Wayamba Journal of Animal Science – ISSN: 2012-578X; P647-P653 2013
First Submitted September 26, 2012; Number 1348673774

REPRODUCTIVE PERFORMANCE OF LOCAL RABBIT DOES ON SWEET POTATO CONCENTRATE MEAL TO FORAGE COMBINATIONS UNDER TROPICAL CONDITION

Defang H.F[1]., Kana J.R[1]., Ngoula F[1].,. Keambou T. C[2], Teguia A[1]., Emene N[1]
[1]Department of Animal Production, Faculty of Agronomy and Agricultural Sciences, University of Dschang - Cameroon., [2]The University of Buea, Cameroon

[*]Corresponding author: fdefang@yahoo.com

An experiment was carried out to evaluate the potential of sweet potato concentrate meal (SPCM) in replacement of maize base diet and forage combinations by breeding does during gestation and lactation periods. 20 (primiparous) local rabbit does (7-8 months of age and 2.7-2.9 kg weight as well as 8 fertile local rabbit bucks 9-10 months of age and 3.2-3.4 kg weight) were used. The does were randomly allocated to 4 dietary treatments. Each treatment having 5 does with 5 replicates in a completely randomized design. The treatments comprised the following concentrate and forage combinations respectively: (R1) Sweet potato concentrate meal (SPCM) and *Echinochloa pyramidalis (E. pyramidalis),* (R2) SPCM and *Leersia hexandra (L. hexandra),* (R2) SPCM and *Imperata cylindrical (I. cylindrica)* and (R3) SPCM and *Panicum maximum (P. maximum).* The SPCM was offered in the morning (08:00 hours) and evening (17:00 hours) *ad-libitum* while forage and clean water were also served *ad-libitum*. The does were mated to intact bucks after two weeks adjustment period. Results showed that the mean feed intake and live body weight during lactation period was significantly (P<0.05) higher for does fed diet (R1) containing SPCM and *Echinochloa pyramidalis* compared to the rest of the treatments. Mean body weight gain and feed conversion ratio were comparable (P>0.05) in all treatments during gestation and lactation periods. Receptivity was significantly (P<0.05) higher for does fed diet R1, R2 and R4 compared to does fed diet R3. Kindling rate was significantly (P<0.05) lower for R4 treatment compared to the rest. Stillbirth and gestation length were comparable in all the treatments. No significant differences (P>0.05) were observed among the treatments with respect to litter size at birth, at weaning and litter weight at birth and at weaning. Litter weight at 21 days (milk yield) was significantly (P<0.05) higher for R2 diet compared to the rest. It was concluded from this study that does fed diet R1 and R3 combination had overall better performance in terms of feed intake, kindling rate and litter weight at weaning

Key words: Sweet potato, forage, Performance, Local rabbit

The scarcity and prohibitive cost of commercial energy sources like maize *(Zea mays)* for poultry, pig and rabbit rations, has been the main cause of the high cost of livestock products especially in developing countries. To arrest this situation, livestock raisers all over the world and particularly those of the developing countries, are forced to think of those plants that can be easily grown and yield more per unit area as compared to maize for inclusion in livestock rations. This will subsequently lead to a reduction of the cost of production of livestock products. Sweet potato (*Ipomoea batatas (L.) Lam*) readily comes to mind as a promising alternative energy source. However, reports on the use of root and tuber crops as alternative energy feedstuffs to maize in rabbit feeding focus mostly on cassava root meal (Eshiett *et al*., 1997; Radwan *et al*., 1985 and Omole T.A., 1990). For sweet potato concentrate meal (SPCM), little or no data exist on their feeding to rabbits, although (Raharjo, Y.C. 1987) found sweet potato leaf to be very pala to rabbits.

Sweet potato tubers are used for livestock feed in Taiwan and China where this root

crop is classified among low ranking priority crops (Huarg, 1982). Over 95% of sweet potato is produced in developing countries (CGIAR, 2001). Asia is the world's largest producer of sweet potato with an annual production of 125 million tons; China alone produces more than 117 million tons, representing 80% of the world's production. Sweet potato strives well in all the ecological zones in Cameroon. It is a stable food in the country and ranks fourth after cassava, cocoyam and yam. The production level of sweet potato in Cameroon was 235,728 tons in 2009 (FAO, 1991) and the production is higher during the dry season contrary to the production of which is lower during this period and scarce as such, it could serve as a suitable alternative to maize.

Sweet potato (fresh basis) contains approximately 20% starch and 5% simple sugars. The protein of sweet potato contains about two-thirds globulin. It contains a reasonably high amount of most amino acids but is limiting in tryptophan and sulphur-containing amino acids. The peel of the sweet potato is higher in proteins, minerals and other non-carbohydrate constituents than the rest of the tuber (Uadia I.O., 1984). Maize and Sweet potato have comparable metabolizable energy values of 3329 and 3190 kcal/kg respectively (Woolfe J.A., 1992). The cost of production of sweet potato is much lower compared to cereal crops according to (Huarg, 1982). The objective of this study was to evaluate the effect of supplementing *Echinochloa pyramidalis, Leersia hexandra, Imperata cylindrical* and *Panicum maximum* with sweet potato concentrate meal in replacement of maize on the reproductive performance of local rabbit does.

MATERIALS AND METHODS

Experimental site:

The study was conducted between April and August 2011 in the rabbitry unit of the Teaching and Research farm of the Faculty of Agronomy and Agricultural Sciences (FASA) - University of Dschang. The area is located at an altitude of 1420 m above sea level, between latitude 5^{o} 26'N and longitude $I0^{o}$ 26'E with an Equato-guinean climate tempered with altitude. The area receives an annual rainfall that range between 1500 – 2000 mm. The wet season begins from mid-March to mid November and the dry season from late November to early March. The temperature varies between l0 and 25 ^{o}C and a relative humidity between 40 – 97%.

Test feedstuff and diets

The yellow variety of sweet potato tubers

Table 1. Ingredients and composition of the experimental diet.

ingredients	Percentage composition (%)
Sweet potato	30
Wheat brand	30
Soya bean cake	9
Palm kernel meal	19.5
Fish meal	2
Concentrate* (5%)	9
Table salt	0.5
Calculated chemical composition	
Energy (ME kcals/kg)	2836
Crude protein (%)	17.69
Crude fibre (%)	7.93
Calcium (%)	0.97
Phosphorous (%)	0.6
Lysine (%)	1
Methionine (%)	0.43
Cost / kg feed (FCFA)	221.25

*Concentrate (5%) : EM (kcal/kg) = 2078 ; CP (%MS) = 40 ; Ca (%MS) = 8 ; P (%MS) = 2,05 ; Met (%DM) = 2,4 ; Lys (%MS) = 3,3.

used for this experiment was bought from a local market in Dschang. The freshly harvested sweet potato tubers were trimmed off rough ends, washed in running water, chipped with peals at 5 mm thickness to facilitate drying. The chipped potato was sun-dried for 5 days to contain less than 10-12 % moisture prior to milling. The sample was milled using a hammer mill of sieve size 2 mm and stored in air-tied polythene bags prior to use in the experimental diet. Samples of the milled potato were analysed for proximate composition (A.O.A.C., 1990).

The sweet potato mash was used to formulate the sweet potato concentrate meal (SPCM) in which maize was replaced at 100% (1).

Harvesting and processing of forage. Four forage: *Echinochloa pyramidalis (E. pyramidalis), Leersia hexandra (L. hexandra), Imperata cylindrica (I. cylindrica)* and *Panicum maximum (P. maximum) basal* diets were harvested from the cultivated plot of the University of Dschang Teaching and Research farm before flowering. The freshly cut leaves were sun-dried under shade for 5 days to constant weight, humidity between 10-12 %. The hay was bailed stored under good condition for later use.

Experimental animal and management

A total of Twenty primiparous local rabbit does (7-8 months of age) and 2.7-2.9 kg weight as well as 8 fertile local rabbit bucks (9-10 months of age and 3.2-3.4 kg weight) were used in a 130 days trial.

The rabbits were weight balanced. Thereafter, they were randomly allocated to the four dietary treatments in a complete randomized design with five does per treatment. Each treatment was replicated five times. Each of the four experimental diet was randomly attributed to the treatments.

The treatments included:

R1: *E pyramidalis* (basal diet) *ad libitum* supplemented with SPCM

R2: *L. hexandra* (basal diet) *ad libitum* supplemented with SPCM

R3: *I. cylindrical* (basal diet) *ad libitum* supplemented with SPCM

R4: *P. maximum* (basal diet) *ad libitum* supplemented with SPCM

The does had free asses to drinking water and all rabbits were treated with a common anthelmintic drug and coccidiostat before starting the trial. Does were allowed to adjust to the treatments for two weeks before being mated to intact bucks. The rabbits were managed intensively and housed individually in specially constructed galvanized metal cages with an approximate dimension of 76 x 62 x 42 cm with facilities for feeding, drinking and trays for the collection of urine and faeces. The cages were kept in an open sided house with asbestos roofing sheets. Pregnancy diagnosis was done by palpation and weight method. On day 27 of gestation, the nest boxes were supplied with wood straw to help the doe in preparing a worm comfortable nest for the kits of her litter. The new-born animals were weaned at six postpartum. Does were weighed at the start, and every seven days during gestation and lactation periods. Kids were weaned at six weeks postpartum.

Data collection

Feed, forage leftovers and wastage were collected in the morning and weighed daily for individual rabbit in order to determine the daily feed intake. Weight gain, feed conversion ratio were monitored

Receptivity: This was determined by the willingness of the doe to mate combined with signs of oestrus such as; swelling of the vulva, exposition of the rear quarters and lordosis. Receptivity was scored on the scale of 1 to 3.

Kindling rate (KR): this was calculated as number of does that kindled over number of does mated multiplied by 100

$$\mathbf{KR} = \frac{\text{Number of does that kindled X 100}}{\text{Total number of does mated}} \quad 1$$

Gestation length: this was recorded as the interval between mating and kindling

Stillbirth, litter size at birth and at weaning: kits born death were recorded as stillbirth while number of kits alive were counted and recorded as litter size at birth and at weaning.

Litter weight at birth, at 21 days (milk yield) and at weaning: Total weight of litter at birth, at 21 days and at weaning.

Body weight: The does were weighed at the start of the trial and subsequently at kindling and at weaning (45 days postpartum)

Kindling rate of does: This was calculated as number of does that kindled over number of does mated multiplied by 100. Kits were counted and weighed at birth and at weekly intervals. Kits were weaned at six weeks postpartum.

Statistical analysis

Data obtained were subjected to analysis of variance as described by (Steel R.G.D. and J.H. Torrie, 1980.), separation of significantly different means was carried out using Duncan's Multiple Range Test as described by (Duncan D.B., 1956).

RESULTS AND DISCUSSION

*The crude protein and fibre content obtained for E. pyramidalis (Table 2) was comparable with values reported by (***Bogdan, A. V., 1977.***)* but significantly lower than values reported by (**Abreu *et al*., 2006**). Also, the analyzed *crude protein and fibre content of I. cylindrical obtained in this trial were similar to those reported by (***Abreu *et al*., 2006***) in Pakistan and Malaysia but lower than those obtained in India.* The level of crude protein of *P. maximum* agreed with the reports of (**Bogdan, A. V., 1977**). The sweet potato concentrate meal had higher dry matter and low crude protein contents compared to other test ingredients. The variation in nutritive values of the forages could be attributed to the variety, soil composition, seasonal changes and preservation.

The average data on feed intake, live body weight, weight gain and feed conversion ratio (g feed: g gain) of local rabbit does fed sweet potato concentrate meal to forage combinations is presented on (Table 3). No significant difference (P>0.05) was observed for feed consumption during gestation period. However, during lactation, feed intake was significantly (P<0.05) higher for does fed diet R1 containing *E. pyramidalis* as basal diet compared to the rest of the treatments. The difference in feed intake could be attributed to differences in the dry matter content of the forage used. In the present

study, the treatment containing forage with the highest feed intake (R1) also had the lowest dry matter content. The results obtained for feed consumption on this study are similar to the findings of

(Göhl B.O., 1975.) who fed maize concentrate meal and *Stylosanthes hamata* combination to gestating does. Body weight of does increased during the gestating period. No significant (P>0.05) difference was observed for this parameter during this period. The regular increase in body weight at this phase could be due to the active growth of the embryos at this stage. However, during the lactation period does on treatment R1 containing *E. pyramidalis* recorded the highest average body weight compared to treatments R2, and R4. During lactation, a slight drop in body weight was progressively observed in all the treatments before 21 days of milk production. The result of this study supports the observation of (Dupe O. O. and Olaniyi J. B,. 2010.) who found similar growth pattern for lactating does. No significant (P>0.05) difference was observed for mean body weight gain during the gestation and lactation periods. A positive and comparable feed consumption ratio was recorded in all the treatment groups during gestation period. However, during the lactation period values for this parameter was negative but comparable for all the groups. The negative weight gain observed during the lactating phase could be due to the mobilization of body reserve to synthesize milk for kids. The

Table 2. Analysed chemical composition of the experimental forage and test meal

Forage	Dry matter (%)	Crude protein (%)	Crude fibre (%)	Ash (%)
E. pyramidalis	27.70	15.60	38.70	8.50
L. hexandra	30.00	9.50	25.60	12.80
I. cylindrica	36.4	11.80	32.10	6.80
P. maximum	36.47	10.20	32.10	10.40
I batatas (L.) Lam	40.00	4.20	2.60	3.1

Table 3. Feed intake of local rabbit does fed concentrate and forage combinations during the gestation and lactation periods.

Parameters	Treatments			
	R1	R2	R3	R4
Feed intake (g)				
During Gestation	4673.86±.35.90[a]	4706.61±44.20[a]	4353.41±79.20[a]	4147.48±66.39[a]
During Lactation	9024.14±10.21[c]	7650.86±40.96[b]	7865.55±74.730[b]	6393.99±50.09[a]
Initial live body weight (g)	2940.60±43.14[a]	2927.25±16.33[a]	2878.75±22.60[a]	2746.00±36.85[a]
During Gestation: (g)	3402.±00.37.57[a]	3352.25±23.90[a]	3413.00±15.35[a]	3149.00±27.81[a]
During Lactation: (g)	3383.20±66.63[b]	2758.75±42.42[a]	3064.75±28.76[ab]	2797.75±36.97[a]
Average weight gain (g)				
During Gestation	485.00±22.00[a]	375.40±13.78[a]	457.50±87.76[a]	448.00±23.07[a]
During Lactation	-158.30±25.32[a]	-475.25±21.80[a]	-291.50±23.80[a]	-308.00±20.09[a]
Feed consumption ratio				
End of gestation	9.15±1.16[a]	9.69±1.35[a]	9.19±0.5[a]	9.36±16[a]
End of lactation	-27.00±03.39[a]	-16.10±01.59[a]	-25.95±03.32[a]	-20.76±03.49[a]

Note: Means with different superscripts within row differ significantly at 5% level.

Table 4. Reproductive performance of local rabbit does fed concentrate to forage combinations.

Parameter	Treatments			
	R1	R2	R3	R4
Receptivity (%)	83.33	77.78	66.67	83.33
Kindling rate (%)	68.56	64.67	66.67	44.44
Gestation length (days)	31.80±0.45[a]	31.25±0.96[a]	31.75±0.50[a]	31.25±0.50[a]
Stillbirth (%)	00.00±0.00[a]	00.00±0.00[a]	00.00±0.00[a]	00.00±0.00[a]
Litter size at birth	7.35±0.96[a]	6.40±0.34[a]	7.15±0.50[a]	7.00±0.27[a]
Litter size at weaning	6.11±0.11[a]	5.01±0.22[a]	5.16±0.27[a]	5.02±0.07[a]
Litter weight at birth (g)	56.89±1.82[a]	48.76±1.76[a]	54.74±1.92[a]	49.60±1.69[a]
Litter weight at 21 days (g)	919.34±08.45[b]	752.71±14.04[ab]	894.92±11.33[b]	632.51±15.23[a]
Mean litter weight at weaning (g)	342.93±04.62[a]	218.00±03.16[a]	322.46±09.25[a]	305.81±04.59[a]

Note: Means with different superscripts within row differ significantly at 5% level.

average feed consumption ratio was positive and comparable in all the treatments during the gestation phase. Values for this parameter were higher compared to those reported by (Iyegbe-Erakpotobor G.T., 2008.) for grower rabbits.

The reproductive performance of local rabbit does fed sweet potato concentrate meal to forage combinations is presented in Table 4. Receptivity was significantly ($P<0.05$) higher for does fed diet R1, R2 and R4 containing *P. maxium, E. pyramidalis* and *L. hexandra* as basal diets respectively compared to diet R3 containing *I. cylindrica*. The high receptivity for the R1, R2 and R4 groups agreed with the reports of (Roca, 1986) who associated significant red coloration of the vulva to high receptivity. This could explain the ease with which the does R1, R2 and R4 groups accepted the male during mating. High conception rates ($P<0.05$) were generally observed for all dietary treatments except for the R3 group fed *L. hexandra* basal diet. The low conception rate observed for treatment R3 may be attributed to some physiological problems in the does. Anoestrus / infertility in the female rabbit could be genetically induced resulting in reproductive tract malformation (Lebas *et al.*, 1986). However, infection or inflammation in any part of the reproductive tract by pathogenic organisms could cause varying types of changes leading to infertility (Oguike M.A and Okocha N.L., 2008). There were no significant ($P>0.05$) differences in the gestation lengths of the different treatments. This observation is in close agreement with (Berepubo N.A. and Umamah A.A., 1996) and (Iyegbe-Erakpotobor G.T., 2008). There

were no abortions or stillbirths observed. However, the lone mortality case observed in the first week post-partum was accidental as the pup left the next box and
hind leg got trapped between the wire mesh. Litter size at birth, at weaning and litter weight at birth were comparable in all the treatments (P>0.05). Similar results were reported by (Arthur *et al.*,1979) and (Omole TA, 1982). No significant difference (P>0.05) was observed for litter weight at birth and at weaning. However, litter weight at 21 days post-partum (milk yield) was significantly higher for does fed diet R1, and R3 compared to the does fed diet R4. This could be due to the high crude protein content in the respective basal diets. These results were in accordance with the observation of (Sanchez *et al* 1985).

CONCLUSION

It is concluded that:
E. pyramidalis and Imperata. cylindrica are good sources of crude fibre and crude protein for breeding rabbit does. Does fed *E. pyramidalis* and *I. cylindrica* forage as basal diets and supplemented with sweet potato concentrate meal had better reproductive performance.

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