EFFECTS OF GUINEA GRASS AND MIXTURES OF GUINEA GRASS, CASSAVA LEAVES AND CENTROSEMA LEAVES ON THE GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF GUINEA PIGS (*Cavia porcellus*)

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ABSTRACT
In order to improve guinea pig rearing in Ghana, a feeding trial was conducted at the Department of Animal Science, Kwame Nkrumah University of Science and Technology, Kumasi- Ghana using twelve guinea pigs. The guinea pigs were allotted randomly to four treatments comprising a mixture of Guinea grass (Panicum maximum) leaves, Cassava (Manihot esculenta) leaves and Centrosema (Centrosema pubescens) leaves. The 4 treatments were T1, T2, T3 and T4 with T_1 being the control, composed of Guinea grass leaves, T_2 composed of 50% Guinea grass leaves and 50% Centrosema leaves, T_3 composed of 50% Guinea grass leaves and 50% Cassava leaves and T_4 composed of 50% Guinea grass leaves, 25% Centrosema leaves and 25% Cassava leaves. Each treatment was replicated three times. The feeding trial lasted for a period of 49 days (7 weeks). Feed and water were supplied on ad libitum basis. The weights of the animals were recorded weekly to determine the weight changes of the animals as the experiment progressed. At the end of the experiment, the animals were slaughtered and eviscerated to determine the carcass characteristics. Significant ($p<0.05$) difference was observed in the total feed intake, where T1 recorded the highest feed intake, followed by T4 then T2 and finally T3. There were no significant ($p>0.05$ difference) in the initial and final weights, weight gain and feed conversion efficiency across the various treatments. Full stomach, empty stomach and spleen weights recorded significant ($p<0.05$) difference among the various treatments. In each of these cases, T4 recorded the highest mean weight and it was in the order T1<T2<T3<T4, nevertheless, the remaining carcass traits recorded no significant ($p>0.05$) differences. The results of the study indicated that the various combinations were acceptable to the animals, did not lead to mortalities and could therefore be used as feeding material for the guinea pigs.

Keywords: *Guinea pig, guinea grass leaves, cassava leaves, Centrosema leaves, minilivestock.*

INTRODUCTION
Guinea pig (*Cavia porcellus*) commonly known as "cuy" or "cavy" comes from the Andean Region of South America, this region covers areas of Columbia, Venezuela, Ecuador, Peru, Argentina and Chile (Sahni, 2003). The Guinea pig was discovered in the 15TH century but their existence dates back to 5000 BC where they served as food for the tribes in the Andean region and used as sacred animals during festivals in Columbia, Peru, Bolivia and Ecuador (Morales, 1994; Sahni, 2003).

Following their discovery, guinea pigs have spread worldwide and have been useful to man in scientific research where many scientific discoveries have established facts using them as test specimens, they also served as pets in house-

holds because of their docile nature (Bradford, 2015). In the native households of Peru, Bolivia, Columbia and Ecuador, the Guinea pig has been a constant and sustainable source of meat for the inhabitants (Sahni, 2003; Maass, 2019). Given their ease of feeding, care, and breeding, they are able to provide quality meat all year round (Sahni, 2003; Maass, 2019). Regrettably, the potentials of this micro livestock has received little scientific attention.

Neglected and underutilized small livestock species such as the Guinea pig can play a vital role in providing better nutrition, poverty reduction and income generation, especially for women and the youth (Calero, 1998; Lammers *et al.*, 2009; Maass *et al.*, 2016). The Guinea pig has great potential in developing countries when it comes to meeting the nutritional needs of the people and ensuring economic Sufficiency. This is because, it is easy to feed these animals since they do not necessarily require feed ingredients that are also being consumed by man (Calero, 1998; Lammers *et al.*, 2009) and they convert feed to meat at a rate of 2.8 kg of feed for 1 kg weight gain (Nuwanyakpa *et al.*, 2009). Guinea pigs can produce a litter of 3 to 4 piglets per female every 68 - 70 days, given their unseasonal estrous; this makes their population to increase within a short period (Bradford, 2015). Their meat is of highest quality having a crude protein content of 21 % and low fat content of 7.4 % compared to the other livestock (Maass, 2019).

Ghana is a country rich in plant resources that can be used for a variety of things, be it nutritional, or medicinal. Some plant resources discovered and recognized as potential sources of feed for livestock in Ghana include *Leucaena leucocephala, Centosema pubescens, Mucuna pruriens, Sesbania sesban, Gliricida sepium, Chromolaena odorata, Ficus exasperate, Andropogon pseudapricus, Loudetia togoensis, Aristida kerstingii, Dactyloctenium aegyptium, Digitaria horizontalis, Afzelia africana, Pterocarpus erinaceus, Piliostigma spp, Balanites aegyptiaca, Ziziphus mauritiana, Acacia spp etc* (Apori *et al*., 2000; Zampaligré *et al*., 2013; Eguavoen, 2013;Smith, 1992; Kusi and Naandam, 2014; Amer, 2016). Most of these plants are locally available and easy to obtain. They can serve as feeding materials that are non-conventional and can ensure the growth and productivity of the guinea pig.

The objective of the study is to observe the performance of the guinea pig in terms of growth and carcass characteristics when fed a mixture of Guinea grass leaves (*Panicum maximum*), Cassava leaves (*Manihot esculenta*) and leaves of Centrosema (*Centrosema pubescens*).

MATERIALS AND METHODS

Study Area

The experiment was conducted at Department of Animal Science, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi Ghana. The study area is located within the semi -deciduous humid forest zone of Ghana at Latitude 06° 41'N and longitude 01° 33W with altitude 261.4M above Mean Sea Level. This zone is characterized by a bimodal rainfall pattern with an average annual rainfall of 1300mm.

Experimental Animal

A total of twenty (20) guinea pigs (three-weeks old) were sourced from the Department of Pharmacy, Kwame Nkrumah University of Science and Technology, Kumasi in the Ashanti Region of Ghana.

Experimental material and treatments

Three forages were use as experimental materials for the study: *Panicum maximum, Centrosema pubescens and Manihot esculenta*. The forages were obtained from areas around the Department of Animal Science and other areas within the Kwame Nkrumah University of Science and Technology, Kumasi main campus. The leaves of the various species were harvested daily in their fresh state chopped into bits before mixing (ie for treatments that require the combination of more than one species). The diets where then weighed before giving to the guinea pigs.

The experimental treatments comprised of T_1 (Control): 100% *Panicum maximum*, T_2: 50% *Panicum maximum* + 50% *Centrosema pubescens*, T_3: 50% *Panicum maximum* + 50% *Manihot esculenta*, T_4: 50% *Panicum maximum* + 25% *Centrosema pubescens* + 25% *Manihot esculenta*.

Experimental design, housing and management

The 12 guinea pigs were randomly allocated to four dietary treatments with 3 replicates per treatment using the Completely Randomized Design. Each replicate comprised of one guinea pig. The guinea pigs were housed in 12 cages which were installed in a well-ventilated room. The guinea pigs were given access to their respective diets and water *ad libitum*. Their cages were cleaned daily.

Growth performance

Feed intake per guinea pig was recorded by subtracting the feed left from the feed given the previous day. This was done using an "Ideen Welt" digital balance. Average weight gain per guinea pig was also determined for each replicate by subtracting the previous weight from the current weight using Ideen welt digital balance

Carcass characteristics

At the end of the experiment, all the guinea pigs were individually weighed and then slaughtered. The animals were eviscerated and the various components of the viscera weighed in addition to the carcass traits.

Chemical analysis of experimental diet

The experimental materials were sun dried for 3 – 4 hours, after which proximate analysis in triplicate was carried out on them at the Nutrition Laboratory, Department of Animal Science, Faculty of Agriculture using the standard procedure of the Association of Official Analytical Chemist (AOAC, 1990).

Statistical analysis

The data collected were analyzed under the General Linear Model as described in Minitab Version 18.1. Means were separated using Tukey's Pairwise Comparisons at 5% significant level.

Dry matter content

Centrosema leaves recorded a significantly ($p<0.05$) highest (63.25 %) dry matter content followed by guinea grass (61.25 %) then cassava leaves (59.75 %). Miegoue *et al.* (2018) reported the dry matter value of guinea grass to be 91.76 %, which is higher than the 61.25% dry matter result obtained in this experiment. This may be due to the difference in methods of drying and processing before analysis of the feed samples.

Table 1: Proximate composition of experimental material and diet

Composition (%)	Ingredients (%)				
	Guinea grass leaves	Cassava leaves	Centrosema leaves		P value
Dry matter	61.25^{ab}	59.75^{b}	63.25^{a}		0.015
Moisture content	38.75^{ab}	40.25^{a}	36.75^{b}		0.015
Crude fiber	2.55^{b}	6.75^{a}	3.25^{b}		0.004
Crude protein	13.57^{c}	24.43^{a}	20.10^{b}		0.000
Ether extract	9.63^{a}	5.85^{b}	8.85^{a}		0.008
Ash	7.75^{a}	3.00^{b}	5.75^{a}		0.003
Protein composition of treatment diets					
Treatments	T_1	T_2	T_3	T_4	**P value**
Crude protein (%)	13.57^{c}	18.35^{b}	24.98^{a}	23^{a}	0.00

^{ab}*Mean values within the same row with different superscript are significantly ($p<0.05$) different.*
T1 *=100% Guinea grass leaves,*
T2 *= 50% Guinea grass leaves + 50% Centrosema leaves,*
T3 *= 50% Guinea grass leaves + 50% Cassava leaves,*
T4 *= 50% Guinea grass leaves + 25% Centrosema leaves + 25% Cassava leaves.*

Morgan and Choct (2016) recorded 43.95% dry matter in cassava leaf, which is lower compared to the results obtained from this experiment. Latif and Joachim (2015) also found the dry matter values of some cultivars of cassava leaves to be in the range 70 – 90 %. This range was also higher than the results obtained in this experiment. These differences may be due to the difference in the drying method used.

The dry matter level in Centrosema leaves was lower (63.25 %) as compared to the 88 % and 88.99 % reported by Nworgu and Fasogbon (2007) and Nworgu (2013) respectively. These differences may be due to the different methods used in drying before analysis.

Moisture content

Cassava leaves recorded a significantly ($p<0.05$) higher value in moisture content (40.25 %) followed by guinea grass leaves (38.75 %), then Centrosema leaves (36.75 %).

Crude fiber

Cassava leaves recorded the highest ($p<0.05$) fiber content of (6.75 %) followed by Centrosema leaves (3.25 %) then guinea grass leaves (2.55 %).

Morgan and Choct (2016) reported fiber content of 17.70 % in cassava leaf meal. This was higher compared to the results obtained from this experiment (6.25 %). Miegoue *et al.* (2017) recorded a higher fiber content 33.08 % in guinea grass leaves as compared to the 2.55 % in present study.

Nworgu and Fasogbon (2007) recorded a crude fiber level of 6.43 % in Centrosema leaves, which was higher than the results (3.25 %) obtained. Nworgu (2013) also reported crude fiber level of Centrosema to be 8.80 %. This was also higher than the results obtained.

Crude protein

Cassava leaves recorded the highest protein content (24.43 %) as compared to guinea grass (13.57 %) and Centrosema (20.10 %). The protein content of guinea grass (13.57 %) was higher than that of Miégoué *et al.* (2018) (13.45 %),. Miegoue *et al.* (2017) also recorded a similarly lower value in protein content (13.45 %) as compared to the value obtained in this experiment (13.57%).

The protein content of cassava leaves (24.43 %) is however within the range of 20 – 30 % as observed by Ravindran (1995). Latif and Joachim (2015) recorded higher values for protein of some cultivars of cassava (24.7 - 34.8 %) as compared to the results obtained. The results were higher compared to values of some cultivars (17.7 % - 24.0 %) reported by Latif and Joachim (2015). With Centrosema leaves, Nworgu and Fasogbon (2007) reported values of 22.45% in crude protein content which is higher compared to the results obtained (20.10 %). This was also lower as compared to the 23.24 % reported by Nworgu (2013), but was higher than the 19.66 % obtained by Teitzel (2016).

T_3 had the highest crude protein level of 24.98 % followed by T_4 (23 %), T_2 (18.35 %), and T_1 (13.57 %). This may be due to the combinations of the ingredients in the various treatment diets. The protein contents of T_3 and T_4 were able to meet the minimum requirement of the guinea pig for growth as suggested by Calero (1998).

Ether extract

There were significant differences ($p < 0.05$) among the ingredients for ether extract. Cassava leaves (5.85 %) was significantly lower than Guinea grass (9.63 %), which was significantly lower than Centrosema (8.85 %).

Miegoue *et al.* (2018) reported 2.67 % as ether extract content for guinea grass, which was lower than the results obtained (9.63 %). Morgan and Choct (2016) reported fat content of 7.92 % of cassava leaf. This was higher than the result obtained (5.85 %). Latif and Joachim (2015) reported higher levels of ether extract in some cultivars of cassava (6.8 – 7.3 %) as compared to the results obtained (5.85 %)

Ash

There was a significant ($p<0.05$) difference in ash content among the ingredients with cassava leaves being significantly higher than guinea grass leaves and Centrosema leaves. Guinea grass leaves recorded the highest level of ash (7.75 %) followed by Centrosema leaves (5.75 %), and cassava leaves (3.0 %).

Miegoue *et al.* (2017) reported 14.12 % for ash content of Guinea grass leaves, but this value was higher than the result obtained in the present study (7.75 %).

Morgan and Choct (2016) reported 7.41 % ash content in cassava leaf. Latif and Joachim (2015) also reported ash contents in some cultivars to be 3.5 – 7.8 %. These values were higher than the 3.0 % value obtained from the present analysis.

The result of ash content from the analysis of the Centrosema leaves (8.85 %) was lower than the report of Nworgu (2013) (9.14 %). Nworgu and Fasogbon (2007) reported ash content to be 7.74 %, which was lower than the results obtained from the analysis.

Total feed intake

There was significant difference ($p < 0.05$) in total feed intake among the treatments with T_1 (5712.33 g) recording the highest amount of feed intake followed by T_4 (5492.00 g), T_2 (5472.00 g), and T_3 (4959.33 g). This could be explained by the palatability of the forage to the animals as high palatability results in higher intake (Ball *et al.*, 1998). A similar work was conducted by Miégoué *et al*. (2017) where guinea pigs were fed 100% guinea grass leaves and the resulting feed intake was 41.32 g per day for unchopped grass and 47.25 g per day for chopped grass. These values were lower than the results obtained from this experiment. This may be due to the amount of feed given to the animals during the experiment.

Feed conversion efficiency

There was no significant ($p>0.05$) difference in the feed conversion efficiency among the various treatments. Notwithstanding, there was numerical difference in the feed conversion efficiency across the various treatments where the guinea pigs fed the control diet were better converters of feed to weight gain as compared to the other treatments. This finding contradicts the findings of Miégoué *et al*. (2018) who rather observed the treatment group performing better in terms of feed conversion efficiency than the control group when they fed guinea pigs with *Centrosema pubescens, Panicum maximum and Pennisetum purpureum.*

Initial and final weight gain

Initial and final weights recorded no significant ($p > 0.05$) difference among the various treatments, but in numerical terms, the treatment with the mixture of *Panicum maximum*, *Centrosema pubescens* and *Manihot esculenta* recorded the highest mean value, followed by the treatment with *Panicum maximum* and *Manihot esculenta,* then the treatment with *Panicum maximum* and *Centrosema pubescens* and finally the treatment with only *Panicum maximum.* This finding is in line with the findings of Miégoué *et al*. (2018) who recorded no significant difference in the initial and final weights of guinea pigs when they fed them with diets containing. 40% *Panicum maximum* 30% *Pennisetum purpureum* and 30% *Centrosema pubescens,*

Weight gain

There was no significant ($p > 0.05$) difference in weight gain among the treatments. Numerically, the other treatments performed better than the control in terms of weight gain. T_4 (96.67 g)

Table 2: Effects of the different diets on the growth performance

Parameters	Treatments				P value
	T_1	T_2	T_3	T_4	
Initial weight (g)	224.33	241.33	261.33	272.00	0.54
Final weight (g)	254.67	301.33	316.00	334.00	0.25
Weight gain (g)	30.33	40.00	44.00	92.67	0.07
Total feed intake (g)	5712.33[a]	5472.00[a]	4959.33[b]	5492.00[a]	0.00
Feed conversion efficiency	0.53	0.73	0.89	1.68	0.07

[ab]*Mean values within the same row with different superscript are significantly ($p<0.05$) different.*
T1 *=100% Guinea grass leaves,*
T2 *= 50% Guinea grass leaves + 50% Centrosema leaves,*
T3 *= 50% Guinea grass leaves + 50% Cassava leaves,*
T4 *= 50% Guinea grass leaves + 25% Centrosema leaves + 25% Cassava leaves.*

recorded the highest weight gain followed by T_3 (44.00 g), T_2 (40.00 g), and T_1 (30.33 g) though T_3 had the highest protein content (24.43%). This may be due to the feed intake of the guinea pigs in T_4 (5492.00 g) as compared to that of T_3 (4959.33 g), which was the lowest. Because according to Schellingerhout *et al*. (2003), the correlation between feed intake and weight gain is positive, increase in feed intake will mean that there will be enough feed to be digested and utilized for growth and development.

There were no significant ($p>0.05$) differences in the viscera, empty carcass, heart, liver, empty and full gut, and kidney weights of the guinea pigs among the treatments. This gives an indication that the experimental materials are wholesome, and can be fed to guinea pig without any negative effect on carcass characteristics. Tandzong *et al*. (2015) recorded no significant difference in the carcass traits when they fed guinea pigs with cassava leaves against the control diet soybean meal. Miégoué *et al*. (2018) also observed no significant difference in the carcass parameters of guinea pigs when they fed them with *Panicum maximum* and *Pennisetum purpureum* leaves.

Empty and full stomach

There were significant differences ($p<0.05$) in the Empty stomach and Full stomach of the animals among the treatments. This may be due to the amount of digesta in the gut of the animal as it was slaughtered. This finding is not in consonance with the findings of Tandzong *et al*. (2015) and Miégoué *et al*. (2018) who rather had no significant difference in the full and empty stomach weights.

Spleen weight

The spleen of the guinea pigs also recorded significant ($p<0.05$) difference among the various treatments, where T_4 recorded the highest weight (0.677 g) followed by T_3 (0.530 g), then T_2 (0.413 g), and T_1 (0.377 g). This could be due to the increase in weight of the animals as the experiment advanced, T4 recorded the highest weight gain, so it is only natural that the mean weight of the spleen from this treatment be higher. Garcia-Carrillo (1977) reported that the spleen of the guinea pig increases in size as its weight increases.

CONCLUSION

The results of the study indicated that the various combinations were wholesome for the ani-

Table 3: Carcass parameters of animals

Parameters (g)	Treatments				P value
	T_1	T_2	T_3	T_4	
Viscera	92.67	103.00	99.67	91.67	0.75
Empty carcass	149.33	186.00	201.67	222.00	0.06
Heart	0.68	0.88	0.86	1.03	0.23
Liver	7.03	7.74	9.74	10.67	0.42
Empty gut	16.62	17.67	17.67	22.60	0.12
Full gut	66.153	76.343	66.230	59.07	0.46
Empty stomach	2.39^{b}	3.02^{ab}	2.82^{ab}	3.307^{a}	0.04
Full stomach	5.21^{b}	6.68^{ab}	9.75^{a}	6.85^{ab}	0.03
Kidney	2.59	2.95	2.98	3.76	0.19
Spleen	0.38^{b}	0.41^{b}	0.53^{a}	0.68^{ab}	0.01

^{ab}Mean values within the same row with different superscript are significantly ($p<0.05$) different.
***T1** =100% Guinea grass leaves,*
***T2** = 50% Guinea grass leaves + 50% Centrosema leaves,*
***T3** = 50% Guinea grass leaves + 50% Cassava leaves,*
***T4** = 50% Guinea grass leaves + 25% Centrosema leaves + 25% Cassava leaves.*

mals given the absence of mortalities and could be used as feeding material for the Guinea pigs. The combinations against the control T_1 showed better results for growth and development of the guinea pigs, but T_4, which was a mixture of Guinea grass leaves, Centrosema leaves and Cassava leaves showed the highest gain in terms of growth performance and carcass weight.

RECOMMENDATION

Guinea pigs in Ghana should be fed diets containing materials as described in T_4 for better performance. In addition, studies should be carried out on the effects of such combinations of the diets on the reproductive performance of the guinea pig.

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