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Physiological Features of Pennisetum Purpureum or Panicum Maximum Consumption in Guinea Pigs (Cavia Porcellus)

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Abstract

Guinea pig diet is essentially based on the use of grasses associated with protein sources. Then, in to improve the herbivores nutrition, the evaluation of intake and In vivo digestibility of Pennisetum purpureum or Panicum maximum in guinea pigs (Cavia porcellus) was carried out in January 2017 at the University of Dschang research and experimental farm and animal production and nutrition laboratory. 20 adult animals of local breed on average weight 450 ± 50g and aged about 5 months were used. They were organized into two batches of 10 animals each (5 males and 5 females). The first batch received 250g of fresh matter of Pennisetum purpureum + 60g concentrate/animal/day, while the second received the same treatment with Panicum maximum as grasses. Leftover and animals were weighed every morning before food distributions, and drinking water containing vitamin C was served ad libitum. According to the results, the highest ingestion was obtained with Panicum maximum. However, the digestibility different nutrients was comparable between treatments; nevertheless, males fed on P. maximum digested crude cellulose (63.78%) better than males fed on P. purpureum (51.17%). With regard to the variation of the bacterial rate of the caecal flora, enterobacteria of animals fed P. maximum was high (11.20 CFU/ml) compared to those of the animals receiving P. purpureum (7.27 CFU/ml), although regardless of the treatment, the level of lactobacilli was higher than that of enterobacteria. In view of the results obtained, these grasses can be alternatively used in feeding guinea pigs.

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Introduction

Africa suffers from poverty, malnutrition and other related social ills, particularly in rural areas, where the lack of capital and the necessary experience precludes the intensive production of animal protein. The low potential for household monetary accumulation does not meet the requirements of traditionally high animal species. Given this situation and given the growing protein deficit, mini-breeding should be considered [1]. Among the species considered in this category, the guinea pig presents itself as one of the opportunities to seize [2-4]. The guinea pig is a monogastric herbivore whose main interest lies in its prolificacy, its high growth rate, its lean meat rich in protein and its inexpensive diet [5]. In fact, this small monogastric herbivore is widely grown and consumed by the populations of many regions of Cameroon; it is also a secondary source of income and does not require significant livestock production [6]. However, guinea pig production in Cameroon is mainly carried out in traditional systems [7]. The bulk of its food comes from household waste and crop residues that are deficient in essential nutrients qualitatively and quantitatively. This results in low productivity characterized by stunted growth, decreased fertility, abortions, new born with low birth weights, and high mortality due to poor health [2]. In addition, it has been reported that by applying a good livestock management strategy such as the provision of an adequate diet, one could improve the productivity of this animal [8]. Indeed, several studies have been conducted on the use of some tropical forages for guinea pig productivity [2, 9-12]. Among the forage, species that are frequently sought are Pennisetum purpureum and Panicum maximum [13]. Indeed, these two grasses have already been the subject of several studies in guinea pig feeding, used alone or in combination with other local protein resources such as Tithonia diversifolia [9], cassava leaves (Manihot esculanta) [10], Desmodium intortum, Arachis glabrata or Calliandra calothyrsus [11 and 12], in order to evaluate growth in these animals. However, no study comparing their ingestion and digestibility in guinea pigs has been conducted to date.

Methods

Experimental site

The study was conducted during the month of January 2017, at the Research and Application Farm (RAF) and in the Laboratory of Nutrition and Animal Feeding (LANAA) of the Faculty of Agronomy and Agricultural Sciences (FAAS) of the University of Dschang. The locality is located at the 15th degree of the eastern meridian, at latitude 5 ° 36'- 5 ° 44 'North and at longitude 09 ° 85'- 10 ° 06' East. The climate of the region is equatorial of Cameroonian type modified by altitude. The rainfall varies between 1500 and 2000 mm per year. The average annual temperature is around 20 ° C, the annual total insolation at 1800 hours and average relative humidity between 40 and 90%. The dry season alternates with the rainy season.

Animal Sample and Housing

For this test, 20 guinea pigs of local breed including 10 males and 10 females, aged about 5 months and average weight 450 ± 50g were used. These animals were placed in individual cages of 10.6 cm^3 (76 cm × 46.5 cm × 30 cm), each equipped with a 100 g plastic feed trough and a concrete drinking trough of 0,5l. The complete cleaning of the building followed by the disinfection of the cages was done with bleach at the dose of 125 ml per 15 l of water before the introduction of the animals. To avoid vitamin C deficiency, a 240 mg tablet of vitamin C was diluted in 1.5 liters of drinking water and fed to the animals at will for the duration of the test.

Plant Sample

Panicum maximum and Pennisetum purpureum were cut at the forage plot on Research and Application Farm the day before, pre-dressed in the livestock building before being served the next morning to the animals. A sample of 100 g of each plant was taken, dried in an oven to constant weight, crushed and analyzed for the evaluation of their chemical compositions according to the methods described by Pauwel et al [14] and AOAC [15] (Table 1).

Conduct of the Test

Preparation of the Compound Food

The proportions of the various ingredients

purchased in the feed mills of the city of Dschang for the manufacture of the compound food are presented in Table 2. A sample of 100 g of said compound food was taken, transported to the laboratory, dried in an oven at 600 C until constant weight, then crushed and analyzed for chemical composition AOAC (1990).

Evaluation of the Ingestion

For each treatment, 5 guinea pigs of each sex were randomly allocated to individual cages, and food was served once daily between 8 and 9 hours. For the intake assessment, the quantities of food served were noted, and the refusals were collected daily and weighed before any new distribution.

Assessment of Digestibility

The animals were adapted to the digestibility cages and the compound food for 10 days. During this period, the quantities of feed served were adjusted to the animal's consumption. During the actual digestibility period which lasted 7 days, each morning before feed distribution, faeces were collected, weighed and a sample of 100g was taken and dried at 60° C to constant weight at the laboratory in a ventilated oven. Subsequently, dried feces were crushed and stored in plastic bags for evaluation of dry matter (DM), organic matter (OM), crude protein (CP) and crude fiber (CF) content. [15].

In order to determine ADC, the daily ration served to each animal was constituted as follows

Lot1: 250g of fresh material of P. purpureum + 60g concentrate/animal/day;
Lot2: 250g of fresh matter of Panicum maximum + 60g of concentrate /animal/day.

Each morning during data collection, each animal was weighed on an empty stomach using a 7kg capacity and 1g precision weighing scale. As for the analysis of the caecal flora, three animals of each sex per batch were randomly selected and sacrificed in order to evaluate the composition of their caecal flora in lactobacilli and enterobacteria according to the method described by Benson [16]. The sacrifice of the animals was followed by their dissection, and organs such as the heart, liver, lung, and caecum were removed and weighed to determine their weight and proportions in relation to the respective live weight of each animal.

Statistical Analyzes

Data from this trial were submitted to the Student test (t-student) at 5% significance level and the analysis software used was SPSS 19.0.

Results

Ingestions of dry matter (DM), organic matter (OM), crude protein (CP) and crude fiber (CF) of Panicum maximum and Pennisetum purpureum by guinea pigs.

With either P. maximum or P. purpureum, males better ingested nutrients than females during the trial (Figures 1a and b). Also, the ingestion was respectively strong with the organic matter, the dry matter, the crude fiber and finally the crude protein. However, no difference was observed ($p > 0.05$) between the ingestions of the nutrients of the two grasses by the animals according to the sexes.

Apparent Digestibility Coefficients (ADC) of DM, OM, CP and CF of P. Maximum and P. Purpureum

The Apparent Digestibility Coefficients of dry matter (DM), organic matter (OM), crude protein (CP), and crude fiber (CF) of both grasses by guinea pigs was comparable ($p > 0, 05$) between males and females. The crude protein was more digested, and in the case of P. maximum, the females digested the nutrients better (Figure 2a). However, with P. purpureum, males better digested crude protein and organic matter, respectively, than females, while females digested crude and dry matter better than males, respectively (Figure 2b).

Effects of P. maximum and P. purpureum on average daily gains (ADG)

During the test, males had high average daily weight gain (ADG) compared to females (Figures 3). No matter the type of grasse used, males has the better growth.

Effect of Forages Use on the Variation of the Bacteria Rate of the Caecal Flora

With P. maximum, the rate of enterobacteria was high ($p<0,05$) in males (9,67%) than in (6,16%) females. however, the rate of lactobacillus was comparable between males and females (Figure 4a). As P. purpureum concerns, the bacteria rate were comparable ($p>0,05$) regardless of the type and the sex,

Table 1. Chemical composition of the different forage used.

Chemical composition	Dry matter (%)	Organic matter (% DM)	Crude protéin (%DM)	Lipids(% DM)	Crude fiber (%DM)	Ash (% DM)
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
DM :Dry matter						

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 in %) Organic matter (%DM) Crude protein (%DM) Lipids (%DM) Crude fiber (%DM) Ashes (%DM) M E (Metabolizable energy Kcal /KgDM)	91,97 89,83 15,76 08,74 17,48 10,17 2576,5

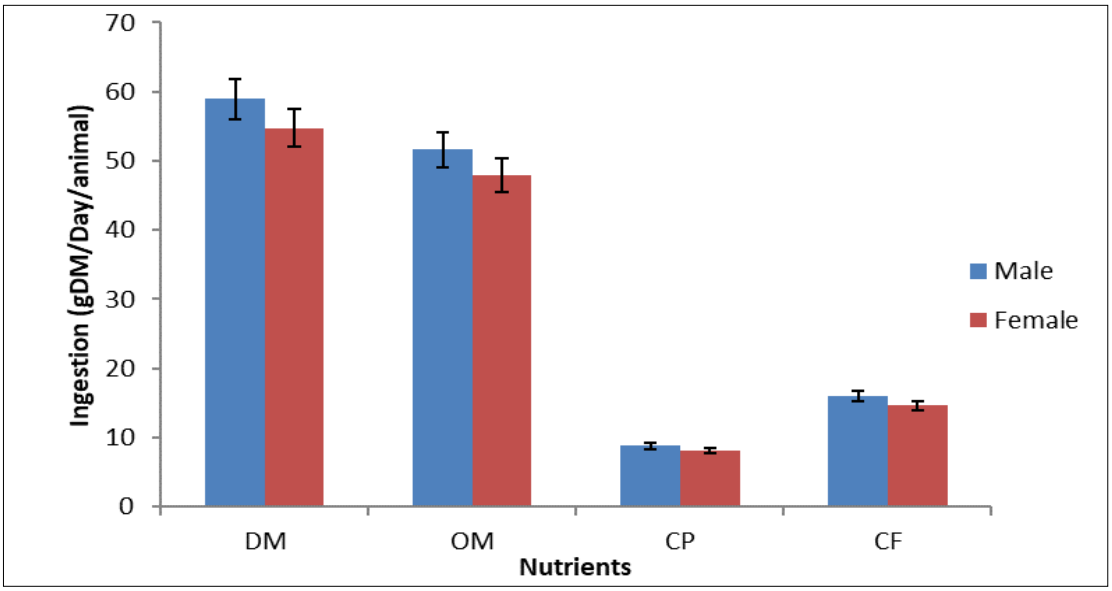

Figure 1a. Ingestion of Dry matter (DM), Organic Matter (OM), Crude protein (CP) and Crude Fibre (CF) of P. maximmum

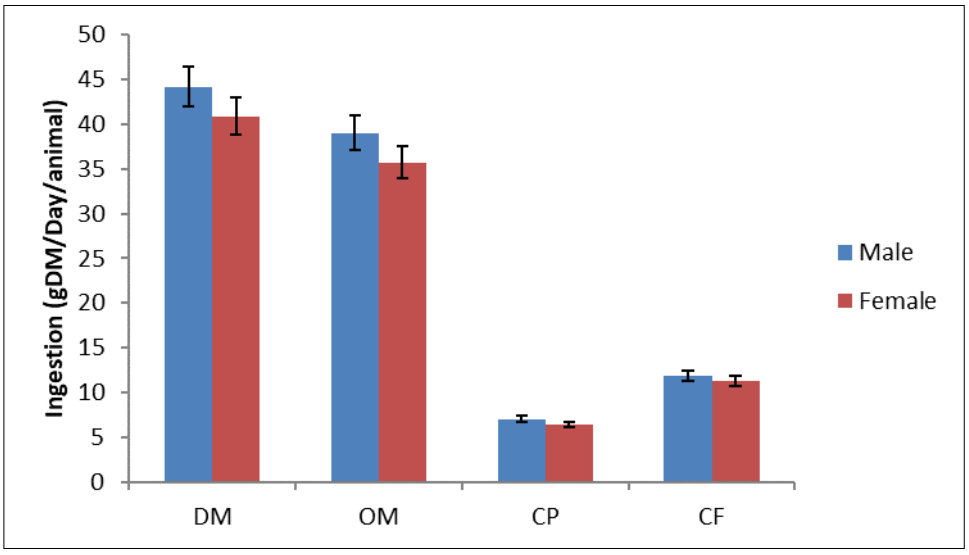

Figure 1b. Ingestion of Dry matter (DM), Organic Matter (OM), Crude protein (CP) and Crude Fibre (CF) of P. purpureum

(Figure 4b).

Comparative Ingestions of P. maximum or P. purpureum in guinea pigs

Panicum maximum was more ingested ($p < 0.05$) by males and regardless of sex (Table 3). The same observation was made with regard to the ingestion of total dry matter, organic matter and crude fiber of this feed. On the other hand, no difference ($p > 0.05$) was observed for the quantities of protein ingested between the two forages in males, and regardless of sex. Overall, animals fed with P. maximum better ingested ($p < 0.05$) the nutrients.

Compared Apparent Digestibility Coefficients (ADC) of P. Maximum or P. Purpureum in Guinea pigs

Digestion of crude fiber was better ($p < 0.05$) in males fed with P. maximum. On the other hand, no difference was observed between the digestion of crude protein (CB) of P.maximum and P.purpureum in females and regardless of sex. The same observation was made with regard to the digestive use of dry matter (DM), organic matter (OM) and crude protein (CP) between P.maximum and P. purpureum both in males than in females and regardless of sex (Table 4).

Average daily gain (ADG) of guinea pigs fed with P. maximum compared with those fed with P. purpureum

Weight gains were comparable ($p > 0.05$) in animals fed with P. maximum or P. purpureum (Table 5). However, Pennisetum purpureum allowed the animals to acquire the best weights during the test.

Variation of bacterial flora of enteric bacteria and lactobacillus in guinea pigs fed with Pennisetum purpureum or Panicum maximum.

Cecal flora analysis revealed that the cecum of animals fed with Panicum maximum contained higher levels of enterobacteria ($p < 0.05$) in both males and females. In contrast, lactobacillus levels were comparable ($p > 0.05$) in males and regardless of sex. In general, the level of lactobacillus was higher than that of enterobacteria (Table 6).

Analysis of the weight of some organs and their proportions in guinea pigs during the test. Organ weights were comparable ($p > 0.05$) between animals and treatments, with the exception of liver weight, which was higher ($p < 0.05$) in males fed with P. purpureum. Similarly, animal weights were comparable ($p > 0.05$) in terms of treatments, as well as the proportions of all organs, whether in males, females, or regardless of sex. Overall, females' live weight and body weights were high relative to males, and among the organs studied, the cecum was the largest (Table 7).

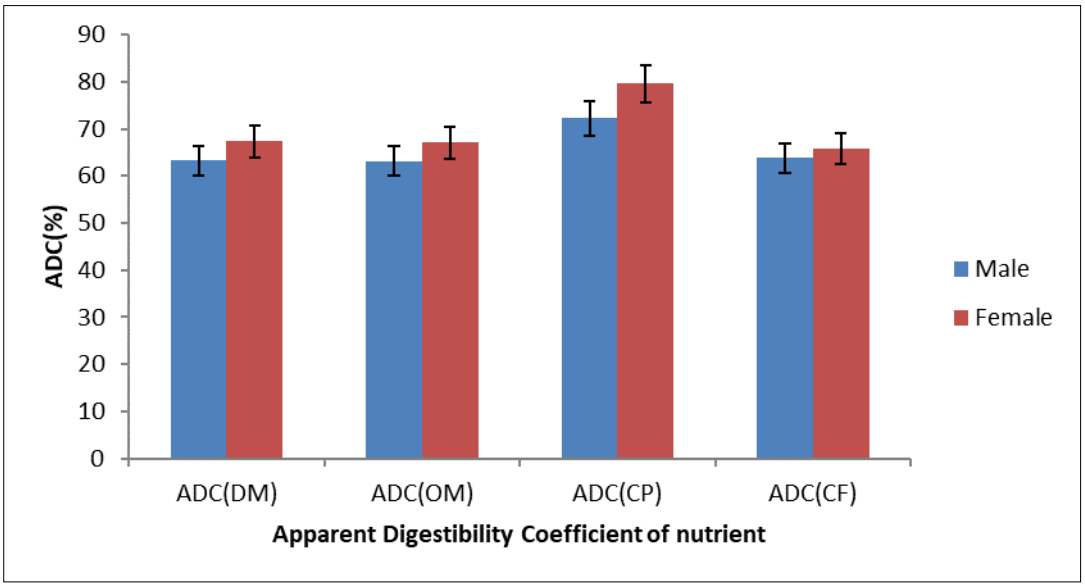

Figure 2a. Apparent Digestibility Coefficient (ADC) of Dry matter (DM), Organic Matter (OM), Crude protein (CP) and Crude Fibre (CF) of P. maximum

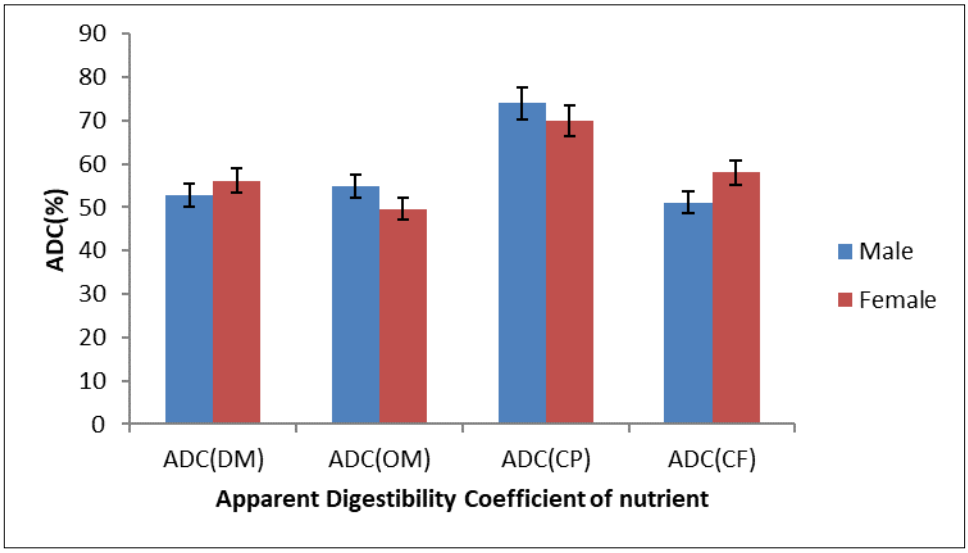

Figure 2b. Apparent Digestibility Coefficient (ADC) of Dry matter (DM), Organic Matter (OM), Crude protein (CP) and Crude Fibre (CF) of P.

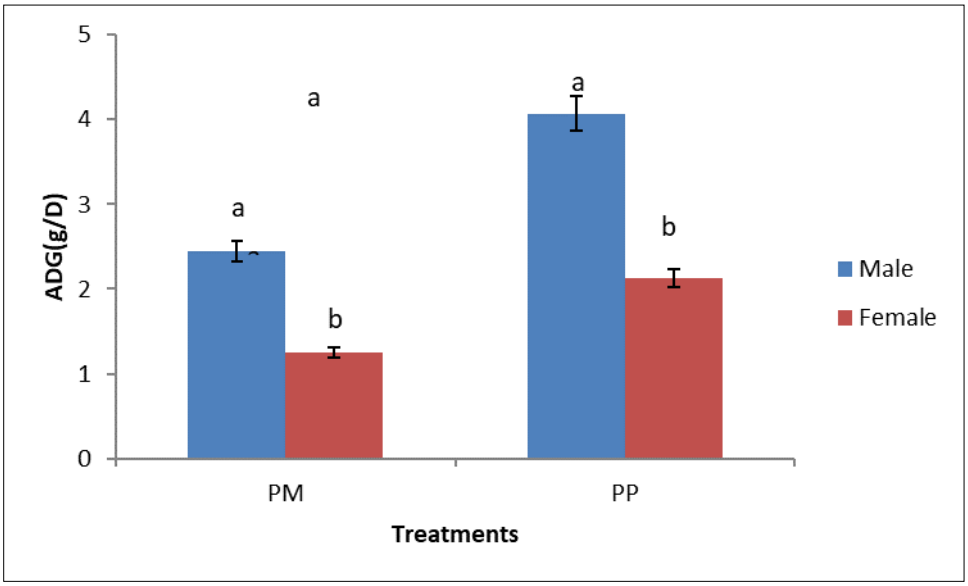

Figure 3. Comparative Apparent Digestibility Coefficient (ADG) between male and female cavy feed on *P. purpureum* or P. maximum.

a, b: The bars bearing the same letters on the same characteristic are not different (p> 0.05).

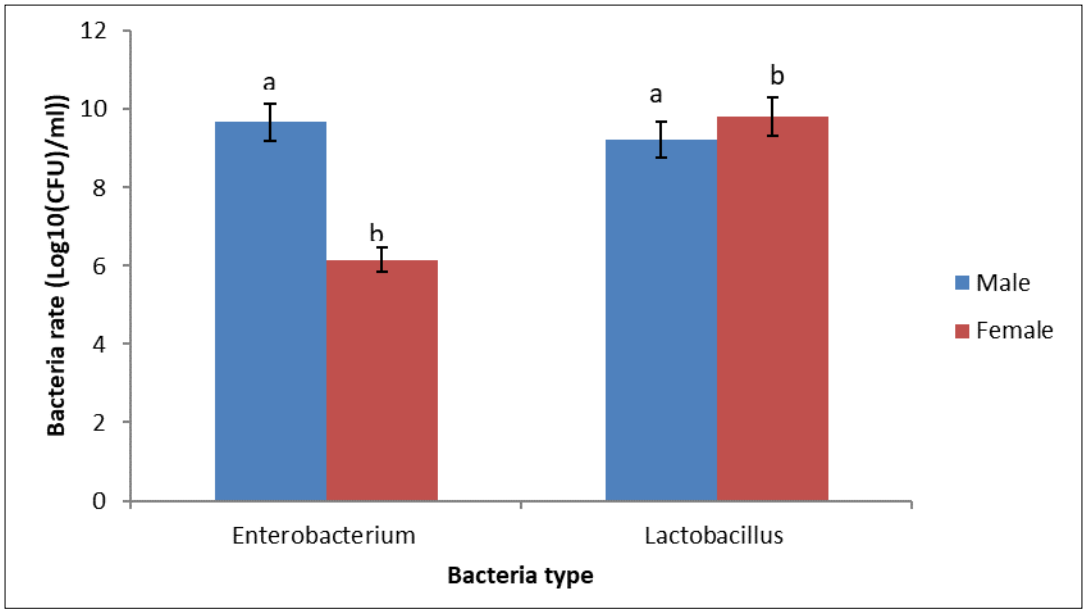

Figure 4a. Effect of P. maximum on the variation of the bacteria rate of the caecal flora.

a, b: The bars bearing the same letters on the same characteristic are not different (p> 0.05).

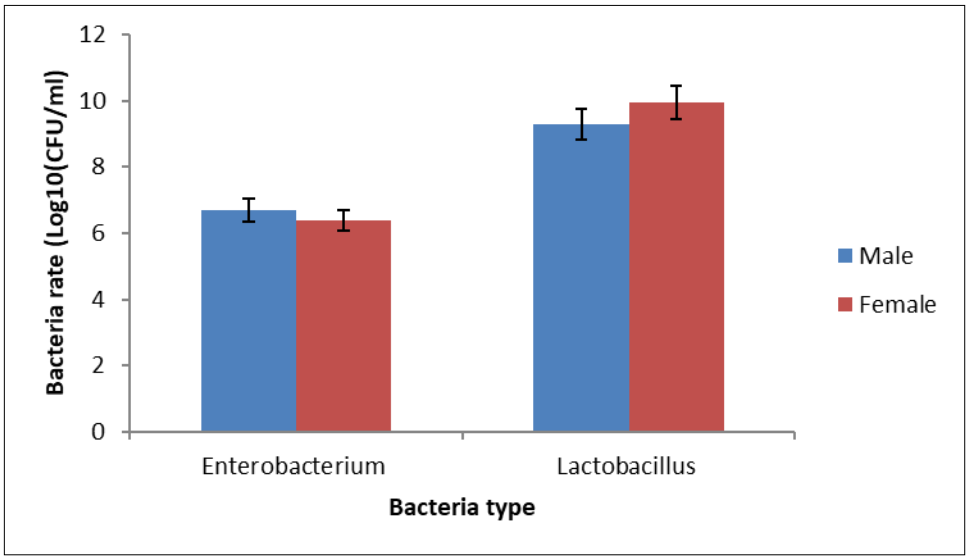

Figure 4b. Effect of P. purpureum on the variation of the bacteria rate of the caecal flora.

Table 3. Comparative Ingestions of P. maximum or P. purpureum in guinea Pigs.

Ingestions (gDM/day/animal)	Treatements		*ESM*	p
	PM	PP		
Grasses				
♂(5)	35,0[a]	22,9[b]	1,20	0,00
♀(5)	30,4[a]	23,1[b]	1,33	0,00
♂♀(10)	32,8[a]	23,0[b]	1,26	0,00
Nutrients				
Total dry matter				
♂(5)	58,9[a]	44,2[b]	2,23	0,00
♀(5)	54,7[a]	40,9[b]	2,35	0,00
♂♀(10)	56,8[a]	42,6[b]	2,17	0,00
Organic matter				
♂(5)	51,6[a]	39,0[b]	3,56	0,06
♀(5)	47,9[a]	35,7[b]	3,38	0,03
♂♀(10)	50,0[a]	37,4[b]	3,29	0,04
Crude protéin				
♂(5)	08,8[a]	07,0[a]	0,63	0,11
♀(5)	08,1[a]	06,4[a]	0,59	0,08
♂♀(10)	08,4[a]	06,8[a]	0,51	0,09
Crude fiber				
♂(5)	16,0[a]	11,9[b]	0,64	0,00
♀(5)	14,6[a]	11,3[b]	0,56	0,00
♂♀(10)	15,2[a]	11,7[b]	0,48	0,00

a, b: Averages with the same letters on the same line are not different at the 5% level; ESM: Standard Error on the Average; P: Probability; ( ): effective ; ♂: male; ♀: female; ♂♀: male and female; PP: Pennisetum purpureum; PM: Panicum maximum

Table 4. Apparent Digestibility Coefficients (ADC) of nutrients in guinea pigs according to treatment and sex.

ADC (%) sex	Treatements		ESM	p
	PM	PP		
ADC (DM)				
♂(5)	63,3[a]	52,8[a]	3,13	0,07
♀(5)	67,3[a]	56,1[a]	6,45	0,22
♂♀(10)	65,3[a]	54,4[a]	3,81	0,78
ADC (OM)				
♂(5)	63,2[a]	54,9[a]	2,88	0,12
♀(5)	67,1[a]	49,6[a]	3,01	0,18
♂♀(10)	65,1[a]	51,9[a]	3,53	0,12
ADC (CP)				
♂(5)	72,2[a]	74,0[a]	1,74	0,63
♀(5)	79,6[a]	70,0[a]	4,60	0,14
♂♀(10)	76,0[a]	72,0[a]	2,88	0,51
ADC (CF)				
♂(5)	63,8[a]	51,1[b]	3,62	0,04
♀(5)	65,7[a]	58,0[a]	3,99	0,24
♂♀(10)	64,8[a]	54,7[a]	3,99	0,07

a, b: Averages with the same letters on the same line are not different at the 5% level; SEM: Standard Error on the Average; P: Probability, (): effective; ♂: male; ♀: female; ♂♀: male and female; ADC: Apparent Digestivity Coefficient of use; PM: Panicum maximum; PP: Pennisetum purpureum

Table 5. Comparative Average Daily Gains (ADG) of Guinea Pigs fed with P. maximum or P. purpureum.

	Sex	Treatements			
		PM	PP	ESM	p
ADG (g/day) (n=5)	♂	2,44[a]	4,07[a]	1,30	0,31
	♀	1,25[a]	2,13[a]	1,19	0,35
	♂♀	1,83[a]	3,20[a]	1,73	0,34

a: Averages with the same lowercase letters on the same line are statistically identical; ADG: Average daily gain; PP: Pennisetum purpureum; PM: Panicum maximum; E SM: Standard Error of mean; P: Probability

Table 6. Variation of the bacterial count of the cecal flora of the Enterobacterium genera and Lactobacillus in guinea pigs fed with Pennisetum purpureum or Panicum maximum

	Sexe	Treatements			
		PM	PP	ESM	P
Enterobacterium (Log10 (CFU/ml))	♂	9,67[a]	6,69[b]	11,1	0,02
	♀	6,16[a]	6,39[a]	6,52	0,44
	♂♀	11,2[a]	7,27[b]	10,9	0,01
Lactobacillus (Log10 (CFU/ml))	♂	9,23[a]	9,28[a]	11,1	0,80
	♀	9,80[a]	9,95[a]	11,1	0,47
	♂♀	11,7[a]	11,7[a]	11,1	0,70

a, b: The averages with the same lowercase letters on the same line are the same; PP: Pennisetum purpureum; PM: Panicum maximum; ESM: Standard Error on the Average; p: Probability. CFU: Colony forming Unit

Table 7. Weight of some organs and their proportions in guinea pigs during the in vivo digestibility test according to the treatments

weight	sex	Treatements		ESM	p
		PM	PP		
LWa	♂	411[a]	436[a]	19,0	0,07
	♀	497[a]	489[a]	14,0	0,48
	♂♀	454[a]	462[a]	21,0	0,31
Heart	♂	1,67[a]	1,67[a]	0,36	0,24
	♀	2,67[a]	2,00[a]	0,32	0,37
	♂♀	2,17[a]	1,84[a]	0,35	0,24
Liver	♂	12,3[a]	14,7[b]	0,69	0,01
	♀	17,0[a]	15,7[a]	0,54	0,08
	♂♀	14,7[a]	15,1[a]	1,39	0,19
Lung	♂	4,33[a]	3,33[a]	0,34	0,25
	♀	4,67[a]	5,33[a]	0,41	0,27
	♂♀	4,50[a]	4,34[a]	0,58	0,40
Cæcum	♂	40,3[a]	40,7[a]	1,58	0,37
	♀	47,0[a]	42,0[a]	1,30	0,39
	♂♀	43,7[a]	41,3[a]	3,62	0,35
Proportion					
Heart /LWa	♂	0,39[a]	0,41[a]	0,24	0,53
	♀	0,41[a]	0,54[a]	0,29	0,59
	♂♀	0,40[a]	0,45[a]	0,27	0,44
Liver /LWa	♂	3,37[a]	2,99[a]	0,26	0,39
	♀	3,22[a]	3,41[a]	0,31	0,40
	♂♀	3,30[a]	3,20[a]	0,48	0,10
Lung /LWa	♂	0,77[a]	1,04[a]	0,25	0,44
	♀	1,09[a]	0,94[a]	0,29	0,63
	♂♀	0,93[a]	0,99[a]	0,31	0,43
Cæcum /LWa	♂	9,58[a]	9,93[a]	0,39	0,64
	♀	8,63[a]	9,47[a]	0,51	0,47
	♂♀	9,11[a]	9,70[a]	0,98	0,40

a, b: The averages with the same lowercase letters on the same line are the same; LWa: Live weight of the animal.

Discussion

The results obtained show that the animals fed with Panicum maximum better ingested the nutrients, during its work, Miégoué [17] obtained P. maximum nutrient ingestion values approaching these results. In addition, for the same author, animals receiving P. purpureum ingested less than those receiving P. maximum, as in the case of this work. These results prove that P. maximum is well liked by guinea pigs, which is probably due to its energy level lower than that of P. purpureum. In her work on guinea pigs, Bindelle [18] also showed that P. maximum had great palatability. Indeed, according to Egena et al [19], in animals fed with low energy rations, food intake tends to increase, and vice versa. Also, regardless of treatment, food intake was high with males. According to Miégoué [17] and Noumbissi et al [2], in adult guinea pigs, males are more vigorous than females and therefore expend more energy. This high energy expenditure would push them to consume more than females.

In this study, animals fed with P. maximum had better nutrient ADC. In the course of its work, Miégoué [17] also obtained values close to the latter. The results of this author also showed that ADC nutrients were low in animals consuming P. purpureum. This phenomenon could be explained by the high intake of P. maximum by guinea pigs. However, some authors like do not share this idea [3], because for the latter, the poor nutritional value of P. maximum would lead to the poor digestibility of its nutrients, which can therefore be at the origin insufficient coverage of needs in females. Despite the good ingestion and best digestibility of P. maximum, the animals fed with this grass obtained low ADG; this could be explained by its low nutritional value. Moreover, since P. purpureum is more nutritious, animals would have better valued its nutrients. By serving P.purpureum supplemented with a concentrate without leguminous, Miégoué [17] had obtained better ADG values in these guinea pigs, compared to those obtained in animals fed with P. maximum served under the same conditions. It was noted that the level of enterobacteria of animals fed with P. maximum was high compared to that of animals receiving P. purpureum. However, the level of lactobacilli was higher than that of enterobacteria in these two grasses, which confirms the quality of these fodder, given that in a healthy and well-fed guinea pig, the digestive flora consists mainly of Gram + anaerobic bacteria such as Peptococaceae, Bifidobacteria, Corynebacteria and Lactobacilli, the Gram- being present in less quantity; this balance of the bacterial flora thus promotes good digestion in guinea pigs [20]. This result is in agreement with that obtained by Miégoué [12], who had higher levels of lactobacilli than enterobacteria in animals fed with P. maximum and P. purpureum. With regard to the weight of the organs, P. maximum allowed the animals to acquire better weights, with the exception of the liver. This situation could be due to the fact that since the liver is involved in digestion through the biliary secession process, the latter had to make more effort to facilitate higher fiber digestion in P. purpureum.

Conclusion

Evaluation of ingestion and digestibility of Pennisetum purpureum, or Panicum maximum in guinea pigs (Cavia porcellus) showed that P. maximum is better ingested by guinea pigs; similarly, regardless of treatment, males ingested more nutrients than females. There was no difference in ADC of nutrients by treatment, with the exception of crude fiber digestion which was better in males fed with P. maximum. Regardless of the treatment, the level of Lactobacillus was higher than that of enterobacteria, which confirmed the quality of these two grasses, because the digestive flora of a healthy guinea pig is composed mainly of anaerobic Gram + bacteria. The liver was involved in the digestion of food through the process of biliary secretion; it was larger in animals fed with P. purpureum due to the high rate of fiber in this grass. Panicum maximum was better ingested by guinea pigs, although not better digested by them (with the exception of its crude fiber). In view of these results, these grasses can be used alternately for feeding guinea pigs; however, given its wide distribution in the wild, P. purpureum would be the best recommended grass of both to feed guinea pigs.

Conflicts of Interest

All the authors agree that there are no conflicts of interest according to this article

References

1. Ndébi G, Niba A T, H F Defang H F 2015 Economic rationality and cavies (Cavia porcellus L.) production objestives in tropicals zones. Tropicultura, 33,1, 2637.
2. Noumbissi M N B, Tendonkeng F, Zougou T G, Pamo T E 2014 Effect of different supplementation levels of Tithonia diversifolia (Hemsl.) leaves on the ingestion and in vivo digestibility of Penissetum purpureum K. Schum. On cavy (Cavia porcellus L.). Tropicultura, 3,138-146.
3. Kouakou N D V, Thys E, Danho M, Assidjo E N & Grongnet J F 2012 Effect of Panicum maximum on the productivity of the primiparous females during the reproduction cycle on cavy (Cavia porcellus L.). Tropicultura, 30(1), 24-36.
4. Metre T K 2012 Improvment possibilities of cavie's (Cavia porcellus L.) breeding on South Kivu, at the east Démocratic Républic of Congo. Thesis presented for partial furfillent of the complemented Master diploma on animals and plant ressources managment in tropical zone. University of Liège, Académie Universitaire Wollonie- Europe. 52p.
5. Cicogna M 2000 cavies: Guide of breeding technics n° 4. Bureau d'Echange et de Distribution de l'Information sur le Mini Elevage (BEDIM). Information and Documentation series. 8p.
6. Kenfack A, Tchoumboué J, Kamtchouing P, & Ngoula F 2006 Effect of the substitution by Arachis glabrata of Pennisetum purpurum the ovulations numbre and pre-born mortalities on adults cavies (Cavia porcellus L.). Tropicultura, 24, 3, 143-146.
7. Niba AT, Manjeli Y, Fonteh F A, Kudi A C, Tchoumboue J et al., 2009 Effect of weaning age on the reproductive performances of adult female guinea pigs. Sciences Agronomique et Développement. 5 (1): 31-40.
8. Zougou T G, F Tendonkeng F, Miégoué E, Noumbissi M N B, Matimuini N F, et al., 2017 Effect the dietary protein levels on the post-weaning growth and carcass on cavies at west-Cameroon. Livestock Research for Rural Development 29 (5) 2017
9. Noumbissi M, Tendonkeng F, Zougou T, Miégoué E, Lemoufouet J et al. 2013 Effect Tithonia diversifolia complementation on the evolution of post- partum weight and the pri-weaning growth of cavies (Cavia porcellus L.). Livestock Research for Rural Development 25 (8).
10. Mweugang NN, Tendonkeng F, Matumuini F N E, Miégoué E, Boukila B et al 2014 Influence of the inclusion of gradel levels of cassava leaf meal in the diet on post-partum weight and preweaning growth of guinea pigs (Cavia porcellus L.) International Journal of Agriculture Innovations and Research (IJAIR), 2(6): 2319-1473.
11. Miégoué E, Tendonkeng F, Lemoufouet J, Noumbissi M N B , Mweugang N N, et al 2016a Pre-weaning growth of cavies fed on Panicum maximum supplemented with a diet containning Arachis glabrata, Calliandra calothyrsus ou Desmodium intortum. International Journal of Biological and Chemical Science. 10(1): 313-325. Available online at http://www.ifg-dg.org.
12. Miégoué E, Tendonkeng F, Lemoufouet J, Mweugang Ngouopo N, Noumbissi M N B et al 2016b Ingestion and digestibility of Pennisetum purpureum associate to one legume (Arachis glabrata, Calliandra calothyrsus ou Desmodium intortum) as protein source on cavy. Livestock Research for Rural Development 28 (1).
13. Kouonmenioc J, Ngou Ngoupayou J D, et Fotso Tadny J M 2000 Consumption of some tropicales grasses by cavies (Cavia porcellus): Performences and determination of the area for a herd production. Tropicultura, 18, 2, 80-83.
14. Pauwels J.M., Van Ranst E., Verloo M. & Mvondo Ze A.D., 1992. Manual of pedology laboratory. analyzis methods of soils and plants, equipment, management of glasses and chemicals products stocks. Agricultural Publications 28. Dschang, Cameruon: MESRST; Bruxelles:AGCD
15. AOAC 1990. Official Methods of Analysis 1990. 15th Edition, Association of Official Analytical Chemists, Arlington
16. Benson H J 2002 Microbiological applications Laboratory manual in general microbiology. Eighth edition. Mc. Graw Hill higher Education pp 478

International edition ISBN 0-07-112169-2.

17. Miégoué E 2016 Evaluation of some leguminouss forages as protein sources dans cavies (Cavia porcellus L.) feeding feed with Pennisetum purpureum ou Panicum maximum. Doctorate thesis in Biotechnology and Animal Production. University of Dschang. 6-11p.
18. Bindelle J 2007 Voluntary intake, chemical composition and in vitro digestibility of fresh forages fed to ginea pigs in periurban rearing systems of Kinshasa (Democratic Republic of Congo). Tropical Animal Health and Production. 13p. Available online at http://www.researchgate.net/ publication/5880382.
19. Egena S S A, Alabi J O, Dikko H A, Stephen E, Silas A T et al., 2010 Growth performance and nutrient digestibility of guinea pigs (Cavia porcellus) fed two levels of protein and energy. International Journal of Applied Biological Research, 2(2): 38-43.
20. Tsukahara T, Ushida K 2000 Effects of animal or plant protein diets on caecal fermentation in guinea pigs (Cavia porcellus), rats (Rattus norvegicus) and chiks (Gallus gallus domesticus). Comparative Biochemistry and Physiology, 127: 139-146.