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# Chemical Composition and Voluntary Intake of Fresh Forages Fed to Domestics' Guinea Pigs (Cavia Porcellus) in Western Highland of Cameroun

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**Abstract**

To improve the guinea pig production, a trial was carried out at the Teaching and research farm and in the Animal Nutrition's laboratory and feeding of the University of Dschang on August 2016. Also, on Chemical composition and voluntary intake of fresh forages fed to domestics' guinea pigs (Cavia porcellus) in west highland of Cameroon. The trial was done during 15 days using a factorial design with three legumes (Arachis glabrata, Desmodium intortum and Calliandra calothyrsus) and five grasses (Trypsacum laxum Panicum maximum, Brachiaria ruziziensis, Pennicetum purpurum and Pennicetum clandestinum). Samples of forages were collected and brought to the laboratory to be analyzed. 30 animals of average body weight 350 ± 40 g were randomly separated into 6 lodges. 3 of the lodges were allocated to chopped grasses while the remaining 3 for the unchopped ones. After cleaning, food was served by fixing the unchopped grasses and legumes on the lodge wall and chopped grasses in the feeder. Before cleaning lodges every day, the leftover of forages were weighed and recorded and, new forages were being weighed before serving to animals (500g of grasses and 250 g of legumes). Result showed that, the level of protein was high in legumes than grasses but, the level of crude fiber was higher in grasses. The combination of grasses and legumes can lead to a good result when feeding cavies based on forages. Minerals content in forages was found to be enough to cover the need of animals. In general, these forages can be used as good sources of minerals in the cavy diet. According to feed voluntary intake of forages, for unchopped form, T. laxum was significantly ($p \leq 0.05$) the most consumed and, Brachiaria ruziziensis significantly ($p \leq 0.05$) the less one. Considering the chopped form, the quantity of Brachiaria ruziziensis consumed was still significantly ($p \leq 0.05$) lower and the highest was also obtain with T. laxum. With chopped or unchopped graminaceous plant, the most significant ($p \leq 0.05$) quantity of legume plant consumed was Arachis glabrata followed by Desmodium intortum. Calliandra calothyrsus was the least significantly ($p \leq 0.05$) consumed. When associated to chopped graminaceous plants, legumes were more consumed. This study shows that guinea pig prefers T. laxum among grasses and, Arachis glabrata among legumes. Chopped graminaceous plants improved the consumption of other forages and, consequently the feed consumption.

**Keywords:** Chemical composition; Voluntary intake; Guinea pig; Fresh forages

## Introduction

The importance of unconventional animal species to livestock development and their role in improving the diet of the very poor is gaining recognition [1]. According to these authors, the commercial exploitation of this class of animals is justified by the fact that they are well adapted to harsh environment and can utilize natural resources that the larger (conventional) animals cannot. Exploiting and engaging in the keeping of the so called non conventional or micro-livestock become necessary [2]. Besides, most of the smaller animals are easy to feed, require limited space and management skill, easily handled and hence can easily be raised by landless and resource poor individuals both in the rural and urban areas of the country. The guinea pig (Cavia porcellus) a member of the cavidae family is one of such micro livestock that can play an active role in bridging the protein gap inherent in the diet of most countries. The production of Guinea pigs can be easily integrated effectively in to a rural economy because of its short gestation period, low cost of production, need for limited space, early maturity and ease of management [3]. Opined that the guinea pig is a more profitable source of food and income than many traditional livestock such as pig and cattle. It can therefore be a source of meat in developing economies to alleviate protein deficiency [4,5].

In Africa, no data is available on the stock of GP and only limited research has been carried out in Cameroon to improve the traditional




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rearing and feeding systems [4-8]. As shown in a previous study [4,9], the choice of forage species fed relies more on forage availability and on its palatability to GP rather than on animal requirements and plant nutritive value. Studies on the nutrient value of forages for GP in South America have been conducted [10-12]. However, no research has been carried out to determine nutritive value of forages for GP in Africa.

They are fed with various grasses and herbaceous dicots harvested daily in the backyards, along the roads or nearby the rivers. Until now, no objective information has been provided to the farmers for the feeding system, which is empirical and mainly depends on forage availability [9]. This study aimed to screen local forages available in urban and periurban areas of Cameroon in order to evaluate their interest for feeding GP. For that purpose, we determined the palatability of a range of fresh forages and, their relation to their potential nutritive value, evaluated through their chemical composition

## Materials and Methods

### Study area

The study was carried out at the Teaching and Research Farm and in the Laboratory of Animal nutrition and feeding of the Department of Animal Production, Faculty of Agronomy and Agricultural Science, University of Dschang. Dschang is located in the Western High Lands of Cameroon, between 25°6' North Latitude and between 10° and 11° East Longitude. The mean altitude of the region is 1420 m. The climate is equatorial. In this zone, rainfall varies between 1500 and 2000mm/yearly. Annual temperatures vary between 10°C in July and 25°C in February. There are two main seasons in the region: a short dry season running from mid-November to mid-March and a long rainy season (corresponding to cultural season) from mid-March to mid-November [13,14]. These last years, the rainy season tend to shift from latest February to early November. Subsistence agriculture, together with breeding and trade are the main economic activities of the region. The vegetation is the savannah with shrub, and sparse forests in some areas [15].

### Plant and animal material

Height forages made of five grasses (Panicum maximum, Brachiaria ruzizensis, Pennisetum purpureum, pennisetum clandestinum and Trypsacum laxum) and tree legumes (Desmodium intortum, Arachis glabrata and Calliandra calothyrsus) were studied. Species were chosen according to their crude protein content, to farmer's habits to use them as feed ingredients for herbivorous animals or to their availability around the farms. All the forages were harvested during the vegetative growth phase. According to animal's materials, 30 animals of average body weight 350 ± 40 g were randomly separated into 6 groups (5animals each) of similar total body weight during the entire experiment. 3 of those groups were allocated to chopped grasses and the remaining 3 for unchopped ones. The animals had free access to fresh water.

### Trial management

The trial was done in 15 days using a factorial design with three legumes (Arachis glabrata, Desmodium intortum and Calliandra calothyrsus) and five grasses (Trypsacum laxum Panicum maximum, Brachiaria ruziziensis, Pennicetum purpurum and Pennicetum clandestinum). 30 animals of average body weight 350 ± 40 g were randomly separated into 6 groups of 5animals each. Each group where allocated to a lodges. First block of 3 lodges was allocated to grasses chopped at 10 cm long and the remaining 3 lodges (a second block) for unchopped ones. Each lodge for a block represents a replication of a treatment. Animals in all groups receive daily 500 g of each grass and 250 g of legumes. After cleaning, food was served by fixing unchopped grasses and legumes on 5 different positions in the lodge wall and chopped grasses in the feeder. Forages were collected every day near the campus or in the forages plot in the university farm and, left to dry about 2 hours before giving to animals. Position of forages in the lodge was change every day during the 15 days of trial in a clock-wise direction. Before cleaning lodges every day, the leftover of forages was weighed and recorded and, new forages were being weighed before serving to animals (500g for grasses and 250 g of legumes). Feed consumption was obtained by the difference between the quantity of forage served to animals and the left over. Clean water was given ad libitum

### Chemical analysis

The amounts of feeds and refusals were recorded for each group. Samples of forages were taken and oven-dried at 60°C for dry matter determination. They were subsequently ground to pass a 1 mm-mesh screen and analyzed for their content in Dry Matter (105°C for 24 h), Ash (550°C for 8 h), Nitrogen (Kjeldahl method, crude protein= 6.25×N content), Crude Fiber according to Van Soest et al. [16] and Total Fat were determine by the Soxhlet technique as describe by AOAC [17]. Mineral and Organic Matter was determine by the method describe by pauwel et al. [18].

### Data collection and statistical analysis

The Daily Voluntary Intake per animal of each forage species was calculated daily for each group of animals as follows:

Intake= (offered-refused)/N  Where N is the number of animal per groups.

Data collected on feed intake were subjected to analysis of variance following the General Linear Model (GLM) procedure. Significant differences between means of plants consumption were compare by duncan's multiple rang test while significant differences between feed presentation were compare by Student T-test [19].

## Results

### Chemical composition

The percentage dry matter of each plant was quite higher, range from 90.92% to 96.69% (Table 1). The level of crude protein was the highest in the legumes (16.79% for A. glabrata to 23.98% for C. colothyrsus) than in grasses (11.87% to 15.20%). The highest crude protein contain in grasses were obtain with P. clandestinum (15.20%) and the lesser one with Trypsacum laxum (11.87%). The similar tendency was observed for total fat and ash about P. clandestinum which has the highest value but the less value of crude fiber. Considering the overall composition, P. maximum and P. purpureum are comparable. This is the same with D. intortum and C. calothyrsus.

Minerals contains of plants were high in general and enough for cavies feeding. The Ca/P ratio of legumes (2.73 for C. colothyrsus and 2.40 for D. intortum) were high and above the cavies' need. The

**Table 1:** Chemical composition of studied forages plants.

| Forages species | Dry Matter (DM) (%) | Crude Protein (CP) (% MS) | Total fat (%MS) | Ash (% MS) | Crude Fiber (CF) (% MS) |
|---|---|---|---|---|---|
| Grasses | | | | | |
| *Brachiaria ruziziensis* | 96.69 | 12.33 | 3.17 | 13.3 | 31.46 |
| *Panicum maximum* | 91.76 | 13.45 | 2.67 | 14.12 | 33.08 |
| *Pennisetum clandestinum* | 91.88 | 15.2 | 3.66 | 16.09 | 28.77 |
| *Pennisetum purpureum* | 94.83 | 14.87 | 2.96 | 14.02 | 34.78 |
| *Trypsacum laxum* | 92.37 | 11.87 | 2.82 | 11.8 | 34.02 |
| Legumes | | | | | |
| *Arachis glabrata* | 90.92 | 16.79 | 2.95 | 11.98 | 26.3 |
| *Calliandra colothyrsus* | 93.29 | 23.98 | 3.5 | 10.35 | 31.63 |
| *Desmodium intortum* | 92.38 | 23.79 | 5.58 | 9.78 | 29.63 |

**Table 2:** Minerals contain of different forages plants.

| Phosphorous mg/kg MS | legumes | | | Grasses | | | | |
|---|---|---|---|---|---|---|---|---|
| | *A. glabrata* | *C. calothyrsus* | *D. intortum* | *B. ruziziensis* | *P. maximum* | *P. clandestinum* | *P. purpureum* | *T. laxum* |
| | 1973.25 | 1434.7 | 1434.75 | 2511.7 | 1704 | 3050.2 | 1973.2 | 1704 |
| Organics Matters (OM) | | | | | | | | |
| Organic Carbon (OC) | 30.22 | 30.04 | 30.4 | 31.64 | 30.04 | 32.53 | 32.89 | 31.82 |
| Organic Matter (OM) | 52.1 | 51.8 | 52.41 | 54.56 | 51.8 | 56.09 | 56.7 | 54.86 |
| C/N ratio | 75.55 | 42.91 | 60.8 | 45.2 | 75.1 | 65.06 | 64 | 39.77 |
| Exchangeables Cations mg/kg MS | | | | | | | | |
| Calcium | 3778.8 | 3918.8 | 3438.8 | 3438.8 | 2998.8 | 3998.8 | 3798.8 | 3758.8 |
| Magnesium | 1329.2 | 1693.7 | 964.7 | 4123.7 | 2422.7 | 3637.7 | 2908.7 | 3394.7 |
| Potassium | 162.5 | 293.75 | 162.5 | 556.25 | 162.5 | 162.5 | 818.75 | 425 |
| Sodium | 43.92 | 11.6 | 24.4 | 55.77 | 20.2 | 40.66 | 10.42 | 23.5 |
| Nitrogen(%) | 0.4 | 0.7 | 0.5 | 0.7 | 0.4 | 0.5 | 0.5 | 0.8 |
| Ca/P ratio | 1.92 | 2.73 | 2.4 | 1.37 | 1.76 | 1.31 | 1.93 | 2.21 |

**Table 3:** Daily voluntary intakes of grasses.

| Presentation form | *B. ruziziensis* | *P. clandestinum* | *P. maximum* | *P. purpereum* | *T. laxum* | SEM | Prob. |
|---|---|---|---|---|---|---|---|
| unchopped form | $22.41^{d}$ | $36.73^{c}$ | $41.32^{bc}$ | $47.15^{b}$ | $53.35^{a}$ | 2.9 | 0 |
| chopped form | $37.91^{c}$ | $51.96^{ab}$ | $47.25^{bc}$ | $56.62^{ab}$ | $63.52^{a}$ | 2.79 | 0.014 |

a, b, c, d : Means with the same letter on the same line are comparables at 5% levels.

fewer ratios amongst legumes were obtained with A. glabrata (1.92). The highest minerals contains were gotten with P. clandestinum and the highest carbon contain with P. purpureum. Amongst grasses, Trypsacum laxum has the best Ca/P ratio follow by P. purpureum. The less C/N ratio was obtained with T. laxum and the Highest with A. glabrata. The best Magnesium, Potassium and Sodium contains were gotten with B. ruziziensis. Fewer differences were observed amongst these forages concerning Organic Carbon and Organic Matter contains (Table 2).

## Voluntary feed intake

Daily Voluntary Intake (DVI) of grasses is shown on (Table 3). The daily grasses intake reaches 200.98 g/Animal on a Fresh Matter basis for unchopped grasses and 247.26 g/Animal for chopped one. As far as unchopped grasses are concerned, T. laxum was highly palatable with DVI of 53,35g dry matter/Animal while B. ruziziensis was less palatable with DVI of 22.4135g dry matter/Animal. Also, The DVI of P. purpureum (47.15g dry matter/Animal) was significantly ($P \leq 0.05$) Higher than that of P. clandestinum but comparable ($P \geq 0.05$) of that of P. maximum. The consumption of this last grass was not significantly ($P \geq 0.05$) higher than the DVI of P. clandestinum.

Concerning chopped grasses, T. laxum (63.52g dry matter/Animal), P. purpereum (56.62 g dry matter/Animal) and P. clandestinum (51.96g dry matter/Animal) were highly palatable with DVI of more than 50 g dry matter/Animal. Their DVI remains comparable ($P \geq 0.05$). P. maximum approaching 47.25 g dry matter/Animal was also appreciated by the GP. Forage, from B. ruziziensis (37.91g dry matter/Animal), could be considered as well accepted since it represents 15.33 % of the ingested grasses. Chopped grasses appeared then to be more ingested by the GP, while unchopped ones were less palatable.

No significant difference ($P \geq 0.05$) was observed in Daily Voluntary Intakes (DVI) of grasses between the two forms of

**Table 4:** Daily voluntary intakes of legumes according to presentation form of grasses.

| Forme | *A. glabrata* | *C. calothyrsus* | *D. intortum* | SEM | Prob. |
|---|---|---|---|---|---|
| Non hachés | 49.95[a] | 6.57[c] | 25.63[b] | 6.29 | 0 |
| Hachés | 49.98[a] | 12.35[c] | 34.09[b] | 5.47 | 0 |

a, b, c : Means with the same letter on the same line are comparables at 5% levels.

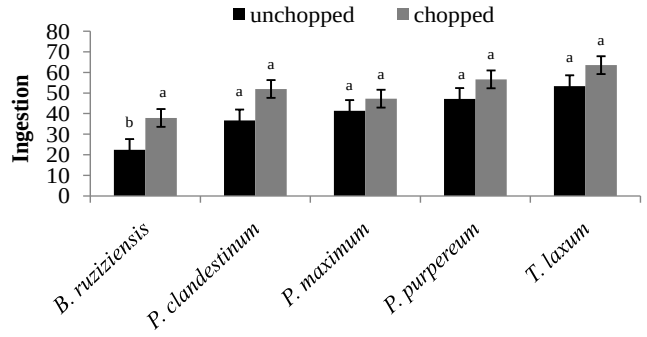


**Figure 1:** Daily voluntary intakes of grasses related to the form of presentation. a, b, c, d : Means with the same letter for each forage diagram are comparable at 5% levels.

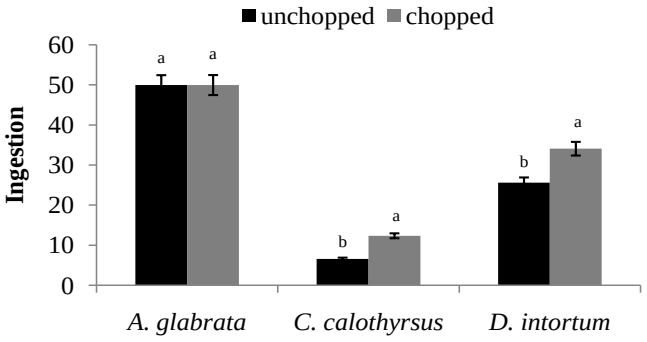


**Figure 2:** Daily voluntary intakes of grasses related to the form of presentation.

presentation (Figure 1). Only B. ruziziensis DVI was significantly higher (P≤ 0.05) when chopped. But, whatever the case, daily voluntary intakes (DVI) of grasses were considerably improved by the chopped form of presentation.

Great differences were observed according to the species of legumes (p≤ 0.05). Arachis glabrata was significantly (p≤ 0.05) highly palatable with DVI of 49.95g DM/Animal/day when associating to unchopped grasses and 49.98g DM/Animal/day to chopped grass. D. intortum with DVI of 25.63 and 34.09g DM/Animal/day when joining respectively to unchopped or chopped grasses were also appreciated by the GP. C. calothyrsus the significantly (p≤ 0.05) less consumed, appeared to be moderately ingested by the GP in the fresh form with the DVI of 6.57g DM/Animal/day and 12.35g DM/Animal/day respectively when associating to unchopped and chopped grasses. Also, grasses and legumes plants become more ingested when associating to chopped form.

The result of comparative daily voluntary intakes of legumes plants associated to chopped and unchopped grasses is shown in (Fgure 2). It appears that the DVI of legumes was significantly (P≤ 0.05) higher when associating to chopped grasses. Irrespective of the form of presentation of grasses, Arachis glabrata remain the most ingested legumes plants by GP.

## Discussion

The dry matter content of studied forages is quite higher. The crude protein content of C. Colothyrsus (23.98%) and that of Desmodium intortum (23.79%) were comparable but higher than that of A. glabrata (16.79%). These values were less than the one obtain by Boukila et al. [5]. These authors obtained 24.4% and 20.1% of crude protein respectively for D. intortum and A. glabrata harvest at the same stage as our plant. The difference may be due to type of soil and the harvesting zone. The level of protein content in these plants can be enough to be used by the animal and the cæcum fermentation to build the microorganism protein that is useful for animals. The crude protein of graminaceous plants were less than the one of legumes forages and ranges from 11.87% (T. laxum) to 15.20% (P. clandestinum). These observations are similar to what obtain by many authors which shows that the crude proteins contain of grasses are always less comparing to that of legumes [20]. The crude protein content of D. Intortum (23.79%) was similar to the value obtain by Bindle et al. [21] (23.4%) but, that of T. laxum (11.87%) and Panicum maximum (13.45% ) was less than that obtained by the same authors (15.0% and 14.8% respectively). This may be due to harvesting period and the soil composition. The value of crude protein and crude fiber obtained by Pamo et al. for T. laxum was higher than that of this study [20]. This may be due to the stage of development and the part of the plant used for analysis. As far as this study, the entire plant was analyzed and, according the previous authors, no detail was mentioned for the part of plant used. The crude protein content of C. Calothyrsus was similar to the one obtained by Pamo et al. in rainy season [20]. In addition, that of P. Purpureum was higher (14.87%) than the one obtained by the same author for the same period (13.83%). The ash content of T. laxum and D. intortum was also similar to that obtained by Bindle et al. [21] but that of P. Maximum was higher. The crude fiber content in each of these forages is highest and can cover the need of cavy. Among grasses, P. Clandestinum shows the highest Total fat, crude protein, ash and the less crude fiber contain. For the legumes, A. glabrata had the less value of crude protein content, crude fiber and total fat but had the highest value of ash content. This shows that these legumes have the highest quantities of minerals mainly Phosphorous.

Minerals contains of forages were similar to the obtained by many authors and can cover the need of cavies [22]. B. ruziensis and P. clandestinum shown less Ca/P ratio but good overall minerals contain. The C/N ratio between 42.91 and 75.55 is high in these plants and, is in the good range according to Giroux and Audesse [23] who state that the C/N ratio of fresh vegetal material varies from 50 to 150. According to the same authors, it is commonly believed that when the C/N ration is high the decomposition should be slow but the product of decomposition is more stable.

According to farmers, Daily Voluntary Intake (DVI) is the main factor influencing their feed choice. The commonly-used forages are amongst those with high DVI. However, since palatability is extremely difficult to define in terms of biological processes involved in feed selection [24], some species show a strong discrepancy between Daily Voluntary Intake (DVI) and nutritive value as measured through

chemical composition. As shown in a previous studies [4,9] the choice of forage species feed relies more on forage availability and on its palatability to GP rather than on animal requirements and plant nutritive value.

P. maximum, P. purpureum with high DVI and P. clandestinum with low DVI had good CP content. A large majority of the species covers the CP requirements of the growing GP. The low CP of P. maximum and T. laxum is however inconsistent with their high palatability. Poacea, P. maximum does not contain any anti-nutritional factors and then is highly digestible [9]. Regrowth of 2 to 3 leaves per tiller were used in this study as indicated by the high CP compared to other studies using this grasses [30]. It is very palatable to ruminants and rabbits [25]. It is also the case for P. purpureum. T. laxum with the highest DVI and B. ruziziensis with the less one, showed the less CP content among forages of this study. Concerning T. laxum, the result is in contradiction with the fact that, the mediocre forage is cumbersome and then less ingested than the rich ones [26]. According to their DVI and their Crude protein content, P. Maximum and P. purpureum can be used with good result for cavies raring.

Despite the fact that A. glabrata had the less CP content among leguminaceous plants, it was the most ingested, follow by D. intortum and, the less ingested was C. calothyrsus. In fact, [27] Nherera et al. shown that C. calothyrsus had the highest content of both soluble phenolics and insoluble proanthocyanidins. D. intortum leaves contain 8.5% of totals phenols, 7.6% of totals tannins and 10.7% condenses tannins [28]. These anti-nutritional factors level in plant can explain the less consumption.

D. intortum and A. glabrata are valuable sources of protein (high CP) with good palatability. They can be recommended as complement for a basal diet made of P. Maximum and P. purpureum. But, treated by sundry for example, C. calothyrsus can also be a good source of Protein according to his high CP content (23.98%).

The DVI was really improved by the form of presentation. This result confirms that of some authors that thinks that the ingestion of a specific food depend of the nature and presentation of the food [26]. Chatsworth and Guerin think that it is possible to improve food intake by reducing the size of food particle [29,30]. They also state that the size of food particles can be reduced by chopping simply long size forages. When associating to chopped grasses, leguminaceous plants intakes were improved. This may be due to balance between energy (grasses) and protein (Legumes). In fact, a good Energy/protein ratio is an indicator for a good food and can lead to good performances of animals.

## Conclusion

Finally, through our analyses, it came out that some species show a strong discrepancy between Daily Voluntary Intake (DVI) and nutritive value as measured through chemical composition. But, the knowledge of the palatability of forages remains important despite the fact that it is not correlated to their nutritional values when using in fresh form. In chopped form, forages intake is really improved also as the overall food intake. According to their high DVI and their chemical composition, a combination of P. purpureum or P. maximum with A. glabrata or D. intortum can be suggested to farmers for cavies breeding. Despite a moderate DVI, explained by the presence of anti-nutritionals factors, C. calothyrsus leaves can also be recommended to guinea pig producers. This species had the highest CP content and, can be dry, ground and incorporate in the Guinea pig diet.

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