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Reproductive and Pre-Weaning Growth Performance of Guinea Pigs *(Cavia Porellus L.)* Fed on *Panicum Maximum* or *Pennisetum Purpureum*

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Abstract

In order to compare the reproduction and pre-weaning growth performance of guinea pigs fed on *Panicum maximum* or *Pennisetum purpureum*, 28 adult guinea pigs, divided into 2 lots of 14 animals (2 males and 12 females) each, were used. Comparative evaluation of the effect of these grasses on reproductive performance was done on 24 females previously mate with 4 males for a period of 31 days according to a completely randomized design. The animals in each lot received grass (Ad libitum) associated with 20g / day / animal of a compound food containing 15.76% crude protein. The results show that litter size was significantly higher (1.50 ± 0.53%) with *P. maximum* than with *P. purpureum* (1.30 ± 0.48%). From birth to the third week age, the viability of pups was comparable (100 and 92.85% respectively for P. *maximum* and 91.67 and 92.31 % for, P. *purpureum* at birth and at weaning) for both grasses. The mean birth weight and mean weaning weight were significantly higher with *P. maximum* (83, 34 and 59.28g at birth and 175, 20 and 145.10g respectively for P. *maximum* and P. *purpureum*). Total gains and average daily gains (GMQ) although comparable were higher with *P. maximum* during pre-weaning growth, (91.86 and 81.57; 4.37 and 3.21g for total gains and average daily gains respectively for *P.maximum* and *P. purpureum*).

Introduction

The development of the mini-livestock appears as a better solution for the fight against protein malnutrition, poverty and food insecurity in Africa in general and Cameroon in particular [1-3]. Among many species in this category is guinea pig is one, whose progressive development is a real guarantee for food security [4,5]. Caviaculture or breeding of guinea pigs presents the characteristics of economically profitable mini-livestock breeding (need little space, easily manageable, requires little capital ...) and can participate effectively in the fight for food security [3,6]. In Cameroon, the guinea pig is not only part of the eating habits [6,7], but it is also used in some areas as a sacrifice for some customary rites [8] and as a diagnostic tool of diseases in other countries. Guinea pig breeding despite these advantages (nutritional, economic and socio-cultural) aspects it presents is still traditional. Such production system presents the qualitative and quantitative deficiencies of the resources resulting from the non-coverage of nutritional requirements and therefore an action depressive on the genetic potential of the animal which leads to a reduction in the impact of this breeding on the quality of life of many of these low-income rural farmers. Previous work has reported that good management of nutrition and adequate nutrition would allow early weaning, reduce losses breastfeeding and improve productivity [9-11]. The guinea pig is a monogastric herbivore that values forage and provides good quality meat (rich in protein, B vitamins and low in fat) depending on the type of diet [12,13]. Among the forages usually used in this breeding type, are *Panicum maximum* and *Pennisetum purpureum* which have the advantage of not containing any anti nutritional factor, are voluntarily consumed by all herbivores and are the two grasses commonly used in animal feeding in general and in caviaculture in particular [14,15]. In order to improve the value of these grasses, it is therefore necessary to determine their comparative effect in animal feeding in general and in cavia culture in particular.

Methods

The study was conducted between January and March 2017 at the Application and Research Farm (FAR) of the University of Dschang, located in the western highlands of Cameroon at an altitude of 1420m, at the east longitude of 09 ° 85 '10 ° 06' and at the north latitude of 5 ° 36 '5 ° 44'. This region receives 1500 to 2000 mm of rainfall per year with an average temperature of

Table 1: Chemical composition of the different forage used.

Chemical composition	Dry maters (%)	Organic material (%MS)	Crude protéine (%MS)	Lipids (%MS)	Gross cellulose (%MS)	Ashes (%MS)
Panicum maximum	91,76	85,88	13,45	2,67	33,08	14,12
Pennisetum purpureum	94,83	85,98	14,84	2,96	34,78	14,02

18 ° C between July-August and 25 ° C between February-March. Its relative humidity varies from 40 to 97% with an insulation of 1800 hours. Climate is an equatorial high altitude Cameroonian type with a long rainy season from mid-November to mid-March and a short dry season from mid-March to mid-November. 28 adult local guinea pigs of similar breed aged between 5 and 6 months were distributed randomly in two homogeneous lots of 14 (12 females and 2 males) animals each. The animals were raised in two boxes made of plywood measuring 1m long, 0.8 m wide and 0.6 m high each equipped with lighting and heating equipment, with 2 wooden feeders for concentrated feed and 2 drinking troughs concrete in one of the farm buildings made of durable materials on the farm of Application and Research of the University of Dschang. The animals were raised on soil made of dry wood chips of 5 cm thick, renewed every 2 days to prevent the accumulation of feces and urine. The different lodges were equipped with a mesh cover with small mesh to protect animals from mice and other predators that can accidentally enter the breeding building. The cleaning of the building followed by the disinfection of the lodges was done with bleach at the dose of 125 ml per 15 liters of water before the introduction of the animals.

Plant material consisted of *Panicum maximum* and *Pennisetum purpureum* grasses harvested at the pre-bloom stage on the FAR farm, pre-faded before being directly serve to animals. A sample of 100 g of each feed as well as the compound food was collected and then dried at 60 ° C to constant weight in a ventilated oven mark Gallemkamp. The samples were subsequently crushed to 1 mm mesh and kept in plastic bags for different bromatological analyzes. The Table 1 shows the chemical composition of the different forage.

Test

31 days after putting in reproduction with a sex ratio of 2 males for 12 females, the males were removed from the lodges. They females were follow-up until the birth. Each parturient and each pig was followed until weaning (21 days after birth). Each animal has been identified by a numbered metal buckle put on his ear. The animals of each lodge received every day between 8am and 9am a grass served Ad libitum and 20g of a compound food using ingredients purchased from dealers of agricultural byproducts in the city of Dschang (Table 2).

- *P. maximum* ad libitum + 20g of compound feed
- *P. purpureum* ad libitum + 20g of compound feed

Vitamin C was diluted in the drinking water and served at will to animals (240 mg tablet in 1.5 liters water)

Data collection

Every morning, food refusals and droppings were cleaned before any new food distribution. Parturient weighing as well as piglets was made weekly until weaning (3 week after birth). Which allowed determine the postpartum weight gain of breastfeeding women and the weight weaning of the young? The weight gains have been evaluated by the formulas below:

Table 2: Percentage and chemical composition of the compound food.

Ingrédients	Quantities
Remolding	31
Maize	30
Cotton cake	5
Palm kernel cake	25
Soybean meal	2
Fish meal	3
Shell Powder	2
Prémix*	1
Cooking salt	1
TOTAL	**1OO**
valeur nutritive	
Dry mater (DM en %)	91,97
Organic material (%DM)	89,83
Crude protein (%DM)	15,76
Lipids (%DM)	08,74
Gross cellulose (%DM)	17,48
Ashes (%DM)	10,17
EM (Kcal /KgDM)	2576,5

- Total gain (g) = Weight of weaning animal - Birth weight

$$-\text{Average daily gain} = \frac{\text{total gain}}{\text{duration of the period}} \quad (1)$$

All weighing were carried out using a digital scale of 7kg of capacity and sensitivity of1g. For reproduction, the following parameters were evaluated.

$$-\text{Fertility rate} = \frac{\text{calving females}}{\text{females raised}} \times 100 \quad (2)$$

$$-\text{Fecundity rate} = \frac{\text{stillborn and live-born piglets}}{\text{females put in reproduction}} \times 100 \quad (3)$$

$$-\text{Size of the litter} = \frac{\text{young born}}{\text{calving females}} \quad (4)$$

$$-\text{Viability at birth} = \frac{\text{Weaned youngs}}{\text{young born}} \times 100 \quad (5)$$

$$-\text{Weaning ability} = \frac{\text{Weaned youngs}}{\text{young born alive}} \times 100 \quad (6)$$

Statistical analyzes

Data on reproduction and growth were tested using Student t-test 5% level of significant and SPSS 19.0 software was used.

Table 3: Mean reproductive performance of guinea pigs fed on *Pennisetum purpureum* or *Panicum maximum*.

Characteristics	Treatments	
	Panicum maximum	***Pennisetum purpureum***
Fertility rate (%)	66,67	91,67
Size of litters	1,50±0,53[a]	1,30±0,48[b]
Fecundity rate (%)	100	116,67
Net fecundity rate (%)	100	108,33
Viability at birth (%)	100	92,85
Viability at weaning (%)	91,67	92,31
Post-weaning viability (%)	100	91,67

a, b: Averages with different letters in small superscripts on the same line are statistically different for the characteristic considered (P 0.05).

Results

Effect of *Panicum maximum* or *Pennisetum purpureum* on reproductive performance of guinea pigs

The litter size of females fed with *P. maximum* was significantly (P 0.05) higher than that of animals fed with *Pennisetum purpureum*. The highest rates of fertility, of fecundity, and viability at weaning were recorded in animals fed with *Pennisetum purpureum*. Else, viability at birth was higher in guinea pigs fed with *P. maximum* (Table 3).

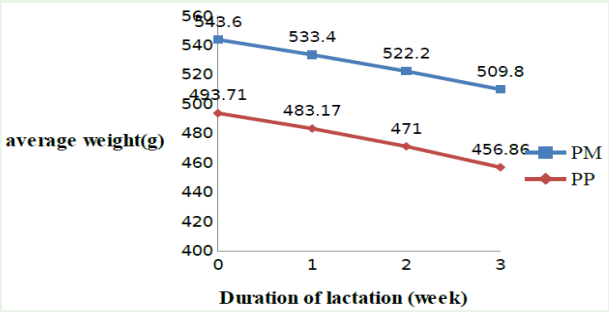

Figure 1: Comparative effect of *Panicum maximum* or *Pennisetum purpureum* on the evolution of the average weight of lactating females from farrowing to weaning.

PM: *Panicum maximum*, PP: *Pennisetum purpureum*; ab: The means bearing the same letters are not significantly different at the 5%.

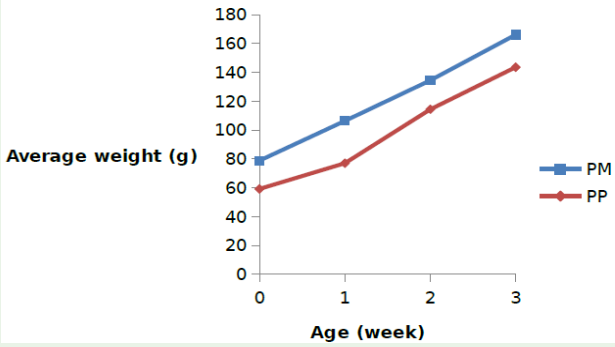

Figure 2: Comparative effect of *Panicum maximum* or *Pennisetum purpureum* on evolution weight of piglets from birth to weaning.

Comparative effect of *Panicum maximum* or *Pennisetum purpureum* on the evolution of average weight of lactating females from farrowing to weaning

Whatever the grass used, the average weight of lactating females gradually decreases from farrowing to weaning (Figure 1). However, during this period, *Pennisetum purpureum* induced significantly higher weight losses (P 0.05) compared with *Panicum maximum.*

Comparative effect of *Panicum maximum* or *Pennisetum purpureum* on the evolution of weight of piglets from birth to weaning

The weight of the piglets has gone from the simple to the double of the farrowing to the weaning, independently of the grass used (Figure 2). However no significant difference (P> 0.05) was observed between the weights of the piglets during this period depending on the grass.

The comparative effect of *Panicum maximum* or *Pennisetum purpureum* on evolution female piglets from birth to weaning (Figure 3) shows that independently of the grass, the weight of the female pigs has progressively increased from birth to weaning. Moreover, during this period the weight of female pigs fed with *P. maximum* was significantly (P 0.05) higher than that of female pigs from animals fed on *Pennisetum purpureum.*

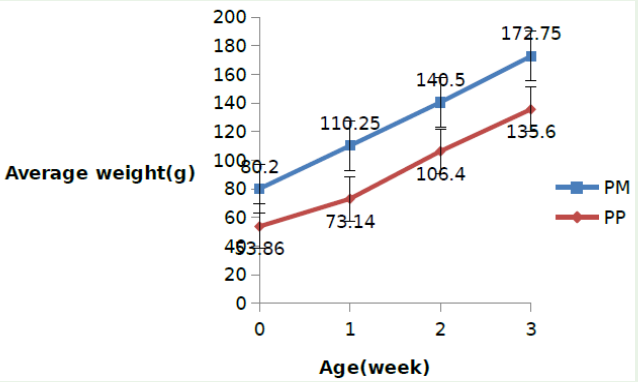

Figure 3: Comparative effect of *Panicum maximum* or *Pennisetum purpureum* on the weight change of female piglets from birth to weaning.

PM: *P. maximum*, PP: *Pennisetum purpureum*; ab: The means bearing the same letters are not significantly different at the 5%.

Table 4: Comparative effect of *Panicum maximum* or *Pennisetum purpureum* on Birth weight, weaning weight, total gain, and Average Daily Gain (ADG) of piglets from birth to weaning.

Characteristic	Sex	Treatments		ESM	P
		Panicum maximum	*Pennisetum purpureum*		
Birth weight (g)	♂	$80,00^{a}{}_{(7)}$	$65,64^{b}{}_{(6)}$	1,49	0,02
	♀	$86,67^{a}{}_{(5)}$	$52,91^{b}{}_{(7)}$	4,54	0,00
	♂♀	$83,335^{a}{}_{(12)}$	$59,275^{b}{}_{(13)}$	2,27	0,02
Weaning weight (g)	♂	$168,4^{a}{}_{(7)}$	$150,64^{a}{}_{(5)}$	5,30	0,10
	♀	$182,0^{a}{}_{(5)}$	$139,57^{b}{}_{(6)}$	10,67	0,02
	♂♀	$175,2^{a}{}_{(12)}$	$145,105^{b}{}_{(11)}$	6,42	0,04
Total gains (g)	♂	$88,40^{a}{}_{(7)}$	$85,00^{a}{}_{(6)}$	4,14	0,55
	♀	$95,33^{a}{}_{(5)}$	$78,14^{a}{}_{(7)}$	6,35	0,09
	♂♀	$91,86^{a}{}_{(12)}$	$81,57^{a}{}_{(13)}$	5,22	0,25
Average daily gain (g/day)	♂	$4,21^{a}{}_{(7)}$	$4,05^{a}{}_{(6)}$	0,20	0,55
	♀	$4,54^{a}{}_{(5)}$	$2,37^{a}{}_{(7)}$	0,60	0,10
	♂♀	$4,37^{a}{}_{(12)}$	$3,21^{a}{}_{(13)}$	0,40	0,25

a, b: Averages with the same letters on the same line are not significantly different at the 5%; ESM: Standard Error on the average; P: Probability.

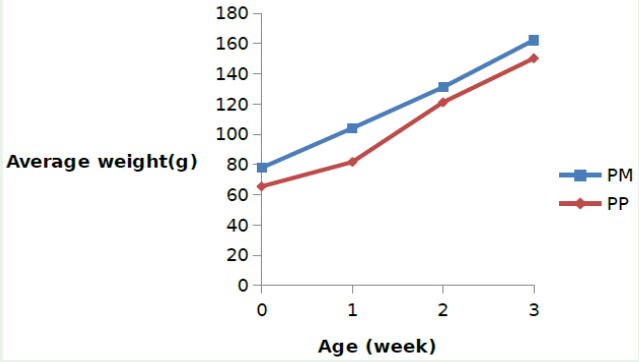

Figure 4: Comparative effect of *Panicum maximum* or *Pennisetum purpureum* on evolution weight of male piglets from birth to weaning.
PM: *Panicum maximum*, PP: *Pennisetum purpureum*

The comparative effect of *Panicum maximum* or *Pennisetum purpureum* on the weight evolution of male piglets from birth to weaning (Figure 4) shows an increased weight of male piglets regardless of grass. However, during this period no significant difference (P> 0.05) was observed between the weight of piglets from females fed on *P. maximum* or *Pennisetum purpureum*.

Comparative effect of *Panicum maximum* or *Pennisetum purpureum* on body weights birth, weaning weight, total gain and average daily gain (ADG) of piglets from birth to weaning

P. maximum feeding achieved birth weights significantly (P 0.05) highest for both sexes that regardless of sex. The highest weights at birth and at weaning were recorded in pigs fed on P. maximum. Moreover, the total gain and mean daily gain were comparable (P> 0.05) for both grasses. However, the pigs fed on *P. maximum* showed gains in higher weight compared to the *Pennisetum purpureum*-fed lot (Table 4).

Discussion

Comparative effect of *Panicum maximum* or *Pennisetum purpureum* on reproduction performance

The highest fertility (91.67%) and fecundity (116.67%) rates were recorded in breeding females fed on *Pennisetum purpureum*. This shows that *Pennisetum purpureum* provides sufficient nutrients to guinea pigs which favorably cover their reproduction requirement. our results are lower (100.00, 206.67% respectively for the fertility rate and fecundity) to those obtained by Mweugang et al. [16] when feeding animals on *P. purpureum* supplemented with 8% cassava leaves. This could be explained by the low protein level of our rations. Our values remain comparable to those of Fogang [17] in animals fed on *P. purpureum* without legume. The size of the litter (1.50) and the highest viabilities were observed in females fed with *P.maximum.* This observation shows that *P. maximum* would increase the number of ovum which is a major component of the litter size [18]. This size of the litter is smaller than that obtained (2,4) by Kouakou et al. [9] in guinea pigs fed with *P.maximum* and supplemented with granules for rabbit. The smallest litter size (1.30) recorded with *P. purpureum* in this study is close to 1.29 obtained by Todou [19] when he fed guinea pigs with *P.clandestinum*. It is, however, less than 2.7 obtained by Mweugang et al., [18] when fed with *P. purpureum* supplemented with 8% cassava leaves. This could be explained by a difference in the protein level of the ration. Indeed, the proteins should contribute 20% of the ration to pregnant females. The litter size also increases with the number of calving [10]. Indeed prim pares have a small litter size and our females were primiparous. Weight growth of postpartum females Regardless of the grass used the average weight of lactating females decreased by giving birth to weaning newborns. This result is in agreement with the observations of Zougou, Mweugang et al., Kouakou et al., and Miégoué et al., [9,16,18,20]. In fact, during lactation, mothers spend a lot of energy for milk production. Not only the needs during lactation are often difficult to cover, but the female must additionally deploy many efforts to ensure the demand of the young. It must therefore, to ensure satisfactory milk production,

mobilize its reserves body weight, which explains the observed weight loss. Any time it has been observed that in lactating females, the least weight loss has been recorded in animals fed maximum Panicum. This could be due to the good palatability of *Panicum maximum* [21] which resulted in greater ingestion of it compared to *P. purpureum*.

Gain weight of pre-weaned piglets at birth and weaning weights of infants born to females fed on *Panicum maximum* were higher than those of animals fed on *Pennisetum purpureum*, regardless of sex. This may be due to good palatability of *Panicum maximum* in guinea pigs. Moreover, weights (59.27g at birth and 145.10 g at weaning) obtained in animals fed on *Pennisetum purpureum* in this study were less than 84.0 g and 158.5 g respectively at birth and at weaning obtained by Noumbissi when feeding animals with *Pennisetum purpureum* alone (T0). Our best weights (83.33g and 175.2g) obtained with *Panicum maximum* are greater than 58.7 ± 12.4 g and 109.8 ± 7.0 g obtained by Kouakou et al. [9] when he fed pigs with P.maximum alone. This difference can be explained by the nutritional quality of the forage served during our test. Indeed, the nutritional value of forage is highly variable depending on the stage of development and seasons (agricultural technical releases, 2009). The forage used in this test was harvested at their best nutritional stage. From birth to weaning, regardless of sex and treatment, all newborns have doubled their weight. This observation is in agreement with that of many authors [10,20]. Indeed the animals being in full growth phase, the proteins in the ration have joined with those in breast milk to help the increase in the number and size of cells, thereby leading to the construction of muscles, skin and organs in the offspring [13]. Generally, the best weight gains and ADG (average daily gain) were observed in animals that received Panicum maximum. The highest ADG with *P.maximum* was recorded in females (4.53g) while that of *Pennisetum purpureum* was recorded in males (4.05). our ADG are higher than those observed by Miégoué et al., (2016) who obtained 4.23 g / day with *Panicum maximum* supplemented with a diet containing D. intortum and those of Zougou (2012) (3.73 g / day). Similarly the highest ADG with *Pennisetum purpureum* (4.05g / d) is greater than 3.55 g / day obtained by Noumbissi in males of the non-supplemented. Our values are lower than those obtained by Kouakou et al., [9] (6.5 g / day) in guinea pigs fed on *P. maximum* associated with granules for rabbit. This difference is explained by the low protein content of the feed.

Conclusion

It appears from this study that compared to *P. purpureum*, *P.maximum* would be more appropriate during the reproductive phase in guinea pigs because:

- This grass induced a significant litter size ($P < 0.05$) same, that better viabilities of the little ones.
- This forage induced low weight loss in postpartum females, and increased weight (at birth and weaning) and better gains weight (Total gain and ADG). This grass would be more advisable to small during pre-weaning growth as a staple.

References

1. Pamo TE. Effets de l'inclusion de feuilles de manioc (Manihot esculenta Crantz) dans la ration sur les performances de reproduction du cobaye (Cavia porcellus L.) local camerounais. Int. J. Biol. Chem. Sci. 2016; 10: 269-280.
2. Dikko AH, Egena SSA, Malik AA, Ibrahim H. Guinea pig (Cavia porcellus) as an untapped protein source for man: The potentialities, opportunities and Challenges. Proceedings of 14th Annual Conference of Animal Science Association of Nigeria (ASAN). 2009; 14-17.
3. Niba AT, Meutchieye F, Fon D, Laisin AG, Taboh H, Njakoi H, et al. Current situation of cavy production in Cameroon: Challenges and opportunities. Livestock Research for Rural Development. 2012; 24.
4. Bindelle J, Buldgen A, Wavreille J, Agneesens R, Destain JP, Wathelet B, et al. The source of fermentable carbohydrates influences the in vitro protein synthesis by colonic bacteria isolated from pigs. Tropical Animal Health and Production. 2007b; 1: 1126-1133.
5. Metre KT. Possibilités d'amélioration de l'élevage de cobaye (Cavia porcellus L.) au Sud Kivu, à l'Est de la République Démocratique du Congo (mémoire). 2012; 67.
6. Kouakou JM, Umba JC, Kashala AN, Ngulu F, Khang'Mate JBO, Lunumbi V. Etude du rendement à l'abattage des cobayes hybrides issus des croisements entre souches parentales d'origine diverses au Centre expérimental de Kimwenza dans la zone périphérique de Kinshasa. Journal of Animal &Plant Sciences. 2017; 32: 5104-5110.
7. Yiva Herman C, Fon Dorothy E, Meutchieye F, Niba AT, Manjeli Y, Djikeng A. Cavies for income generation, manure for the farm and meat for the table. Scholarly Journal of Agricultural Science. 2014; 4: 260-264.
8. Kenfack A, Tcoumboué J, Kamtchouing P, Ngoula F. Effets de la substitution par l'arachide fourragère (Arachis glabrata) de l'herbe à éléphant (Pennisetum purpureum) sur le nombre d'ovulations et les mortalités prénatales chez le cobaye (Cavia porcellus) adulte. Tropicultura. 2006; 24: 143-156.
9. Kouakou N'GoranDV, Thys E, Yapi YM, Assidjo EN, Marnet PG, Grongnet JF. Effet de panicum maximum Jacq.associé à Euphorbia heterophylla(L.) klotz.&Garcke sur la productivité des femelles durant le cycle de reproduction chez le cobaye (Cavia porcellus L.). Tropicultura. 2015; 33: 277-287.
10. Miégoué E, Tendonkeng F, Lemoufouet J, Noumbissi MN, Ngouopo Mweugang N, Tovignon Zougou G, et al. Croissance pré-sevrage des cobayes nourris au Panicum maximum supplémenté avec une ration contenant Arachis glabrata, Calliandra calothyrsus ou Desmodium intortum. Int. J. Biol. Chem. Sci. 2016; 10: 313-325.
11. Zougou TG, Tendonkeng F, Miégoué E, Noumbissi MNB, Matimuini NF, Mboko AV, et al. Effet du niveau de protéines alimentaires sur la croissance post-sevrage et la carcasse chez le cobaye à l'Ouest-Cameroun. Livestock Research for Rural Development. 2017; 29.
12. Cigogna M. Les Cobayes: Guide technique d'élevage n° 4. Bureau d'Echange et de Distribution de l'Information sur le Mini Elevage (BEDIM). Série Information et Documentation. 2000; 8.
13. Egena SSA, Alabi JO, Dikko HA, Stephen E, Silas AT, Musa CT. Growth performance and nutrient digestibility of guinea pigs (Cavia porcellus) fed two levels of protein and energy. International Journal of Applied Biological Research. 2010a; 2: 38-43.
14. Kouakou N'Goran DV, Thys E, Danho M, Nogbou Assidjo E, et Grongnet JF. Effet de Panicum maximum sur la productivité des femelles primipares durant le cycle de reproduction chez le cobaye (Cavia porcellus L.) Tropicultura. 2012; 30: 24-36.
15. Miégoué E. Evaluation de quelques légumineuses fourragères comme source de protéine dans l'alimentation du cochon d'Inde (Cavia porcellus L.) nourri avec Pennisetum purpureum ou Panicum maximum. Thèse pour l'obtention du grade de Docteur/PhD de la Faculté d'Agronomique et des Sciences Agricoles de l'Université de Dschang. 2016; P150à 157.
16. Miégoué E, Tendonkeng F, Lemoufouet J, Mweugang Ngouopo N, Noumbissi MNB, Fongang MD, et al. Ingestion et digestibilité de Pennisetum purpureum associé à une légumineuse (Arachis glabrata, Calliandra calothyrsus ou Desmodium intortum) comme source de protéines chez le cobaye. Livestock Research for Rural Development. 2016; 28.

17. Todou R. Effets de pennisetum clandestinum et de brachiaria ruziziensis supplémentés au zinc et à la vitamine E sur les performances des cobayes (cavia porcellus). Thèse de Msc, Faculté d'Agronomie et des Sciences Agricoles, Université de Dschang. 2013; 88.

18. Fogang. Effet de différentes sources de protéines sur la digestibilité in vivo et les performances de production des cobayes (Cavia porcellus L.) nourris au Pennisetum purpureum. Mémoire de Master of Science Biotechnologie et Productions Animales. Université de Dschang. 2016; 75.

19. Bindelle J, Ilunga Y, Delacollette M, Muland Kayij M, Umba di M'Balu J, Kindele E, et al. Voluntary intake, chemical composition and in vitro digestibility of fresh forages fed to Guinea pigs in peri-urban rearing systems of Kinshasa (Democratic Republic of Congo). Trop Anim Health Prod. 2007; 39: 419-426.

20. Mweugang NN, Tendonkeng F, Matumuini FNE, Miégoué E, Boukila B, et Pamo ET. Influence of the inclusion of gradel levels of cassava leaf meal in the diet on post-partum weight and pre-weaning growth of guinea pigs (Cavia porcellus L.). International Journal of Agriculture Innovations and research IJAIR. 2014; 2: 2319-1473.

21. Zougou TG. Effet de différents niveaux de supplémentation aux feuilles de Tithonia diversifolia sur les performances de croissance et les caractéristiques de la carcasse chez le cochon d'Inde (Cavia porcellus). Thèse de Master of Science Biotechnologie et Productions Animales. Université de Dschang. 2012; 75.

22. Noumbissi MNB, Tendonkeng F, Zougou TG, Pamo TE. Effet de différents niveaux de supplémentation de feuilles de Tithonia diversifolia (Hemsl.) A. Gray sur l'ingestion et la digestiblité in vivo de Penissetum purpureum K. Schum. Chez le cobaye (Cavia porcellus L). Tropicultura. 2014; 3: 138-146.