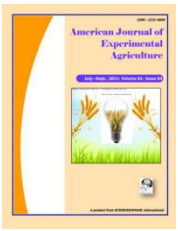

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Dietary Influences of *Aspilia africana* on Litter Traits of Breeding Female Rabbits

NseAbasi N. Etim[1*], Joseph S. Ekpo[1] and Glory E. Enyenihi[2]

[1]Department of Animal Science, Akwa Ibom State University. P.M.B. 1167, Uyo, Akwa Ibom State, Nigeria.
[2]Department of Animal Science, University of Uyo, P.M.B. 1017, Uyo, Akwa Ibom State, Nigeria.

Authors' contributions

This work was carried out in collaboration between all authors. Author NNE designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author JSE managed the analyses of the study. Author GEE managed the literature searches and type setting of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The study examined the effect of feeding *Aspilia africana* on litter traits of breeding does in a replicated completely randomized design at College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria, between March 2009 and June, 2009. Thirty dutch breed rabbit does aged 5 to 6 months were used for the experiment. The treatments consisted of mixed forages (Centrosema pubescens (200g)), Ipomea batatas leaves (100g) and Panicum maximum (200g) without *Aspilia africana* (T_1; control), fresh *Aspilia africana* (500g/doe/day) and wilted *Aspilia africana* (500g/doe/day). The rabbits were fed the same concentrate diet (300g/animal/day) throughout the study and mixed forages from the commencement of the experiment till the does kindled. After parturition, fresh and wilted *Aspilia africana* forages were introduced in Treatment 2 (T_2) and Treatment 3 (T_3) respectively while the control continued on mixed forages throughout the study. The result of the study revealed no significant differences ($P > .05$) in the litter sizes at birth and at weaning among the various treatment groups, though T_1 had the highest numerical mean value at birth (5.60) and lowest at weaning (3.70). Litter weight at birth revealed significant differences ($P < .05$) in which T_1 recorded the highest

**Corresponding author: Email: etimbobo@yahoo.com;*

mean litter weight (261.50g) while T_2 and T_3 weighed 116.50g and 175.00g respectively. At weaning, T_2 recorded significantly higher ($P < .05$) litter weight (736.30g), followed by T_3 (621.30g) while the control group (T_1) weighed the least (410g). The weekly litter weights from birth to weaning showed no significant differences ($P > .05$) in week 1 but from weeks 2 to 4 there were significant differences ($P < .05$) in which litters in T_2 had the highest values, 534.38g, 690.60g and 736.30g while T_1 recorded the lowest mean values of 297.50, 405g and 410g respectively indicating the *Aspilia africana* groups had superior growth rate to the control group. This study revealed that *Aspilia africana* has the potential for increasing body weights of litters during lactation.

Keywords: Aspilia africana; rabbit does; litter traits; forage process.

1. INTRODUCTION

One of the problems facing Nigeria and most developing countries is scarcity of food for the teeming population and feed for the dwindling livestock industry [1]. The relevance of animal protein in human and animal nutrition in Nigeria cannot be overemphasized. In recent times, there has been a significant short fall between the production and supply of animal protein to feed the ever increasing population [2]. Animal protein content in the diets of low income earners that constitute the majority of Nigerian populace is very low [3]. Average consumption of animal protein in this country is estimated at 4.5g/head/day as against a minimum requirement of 35g/head/day recommended by the Food and Agriculture Organization of the United Nations [4]. The level of nutrition greatly influences productivity in livestock, when adequate; it increases animal performance and makes animal products available for human use. Conversely inadequate quantity and quality of feed is known to be largely responsible for low livestock productivity in the tropics [5]. Various plans and agricultural policies have been formulated at one time or the other to combat the acute shortage of animal protein supply [6]. The production of the conventional protein and energy sources is still grossly inadequate in most developing countries of the world and often times demand exceeds supply [7]. This is reflected in the competition between man, livestock and industries for existing conventional feedstuffs which has led to high costs of these ingredients which consequently has contributed to the existing high prices of animal protein for the average Nigerian [8,9]. This situation warrants the evaluation and use of neglected novel plants that are cheap and locally available in feeding animals [10,11]. One of such plants are forages. Proper processing of forages is yet another link in the chain of controlling quality of feedstuffs [12]. One of the forages suitable for feeding rabbits is *Aspilia africana. Aspilia africana* is high in protein, vitamins and minerals. It is reported that *Aspilia africana* contains ascorbic acid, riboflavin and thiamin. It is a good source of minerals such as Ca, P, K, Mg, Na, Fe and Zn [13]. The plant is also reported to be high in anti-nutritional factors such as alkaloids, saponins, flavonoids, phenols and tannins [13], some of which might be reduced through drying/wilting.

Moreover, to meet the increasing demand for animal protein, emphasis needs to be given to non-conventional sources as against the conventional sources such as cattle, sheep, goat, pig and poultry that would require more capital, space and time [3]. Efforts have to be directed towards boosting the micro-livestock sector [2]. There is need to focus attention on the production of livestock whose nutritional requirement does not put much strains on the limited sources of feed ingredients to which men also subscribe. An example of such livestock is rabbit. Adisa [14] stated that if efforts are intensified in encouraging and

motivating rabbit keepers to increase their stock and adapt more rabbit innovations, this will undoubtably increase rabbit production and ensure adequate nutrition for every household through animal protein consumption. This will enable developing countries like Nigeria attain household food and nutritional sufficiency. The means through which the aforementioned can be achieved lies with an improvement on litter traits of breeding does.

Nutritional status, parity, and environment among other factor were identified by [15] as influencing litter traits of breeding does. The litter traits of rabbits are very important features that determine the efficiency of rabbit production [16, 17, 18]. According to [19] breeder could influence the litter size and litter weight at weaning by the food provided for the nursing doe. Increased feed utilization is reported to result in a higher litter birth weight brought by high milk production of does [20]. Burkil [21] reported that *Aspilia africana* is used as lactation stimulant. [15] reported that does fed A. Africana had higher milk production. Lebas [19] observed rapid growth of kits during the peak of lactation coincides with three weeks of lactation. [22] reported that after the third week, milk production gradually declines. Ugwuene [23] reported that the mean daily weight gain of rabbits fed *A. africana* at four weeks of age was significantly greater than others. [23] further observed that feeding *A. africana* or Centrosema pubescens to rabbits at four weeks will enhance their performance.

There is a paucity of information on the effects of *Aspilia africana* on litter traits of breeding does. Therefore, this study was carried out to evaluate the feeding value of *Aspilia africana* on performance and growth of rabbit litters.

2. MATERIALS AND METHODS

2.1 Experimental Location

The study was conducted in the Rabbitry Unit of the Teaching and Research Farm of the College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

2.2 Experimental Animals and Management

Thirty sexually mature nulliparous dutch breed rabbit does and four bucks aged 5 to 6 months were used for the study. The rabbits were certified healthy and were identified with ear tagged for ease of identification. Both sexes were separated. Two weeks pre-experimental period was allowed to enable the animals adjust to the new environment. They were housed singly in rabbit hutches made of wooden frame and wire mesh. The animals were fed concentrate diet 300g/animal/day (Table 1) throughout the period of the trial and mixed forages (Centrosema pubescens (200g/animal/day), Ipomea batatas leaves (100g/animal/day) and Panicum maximum (200g/animal/day) at the ratio of 2:1:2 until the start of the experiment. The does were mated two weeks after commencement of the experiment. The mating ratio was 1 buck : 10 does. The does were taken to the bucks' pen for mating and were all mated within an interval of 3 days. The does were palpated after 14 days of mating to confirm pregnancy. Following kindling (which means the act of giving birth to young ones by female rabbit). *Aspilia africana* forage was introduced as the experimental diet at the rate of 500g per animal per day.

Table 1. Percent composition of concentrate ration

Ingredients	T_1	T_2	T_3
Maize offal	45.5	45.5	45.5
Palm kernel cake	30	30	30
Soybean meal	20	20	20
Blood meal	2.0	2.0	2.0
Bone meal	2.0	2.0	2.0
Vitamin-mineral Premix *	0.25	0.25	0.25
Salt	0.25	0.25	0.25
	100	**100**	**100**

Metabolizable Energy = 2620Kcal/kg; Calcium = 1.10%
Crude protein = 18.0%; Phosphorus = 0.80%

*0.25kg of premix will supply the following: Vitamin A 1500 IU, Vitamin D 300 IU, Vitamin E 3.00, Vitamin K 0.25g, Thiamine 0.2mg, Riboflavin 0.6mg, Pantothenic acid 1.00mg. Pyridoxine 0.4999mg, Niacin 4.00mg, Vitamin B_2 0.002mg, Folic acid 0.10mg, Biotin 0.008mg, Choline 0.05g, Antioxidant 0.012g, Manganese 0.0096g, Zinc 0.0060g, Copper 0.0006g, Iodine 0.006g, Iodine 0.00014g, Selenium 0.024, Cobalt 0.004mg.

2.3 Experimental Design and Data Collection

The experiment was a completely randomized design with three treatments. The treatments consisted of mixed forages (Centrosema pubescens, Ipomea batatas leaves and Panicum maximum) without *A. africana* (control; T_1), fresh *Aspilia africana* (T_2), wilted *Aspilia africana* (T_3). The proximate composition of *Aspilia africana* is presented in Table 2 and that of the control forages (Centrosema pubescens, Ipomea batatas leaves and Panicum maximum) in Table 3. Concentrate diet (300g/animal/day) was offered to does in all the treatment groups during the trial. Ten does were randomly assigned to each treatment, each of which was replicated five times with two does per replicate.

Following kindling, data were collected on the litter size, (which means the offspring produced at one birth by a multi parous animal), litter birth, (which means the (total) weight of all the offspring produced at one birth by a multi parous animal), weight and weekly weight gain of the litters measured using kitten scale. Then at weaning; litter size and litter weight were measured.

Table 2. Proximate composition of *Aspilia africana*

Components (%)	Percent composition
Crude protein	23.0
Nitrogen free extract	43
Crude fibre	20.2
Ether extract	3.0
Ash	8
Metabolizable energy (Kcal/kg)	2920

Adapted from: Ugwuene and Ojewola (2009)

Table 3. Proximate composition of the control forages (Centrosema pubescens, Ipomea batatas leaves and Panicum maximum)

Components (%)	Centrosema pubescens	Ipomea batatas leaves	Panicum maximum
Crude protein	22.8	13.2	8.5
Nitrogen free extract	46	45.5	39.2
Crude fibre	21	8.41	25.1
Ether extract	2.3	2.8	1.0
Ash	7.0	11.8	8.0
Metabolizable energy (Kcal/kg)	2856	2672.4	2810

2.4 Data Analysis

The data that were generated were subjected to the Analysis of Variance (ANOVA) [24] for a completely randomized design. Significant means were separated using Least Significant Difference (LSD) according to the methods of [24].

3. RESULTS AND DISCUSSION

The results of the dietary effects of *Aspilia africana* on litter traits of experimental breeding rabbit does are presented in Table 4. Mean litter size for the group assigned to T_1 was higher than, the others followed by that of the group assigned to T_2. The group placed on T_3 had the lowest litter size. Nevertheless, there was no statistically significant difference ($P > .05$) in litter size between all the treatment groups. The study recorded no still birth.

The litter sizes recorded in this study was lower than 7 to 8 kits reported by [25] and within the range of 2 to 9 kits observed by [17]. The low litter size of the study could be as a result of the does being in their first parity, since it has been shown that litter size at birth increase with successive kindling [19,26].

The mean litter size at weaning was statistically not different ($P > .05$), but varied numerically. The mortality rate in T_1 (control) was higher than in T_2 while T_3 (treated with *Aspilia africana)* recorded no mortality. Thus, there was a relatively high decrease in litter size at weaning of the control compared with the treated groups. This could be attributed to high milk production from does in T_2 and T_3 which were fed fresh and wilted *Aspilia africana* respectively. This is in line with the report by [15] that does fed *Aspilia africana* had higher milk production. The test plant (*A. africana*) helped stimulate milk let down and increase milk yield which thereby increased the survival of the litter and reduced preweaning mortality. This in turn resulted in higher litter size at weaning for T_2 while T_1 had the least although at birth T_1 had the highest litter size.

Litter weight at birth as shown in Table 4 were significantly different ($P < .05$) among the various treatment groups, which T_2 had the lowest mean body weight at birth and T_1 had the highest. This could be due to litter size at birth since T_1, had the highest litter size at birth. This agrees with the findings of [27] who reported that litter size exerts a positive effect on litter weight. The result of this study is also in line with the findings of [17] who stated that litter weight at birth depends on the breed and a mean birth weight per individual. However, the litter birth weight for T_1 may also be due to the ability of the rabbits in that group to effectively utilize the feed which enhanced better embryonic development as observed by

[20] that increased feed utilization will result in higher litter birth weight. The overall litter birth weight obtained in this study is lower than 223.3g obtained by [17] and also lower than 246.77g obtained by [20]. The differences could be attributed to higher litter sizes the authors obtained at birth.

The mean litter weaning weight was highest in T_2 followed by T_3 while T_1 had the lowest. The mean weaning weights were significantly different ($P < .05$). Higher weaning weights in treatments 2 and 3 may be due to the role of the experimental plant as lactation stimulant as reported by [21] and the ability of the does in these treatment groups to effectively utilize minerals and other nutrients in the feed to increase the quantity/quality of milk for proper nursing of the kittens which thereby resulted in the higher litter weaning weight. The difference in mean weaning weights of litters in T_3 compared to T_2 could be due to level of utilization, differences in palatability, nutrient content and other unknown factors. While on the other hand, low litter weaning weights observed for the control group (T_1) could be as a result of low milk let-down from the does. This agrees with the findings of [19] that the breeder could influence the litter size and litter weight at weaning by the feed provided for the nursing doe.

Table 4. Effects of *Aspilia africana* on litter traits

Parameters	T_1	T_2	T_3	SEM
Average litter size at birth	5.60	5.20	4.00	0.40
Average litter size at weaning	3.70	4.60	4.00	0.45
Average litter weight at birth (g)	261.50^{a}	116.50^{b}	175.00^{ab}	23.70
Average litter weight at weaning (g)	410.00^{b}	736.30^{a}	621.25^{a}	47.17

^{a,b}means in same row with different superscripts are significantly different ($P < .05$).

The results of the effect of *Aspilia africana* on weekly litter weights from birth to weaning are presented in Table 5. The body weights of the kits in week 1 showed no significant differences ($P > .05$) between the different treatments. Kits in T_2 had the highest mean value, followed by T_3 while T_1 had the lowest mean value. By the second week, the weight gain of litters in T_1 was significantly lower than those of T_2 and T_3. However, the rate of gain in all the treatment groups in weeks 3 and 4 were higher than those in weeks 1 and 2 and T_2 had the highest mean value. The sharp increase in weights of kits at three weeks postpartum agrees with the findings of [20] who observed that rapid growth rate of kits during the peak of lactation coincides with three weeks of age from birth. Furthermore, it could be observed that T_2 and T_3 showed superior increase compared to T_1 (control) in week 3 which may be as a result of high milk yield/let-down from the mammary gland of does which was stimulated by the test plant (*Aspilia africana*) as reported by [25]. The mean weekly body weight gain for week 4 also showed significant difference ($P < .05$) between the different treatments in which T_2 had the highest mean value, followed by T_3 and T_1 (control) still had the lowest value. The slight difference in the weights of kits in T_3 whose dam were fed wilted *A. africana* compared with T_2 which received fresh *A. africana* could be as a result of differences in palatability and nutrient loss during wilting. The higher weight gains for T_2 and T_3 groups could be due to better nutritive value of the test plant (*Aspilia africana*) since the does in all the treatment groups consumed all the concentrate and forages offered them without remnants and thus had similar feed intake/consumption. The results of this study agrees with the findings of [26] who reported that the mean daily weight gain of rabbits fed *A. africana* at four weeks of age was significantly greater ($P < .05$) than others. [26] further stated that feeding *A. africana* to rabbit at four weeks will enhance their performance.

Table 5. Effect of *Aspilia africana* on weekly litter weights from birth to weaning (g)

Weeks	T_1	T_2	T_3	SEM
Week 1	290.00	380.63	316.25	30.94
Week 2	297.50^b	534.38^a	445.00^a	41.25
Week 3	405.00^b	690.60^a	584.40^a	43.43
Week 4	410.00^b	736.30^a	621.30^a	47.15

^{a,b}means in same row with different superscripts are significantly different (P < .05).

4. CONCLUSION

The various parameters (litter sizes and weights at birth and at weaning and weekly litter weights from birth to weaning) studied to observe the effect of A. Africana on litter traits of breeding rabbit does showed that litters from does fed *A. Africana* showed superiority in values for all the parameters investigated. Thus, both fresh and wilted *Aspilia africana* improved the litter performance at weaning in rabbits. Therefore, *Aspilia africana* is favourable in lactating rabbit does feeding and the nutritive value of it is better than that of the mixed forages (*Centrosema pubescens, Ipomea batatas leaves* and *Panicum maximum*) used as control. Therefore, *Aspilia africana* is strongly recommended for feeding breeding/lactating rabbit does to enhance the growth performance of their litters.

COMPETING INTERESTS

Authors declare that no competing interests exist.

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