nutritious, low in cholesterol and sodium levels and easily digestible (Omole et al., 2005; Kalio et al., 2008). The meat does not form uric acid during metabolism. It is recommended for diabetic and hypertensive patients. Rabbit is an economic livestock that can bridge the wide gap in dietary protein intake in Nigeria (Kalio et al., 2008). It produces about 47 kg of meat per doe per year, which is enough to solely meet the animal protein requirements of a medium-sized family under small-scale rural farming systems (Abdulmalik 1994; Hassan and Owolabi 1996; Kalio et al., 2008).
In spite of the fact that rabbit production holds a great potential for meeting the animal protein needs of the people in developing countries, high cost of rabbit concentrates, can constitute serious challenge to its expected expanded production (Oyebiyi *et al*., 2013). It therefore becomes imperative to source for alternative feed sources which are cheap or free of cost and readily available. One of such alternatives is forages, such as *Aspilia africana*.

Although available literature by Eweka (2008); Etim and Oguike (2014); Etim (2016) and Etim (2017) showed that *Aspilia africana* is a growth promoter, studies by Eweka (2009); Oyesola et al. (2010); Etim and Oguike (2015); Olaitan et al. (2015); Etim *et al*. (2017) and Etim and Hagan (2020) reported that it is deleterious to fertility and reproduction. Therefore, this study investigated if combining *Aspilia africana* with other forages will promote growth without deleterious effect on fertility and reproduction.

2. Materials and Methods

2.1. Experimental site and location

The experiment was conducted at the Rabbitry Unit of the Department of Animal Science Teaching and Research Farm, Faculty of Agriculture, Akwa Ibom State University, Obio Akpa Campus in Oruk Anam L.G.A. Obio Akpa is located between latitudes 5°17'N and 5°27'N and between longitudes 7°27'E and 7°58'E. It has an annual rainfall ranging from 3500mm – 5000mm and average monthly temperature of 25°C. Akwa Ibom State is a coastal State lying between latitudes 4°28'N and 5°3'N and between longitudes 7°27'E and 8°20'E, with a relative humidity between 60 – 90%. It is in the tropical rainforest zone of Nigeria.

Figure 1. Map of Akwa Ibom State (Source: Udotong et al., 2017)

2.2 Experimental Animals and Management

Eighteen does of 5 – 6 months of age sourced from Akwa Ibom State, Nigeria were used for the study. The rabbits were dutch and chinchilla crosses and were certified healthy. The animals were allowed two weeks for quarantine and acclimatization. On arrival of the animals to the farm, anti-stress (vitalyte) was administered to check stress. The rabbits were housed singly in cells in rabbit hutches made with wooden frames and wire mesh. The health of the animals was monitored regularly. Regular cleaning was carried out.

2.3. Experimental Design

Six does were randomly distributed into 3 treatment groups in a Completely Randomly Design (CRD). Each treatment was replicated 3 times with 2 does per replicate. The treatment were as follows: T_1 (control) were given 300g of mixed forages (150g of *Calopogonium mucunoides* and 150g of *Ipomea batatas*), daily T_2 were given 100g *Aspilia africana*, 100g of *Ipomea batatas* and 100g of *Calopogonium mucunoides*, daily, T_3 were given 200g of *Aspilia africana*, 50g of *Ipomea batatas* and 50g of *Calopogonium mucunoides*, daily, 70g of concentrate was fed daily to all the rabbits in each treatment groups. The concentrate was compounded using the ingredients on the Table below, while the forages were harvested daily from nearby bush around the research farm of the University and also around the community. The forages were weighed daily with their stems using an electronic.

2.4. Experimental Diet

Each rabbit in all treatment groups were fed 70g of same commercial grower mash (concentrate diet), daily and same quantity (300g) of forages which comprised *Calopogonium mucunoides*, *Ipomea batatas* leaves and *Aspilia africana* leaves. *Aspilia africana* leaves were fed to animals in treatments 2 and 3 only. The forages with the stems were weighed daily before being fed to the rabbits.

2.5. Measurement of Feed Intake

The quantity of feed offered to each animal was weighed every morning using an electronic scale. Daily feed intake was calculated by subtracting the left-over feed from the quantity of feed offered. Percentage composition of daily feed intake was also calculated by dividing quantity of each feed consumed by the total quantity of different feeds consumed. The answer was multiplied by 100.

Feed intake= quantity of feed offered – quantity of feed consumed

$$\text{Percentage composition of daily feed intake} = \frac{\text{quantity of each feed consumed}}{\text{Total quantity of different feeds consumed}} \times \frac{100}{1}$$

2.6. Blood Collection for Analysis

On the 8th week of the experiment, blood samples, 5ml each were collected from 3 does per treatment group and used to determine the sera concentrations of progesterone.

2.7. Measurement of Body Weight

The experimental animals were weighed on arrival to the research farm to obtain initial weight. Thereafter, the does were weighed weekly and on the last day of the experiment using a weighing balance. Growth rate was estimated as shown below:

$$\text{Growth rate} = \frac{\text{Final weight} - \text{initial weight}}{\text{Initial weight}} \times \frac{100}{1}$$

2.8. Measurement of Reproductive Performance of the Rabbits

- *Mating of Animals*

On the 7th week of the experiment, each of the females was taken to a buck's cage and was left overnight for mating at a ratio of 1:1.

- *Slaughtering of Animals and Measurement of Conception Rates*

A week after mating the animals (8th week) of the experiment, three rabbit does were randomly selected from each treatment group. The animals were stunned and slaughtered by severing the jugular vein and carotid arteries. Ovaries were removed from the carcass and weighed with an electronic scale. The number of pregnant does (with developing embryos) were used to calculate conception rates as shown below:

$$\text{Conception rate} = \frac{\text{No. of does that conceived}}{\text{No. of services}} \times \frac{100}{1}$$

2.9. Data Analysis

The data generated were subjected to Analysis of Variance (ANOVA) using Statistical Package for Social Science (SPSS). Significantly different means were separated using Fisher's Least Significant Different LSD (Akindele, 2004).

3. Results and Discussion

3.1. Feed intake and percentage composition of feed intake per doe per day

The result for the daily feed intake and percentage composition of feed intake/doe/day are presented in Figures 1 and 2:

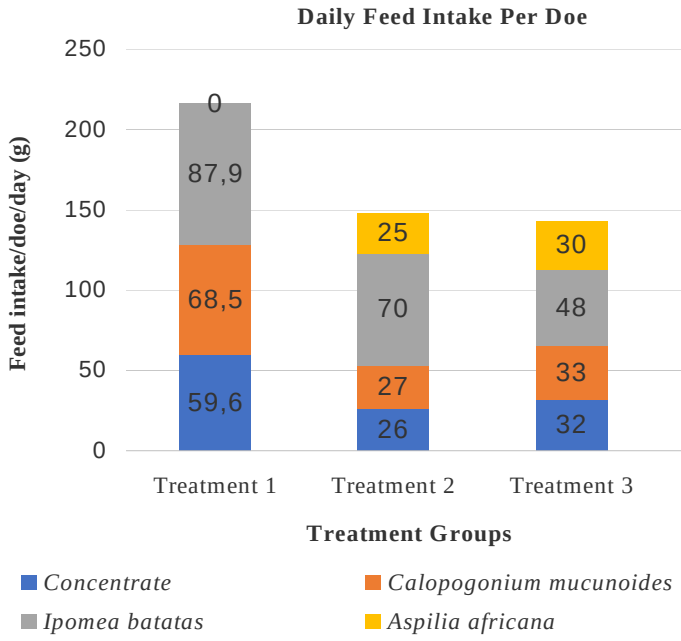

Figure 2. Feed intake/doe/day (g). There were significant differences ($P>0.05$) in the daily feed intake among the various treatment groups.

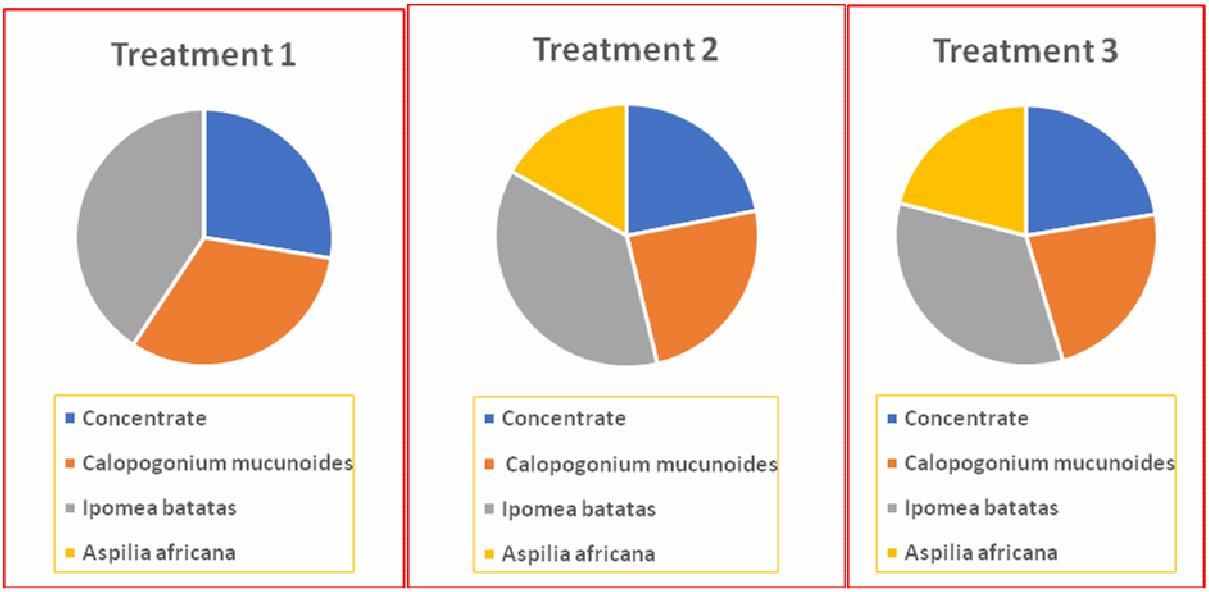

Figure 3. Percentage composition of daily feed intake. Significant differences (P<0.05) existed in the quantities of each feed consumed relative to the total quantity of each feed consumed per doe per day.

The result for feed intake/doe/day revealed significant differences (P<0.05) among the various treatment groups. Feed intake by does in the treated groups (T_2 and T_3) were statistically similar, but different and lower than that of does in the control group. Does in T_1 consumed the highest quantity of feed (216.00g), followed by T_2 (148.00g), while animals in T_3 consumed the least quantity of feed (143.00g). The result of percentage composition of daily feed intake/doe/day also showed that significant differences (P<0.05) existed in the quantity (in percent) of each feed consumed relative to the total quantity of all feeds consumed by does in all the treatment groups. The quantities (%) of *Ipomea batatas* consumed by does in the various treatment groups were significantly higher (P<0.05) and statistically different from the quantities (%) of the other forages and concentrate diet consumed. *Ipomea batatas* was the most consumed feed and made up to 40.69%, 36.83% and 33.57% of the total daily feed intake by does in T_1, T_2 and T_3, respectively. On the contrary, *Aspilia africana* was the least consumed feed by does in the various treatment groups. It only constituted 0%, 16.89% and 20.98% of the feed intake of animals in T_1, T_2 and T_3, respectively.

The observed significant differences (P<0.05) in feed intake/doe/day and percentage composition of daily feed intake could be attributed to the preferences of the animals for *Ipomea batatas*, *Calopogonium mucunoides* and concentrate diet than for *Aspilia africana*. This is because it was observed that the daily feed intake by does in the treated groups (T_2 and T_3) reduced with increase in the quantity of *Aspilia africana*, which may indicate that the animals had higher preferences for the other forages and concentrate diet than for *Aspilia africana*, probably because of the bitter taste of *Aspilia africana*. This finding is consistent with the report by Nwachukwu and Okwuosa (2012), that *Aspilia africana* contains phytochemicals such as saponins, which may serve as anti-feedants. The saponin in *Aspilia africana* are often bitter in taste and so can reduce plant palatability. This explains the reason for the decline in daily feed intake and lower quantities of *Aspilia africana* leaves consumed by does in treatment groups fed *Aspilia africana*. The result of this study varies with the finding by Etim and Oguike (2015), where the intake of *Aspilia africana*/doe/day was statistically similar with the intake of mixed forages (*Panicum maximum*, *Ipomea batatas* leaves, *Centrosema pubescens* and *Musa sapientum* leaves) by does in the control group of that experiment. This may indicate that rabbit does consume larger quantities of *Aspilia africana* leaves when presented as a sole forage than when combined with other forages. The finding of this study also differs from the observation by Elamin et al., (2011), that the weaner rabbits in his study consumed less sweet potatoes vines (61.30g) than Barseem (64.17g) and *C. ternatea* (56.53g). The daily feed intake/animals recorded in this study was lower than those reported by Etim and Oguike (2015), which ranged from 258.33g-323.67g and also lower than 329.71-500.09g reported for sexually matured rabbit does by Ironkwe and Ukanwoko (2016). Conversely, the daily feed intake by does in this were higher than 75.94-90.85g reported by Akinmutimi and Osuagwu (2008) and also exceeds the record of 56.53g-64.17g reported by Elamin et al., (2011) for weaner rabbits.

3.2. Body weight of does fed *Aspilia africana* in combination with *Calopogonium mucunoides* and *Ipomea batatas*

The results for body weight of does fed *Aspilia africana* in combination with *Calopogonium mucunoides* and *Ipomea batatas* leaves is shown in Table 1.

Table 1. Body Weight and Ovarian Weight (g) of Does Fed *Aspilia africana* Leaves in Combination with *Calopogonium mucunoides* and *Ipomea batatas* Leaves.

Parameters	T_1	T_2	T_3	SEM
Initial body weight	1350.00	1350.00	1350.00	0.00
Average weekly body weight	1610.00	1590.00	1600.00	0.01
Final body weight	1630.00	1620.00	1610.00	0.01
Daily weight gain	5.00	4.82	4.64	0.10
Weekly weight gain	35.00	33.75	32.50	0.72
Total weight gain	280.00	270.00	260.00	5.77
Weight of ovary (right)	0. 21	0.39	0.29	0.05
Weight of ovary (left)	0.29	0.25	0.26	0.01

No significant differences (P>0.05) existed in the initial bodyweight of the does in the various treatment groups. During the study, the average weekly body weight of the animals remained statistically similar (P>0.05), although does in T_1 had the highest numerical value of 1610.00g, followed by T_3 with 1600.00g, while T_2 had the lowest weight of 1590.00g. Although the final body weight of the animals were not still significantly different (P>0.05), contrary to the average weekly body weight, does in T_3 had the lowest mean values for final body weight. The same trend was observed for daily weight gain, weekly weight gain and total weight gain. The finding of this study is inconsistent with earlier findings by Etim and Oguike (2014) and Etim (2015) where rabbit does were fed over 321.67g and 323.67g of fresh and wilted *Aspilia africana*, respectively, as sole forage with over 250g of concentrate diet, daily, had significantly higher body weight than the does in the control group that were fed mixed forages (*Panicum maximum*, *Ipomea batatas* leaves, *Centrosema pubescens* and *Musa sapientum* leaves). It also varies with the finding by Etim (2016) who observed significantly higher body weight in West African Dwarf rams administered aqueous *Aspilia africana* extract. This finding is also contrary to the report by Taziebou et al. (2007) who observed slight but non-significant increase in body weight of mice administered aqueous *Aspilia africana* extract. The performances of the does in this study vary with those reported by Ironkwe and Ukanwoko (2016). The finding of this study is contrary to the report by Oyetola et al., (2010), that rats treated with *Aspilia africana* leaf had a significant decrease in body weight. It is also different from the report by Ugwuene and Ojewola (2009) showed that the mean daily weight gain of rabbits fed *Aspilia africana* were significantly greater than those not fed *Aspilia africana*.

The weight of the left and right ovaries of does in the various treatment groups were not statistically different (P>0.05), but does in T_2 had the highest weight for the right ovaries, followed by T_3 while T_1 had the lowest weight. The reverse was the case for the weight of the left ovaries, T_1 had the highest ovarian weight while T_2 had the lowest weight. These results vary with earlier finding by Etim and Oguike (2015) who observed significant reduction in the weight of ovaries (13g) of rabbit does fed *Aspilia africana* as sole forage with concentrate diet. In this study, the weight of ovaries of does fed *Aspilia africana* are higher and range from 0.25-0.39. The findings of this study disagrees with the report by Eweka (2008).

3.3. Progesterone levels in rabbit does fed *Aspilia africana* leaves in combination with *Calopogonium mucunoides* and *Ipomeas batatas* Leaves.

The result for progesterone concentration in does fed *Aspilia africana* leaves in combination with *Calopogonium mucunoides* and *Ipomeas batatas* leaves is shown in Figure 3.

Although the progesterone levels in the does varied numerically, there were statistical similarities (P>0.05) in the mean progesterone concentration in animals in the various treatment groups. While does in T_2 had the highest concentration of progesterone (111.17ng/ml), followed by does in T_1 (109.70ng/ml), the lowest concentration was recorded for does in in T_3 (104.65ng/ml). These values are higher than the highest value of 91ng/ml reported by Welschein et al., (1975) for pseudo-pregnant rats.

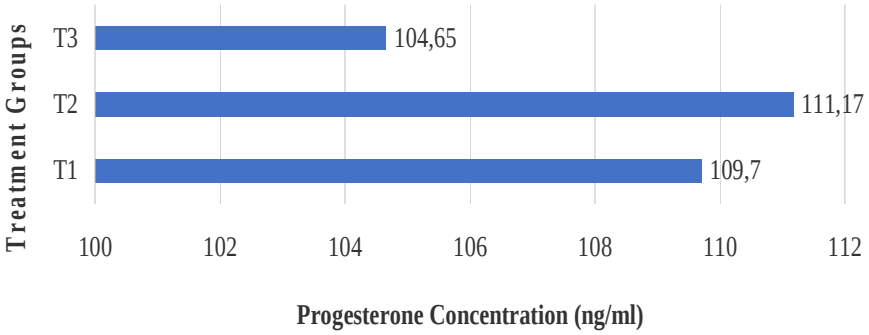

Figure 4. Progesterone Concentration in Rabbit Does Fed *Aspilia africana* Leaves in Combination with *Calopogonium mucunoides* and *Ipomea batatas* Leaves

3.4. Growth and conception rates of rabbit does fed *Aspilia africana* Leaves in Combination with *Calopogonium mucunoides* and *Ipomea batatas* Leaves

Figure 4 shows the results for growth and conception rates of rabbit does fed *Aspilia africana* leaves in combination with *Calopogonium mucunoides* and *Ipomeas batatas* leaves.

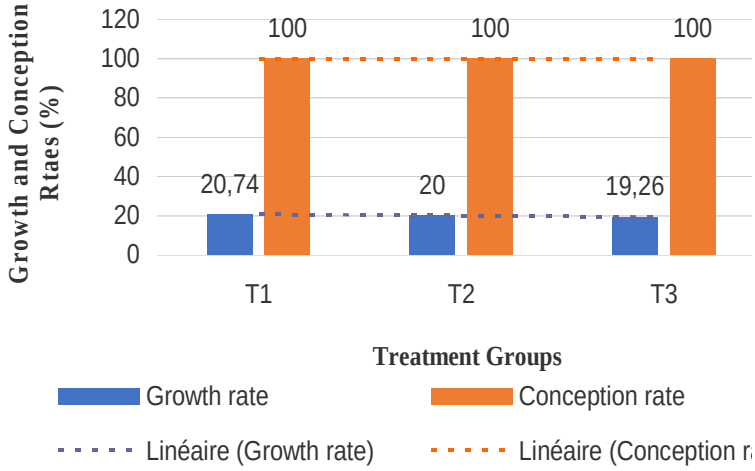

Figure 5. Growth and Conception Rates of Rabbit Does Fed *Aspilia africana* Leaves in Combination with C*alopogonium mucunoides* and *Ipomea batatas* Leaves.

The rates at which the does in the various treatment grew during the experiment were not significantly different (P>0.05). Mean values obtained for T_1 was 20.74%, 20.00% for T_2 and 19.26% for does in T_3. The conception rates of does in all the treatment group were not only numerically similar but also statistically synonymous (P>0.05) (100%). The result for conception rates of rabbit does in this study differs from earlier finding by Etim and Oguike (2015) who observed non-conception in rabbit does fed *Aspilia africana* as sole forage with concentrate diet. This finding is not in line with the reports by Oyesola et al. (2010); Etim and Oguike (2015); Olaitan et al. (2015); Etim et al. (2017) and Etim and Hagan (2020) about the anti-fertility effects of *Aspilia africana*. The conception rates recorded in this study was higher than 26.7% reported by Howard et al., (2006) for dairy cattle administered gonadotropin releasing hormone 5 days after artificial insemination. The recorded conception rate of 100% is also higher than the 60%-90% reported by Ola et al. (2012) for rabbits fed *Moringa oleifera, Tephrosia candida and Cajanus cajan, Centrosema pubescence* or sole concentrate diets.

4. Conclusion

From the study, it was observed that the daily feed intake of the animals reduced with increase in the level of inclusion of *Aspilia africana*, signaling that the does had lower preference for *Aspilia africana* when combined with *Calopogonium mucunoides* and *Ipomea batatas*. The observed statistical similarities in the body weight, growth rates, weight of ovaries, progesterone concentration and conception rates of the rabbit does in the treated groups (T_2 and T_3), despite the significantly low feed consumption by animals in those groups, compared to the enormous quantity of feed consumed by does in the control group may be an indication that lower quantities (25

– 30g) of *Aspilia africana* when combined with forages such as *Calopogonium mucunoides* and *Ipomea batatas* can neutralize the anti-fertility effect of *Aspilia africana* and at the same time support optimum growth. It is recommended that further research be conducted to investigate its effect from time of conception to parturition, in order to ascertain whether the does can successfully carry the pregnancies to full term and to examine the health status of the kits.

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