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# Effects of garlic powder as a food additive on the *in vivo* digestibility of rations enriched with *Stylosanthes guianensis* in cavies (*Cavia porcellus*. L)

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## ABSTRACT

**Aim:** The study was aimed to contribute better productivity of cavies through the valorization of rations enriched with *Stylosanthes guianensis* powder associated with phytobiotics.

**Method and materials:** Fourty adult cavies of English breed including 20 females and 20 males aged 03 to 04 months and weighing around 350 ± 100g, purchased from producers in the neighboring villages of the experimental site. The cavies were acclimatized in the farm for one (01) month, the males isolated from the females in the breeding rooms previously cleaned and disinfected with a solution of sodium hypochlorite and cresyl, then 10 days of adaptation to individual cages of digestibility and experimental treatments. Drinking water enriched with vitamin C was distributed *ad libitum*. The animals were housed in individual cages and each received daily for the 7 days of the trial itself, 40g of rations each enriched with 20% *Stylosanthes guianensis* containing respectively 0% (R0), 0.25% (R0.25) 0.50% (R0.50) and 0.75% (R0.75) garlic powder. The rations were iso-nitrogenous (about 18% protein) and iso-energetic (about 2865 kcal DE/kg DM).

**Results:** Findings revealed that food intake significantly ($P<0.05$) decreased with the increase in the level of garlic powder in the ration. The Dry Matter (DM) ingestion was significantly ($P<0.05$) higher in both females and males and independently of sex with the R0.25 ration giving better results. The same trend was observed for the other parameters. Gender had no significant effect on the feed intake. The R0.25 and R0.50 rations made it possible to obtain the best digestive utilization coefficients for Dry Matter (DM), Organic Matter (OM) and Crude Protein (CP) and the R0.75 ration for Crude Fiber. Garlic powder can therefore be used at 0.25 or 0.50% to improve the ingestion and digestibility of rations enriched with 20% *S. guianensis* powder in cavies.

**Conclusion:** It was concluded that the rate of incorporation of garlic powder at 0.50% in the ration could allow the cavies to better utilize the nutrients.

**Keywords:** *Allium sativum*; cavies, food additive, ingestion, *in vivo* digestibility.

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## Introduction

The development of mini-breeding like cavia culture has been advocated as one of the sustainable solutions to fight against protein malnutrition, poverty and food insecurity in Africa in general and in Cameroon in particular (Niba *et al*., 2012; Miégoué *et al*., 2018). Indeed, the relatively low cost of capital and labor for raising cavies has allowed its popularization among low-income families living mainly in rural areas (WFP and FAO, 2011; Baldi and Gottardo, 2017).



In addition, the prolificacy of the cavy, its high growth rate, its lean meat rich in protein and its marketing as an animal for slaughter and experimentation (Metre, 2012; Faihum *et al*., 2019) offer these vulnerable populations a source of animal protein and income to reduce the incidence of nutritional diseases that can increase infant mortality rates and reduce life expectancy at birth (Defang *et al*., 2014).

However, the feeding of cavies remains a permanent constraint for the development of cavia culture due to digestive disorders linked to the frequent instability of the balance of its caecal flora. The imbalance of the flora thus constitutes a major handicap for the valorization of natural

resources local fodder available and at lower cost. Many authors have shown that several legumes and forage plants rich in nitrogen can be used as a source of protein in cavies. However, their digestibility is highly variable due to the unstable balance of the flora (Noumbissi *et al*., 2014; Miégoué *et al*., 2018; Nguedia *et al*., 2019; Ntsafack *et al*., 2020 Fokom *et al*., 2020). Indeed, although Miégoué *et al*. (2016) then Faïhun *et al*. (2019) suggested, among other things, the provision of balanced rations with a high intake of fodder legumes and other nitrogen-rich plants to cover their nutritional needs, digestive disorders remain the main cause of death in this animal. The instability of the Caecal flora inherent in the variation of the diet thus constitutes a real concern in cavia culture, especially since several antibiotics are detrimental for the cavy and destroy not only the infectious bacteria, but sometimes also those which are beneficial to the digestive system (Germain, 2018). Thus, the disruption of this balance promotes the proliferation of pathogenic bacteria to the detriment of useful ones, considerably reducing the digestibility of food and the performance of this animal (Bindelle and Picron, 2013; Losson, 2013; Miégoué *et al*., 2019).

With the ban on the use of antibiotics in animal feed by the European Union (Aouadi and Ben, 2012) and their very high sensitivity on the caecal microbiota of the cavy (Mba *et al*., 2020), natural substances from plants have attracted considerable interest, due to their great diversity and varied biological activities (Gong *et al*., 2014). Therefore, the stabilization of the caecal flora of the cavy by phytobiotics is a major asset for optimizing its production by promoting the degradation of fodder resources with high nitrogen potential and fibers such as *S. guanensis*. This is how Blas and Wiseman (2010), then Varga (2013) reported that the inulin contained in garlic (*Allium sativum*) had a stimulating effect on the growth of lactobacilli in cavies. However, Fogang *et al*. (2021) reported that garlic powder incorporated at 1% in the cavies diet did not significantly improve feed intake and digestibility, compared to the garlic-free diet. However, the allicin contained in garlic powder is a sulfur phytobiotic and as such, belongs to the family of sulfonamides which are antibiotics with a broad spectrum of bacteriostatic action, which prevent bacterial proliferation and facilitate the destruction of germs by host defenses. Thus, these phytochemicals can be bacteriostatic at low doses and bactericidal at higher doses (Torché and Bensegueni, 2020). Associated therefore with phytobiotics, rations enriched with *S. guianensis* powders could be better ingested and even valued. It is on the strength of this observation that the present study has the general objective of contributing to a better productivity of cavies through the enhancement of phytobiotics in their diet. More specifically, it is a question of evaluating in these animals, the effect of four levels of incorporation of garlic powder in the ration as a food additive, on the ingestion and digestibility of food enriched with *S. guianensis* powders.

## Materials and Methods

The study was conducted between September and November 2022 at the Teaching and Research Farm and the Animal Production and Nutrition Laboratory (LAPRONAN) of the University of Dschang. The locality is located between 5° 25' and 5° 30' north latitude, 10° 0' and 10° 05' east longitude and at an altitude of about 1420 m west of Cameroon. The climate of the region is equatorial of the Cameroonian type, with an average annual temperature of 20°C. The months of July and August are the coldest and the average annual rainfall varies between 1500 and 2000 mm, with relative humidity varying between 40% (in the middle of the dry season) and 97% (during the heavy rains).

*Housing and animal equipment*

The walls and the floor of the rearing rooms, the digestibility cages as well as the rearing equipment were cleaned and disinfected with a solution of sodium hypochlorite at a dose of 125 ml for 15 l of water and cresyl.

The realization of the crawl space for two weeks preceded the introduction into the breeding rooms of forty (40) adult cavies of English breed including 20 females and 20 males aged 03 to 04 months and weighing between 350 and 450g. The cavies were then acclimatized in the farm for one (01) month, the males isolated from the females in plywood breeding boxes, each equipped with a lighting device and the floor was covered with untreated dry wood shavings renewed every 2 days. After this phase, the animals were randomly introduced into individual metal digestibility cages equipped with a faeces collection device, a feeder and a plastic drinker. Drinking water enriched with vitamin C at the rate of one 250 mg tablet for 1.5

liters of water, was each time distributed *ad libitum* and renewed daily, to compensate for the vitamin C deficiency.

*Plant material*

The plant material consisted of *Trypsacum laxum* and *Stylosanthes guianensis* harvested before flowering in the fodder field of the Dschang University farm and its surroundings, then used respectively as a source of fiber and protein, and garlic of the pink variety. Bought from the market in the city of Dschang and used as a food additive. *Trypsacum laxum* and *Stylosanthes guianensis* were chopped and dried at room temperature to constant weight then ground before being incorporated into the compound feed. The garlic was peeled then chopped and dried in the sun until constant weight, then crushed and the powder kept in airtight and hermetically sealed packaging before being incorporated into the corresponding rations.

*Conduct of trials*

*Phytochemical screening of garlic*

One hundred (100) g of garlic powder were sent to the Laboratory of Biochemistry of Medicinal Plants, Food Sciences and Nutrition (LABPMAN) of the University of Dschang for the determination of the classes of compounds present in this sample according to the method described by Harbone (1973) and their total phenol contents according to the method described by Ramde-Tiendrebeogo et al. (2012), in total flavonoids according to the aluminum chloride colorimetric method (Chang *et al*., 2002) and in total tannins according to the Folin-Ciocalteu method described by Govindappa *et al*. (2011).

*Manufacture of experimental rations*

To make the basic ration (R0), some ingredients came from the Teaching and Research Farm fodder garden while others were purchased from the market and from agricultural by-product dealers in the city of Dschang. The percentages of incorporation of these ingredients in the basic ration were recorded (Table 1).

To evaluate the chemical composition of the basic ration (R0), one hundred (100) g of this ration were sent to the nutrition laboratory for the determination of their content in dry matter (DM), in organic matter (OM), in crude protein (CP) and crude fiber (CF) as described by AOAC (1990).From the basic ration R0, three (03) other rations were formulated by adding 0.25, 0.50 and 0.75% garlic powder. The R0, R0.25, R0.50 and R0.75 rations were pelleted and dried before being served to the animals which were divided into four (04) groups made up as follows:

- groups 0: 40g R0 (Basic ration containing 0% garlic powder) / animal / day
- groups 1: 40g R0.25 (Basic ration containing 0.25% garlic powder) / animal / day
- groups 2: 40g R0.50 (Basic ration containing 0.50% garlic powder) / animal / day
- groups 3: 40g R0.75 (Basic ration containing 0.75% garlic powder) / animal / day

20% of *Stylosanthes guianensis* was added to each group ration

**Table 1:** Percentage composition of the basic ration (R0)

| **Ingredients** | **Proportion (%)** |
|---|---|
| Remoulding | 22 |
| Corn | 25 |
| *Trypsacum laxum* | 27 |
| Cottonseed cake | 4 |
| Palm kernel meal | 7 |
| Soybean meal | 4 |
| Fishmeal | 7 |
| Shell powder | 1 |
| Premix 5% * | 1 |
| Palm oil | 2 |
| **TOTAL** | **100** |
| **Chemical composition** | |
| Dry matter (%) | 95.38 |
| Organic matter (% DM) | 88.56 |
| Crude protein (% DM) | 18.77 |
| Fats (% DM) | 02.84 |
| Crude fiber (% DM) | 15.89 |
| Ca/P (% DM) | 02.07 |
| DE (kcal/kg DM) | 2865 |

*VitA : 3000000UI, Vit D : 600000UI, VitE : 4000mg, VitK : 500mg, Vit B1 : 200mg, Vit B2 : 1000mg, Vit B6 :400mg, Vit B12 : 4mg, Iron : 8000mg,Copper : 2000mg, Zinc : 10000mg, Selenium: 20mg, Manganese: 14000mg, Methionine : 200000mg, Lysine : 78000mg),DM: Dry Matter, DE: Digestible Energy.

*Assessment of food intake and in vivo food digestibility*

After their acclimatization on the farm, 40 cavies were randomly distributed in individual digestibility cages comprising 10 repetitions per treatment where each sex was equally represented. The trials began with a 10 day adaptation phase during which the quantity of food served was adjusted to the animal's daily consumption estimated at 40g of ration. This phase also allowed the cavies to become familiar with the digestibility cages and the experimental rations. Drinking water fortified with vitamin C continued to be served and

digestibility cages cleaned daily. During the trial itself, which lasted seven (07) days, the rations were weighed and served only once a day, between 8 and 9 AM each morning. During data collection, before any new service, the refusals were collected and weighed, which allowed us to evaluate the daily feed intake in each experimental unit.

**Feed intake** = Daily quantity of feed served - Quantity not consumed

The faeces produced by the animals were collected and then weighed every morning using an electronic scale with a capacity of 5 kg and a sensitivity of 1 g, before each new feed distribution. The collected faeces were dried at 60°C in an oven until a constant weight was obtained, then their chemical composition (dry matter, organic matter, crude protein and crude fiber) was determined according to the method described by AOAC (1990) in order to calculate the apparent digestive utilization coefficient of each nutrient. The apparent Digestive Utilization Coefficients of Dry Matter (aDUCDM), Organic Matter (aDUCOM), Crude Protein (aDUCCP), and Crude Fiber (aDUCCF) were calculated according to the formula of Roberge and Toutain (1999):

**aDUCDM (%)** = (DM ingested − fecal DM)/(DM ingested) × 100;

**aDUCOM (%)** = (OM ingested − OM fecal)/(OM ingested) × 100;

**aDUCCP (%)** = (CP ingested − CP fecal)/(CP ingested) × 100;

**aDUCCF (%)** = (CF ingested − CF fecal)/(CF ingested) × 100.

*Statistical analysis of data*

The statistical analysis software used was SPSS 20.0. The data on feed intake and food digestibility were subjected to the 2-factor analysis of variance (ration and sex) according to the general linear model (GLM). When differences existed between the treatments, the means were separated using the Waller Duncan test at the 5% significance level (Steel and Torrie, 1980).

## Results and Discussion

*Evaluation of the phytochemical composition of garlic*

Garlic powder contains bioactive compounds such as alkaloids, phenols, flavonoids, sterols, triterpenoids, tannins and anthraquinones (Tables 2 and 3). Among the compounds quantified, the phenol content of this garlic powder is the highest.

*Evaluation of food intake according to the levels of incorporation of garlic powder in the ration*

Food ingestion decreased significantly ($p<0.05$) with the increase in the level of incorporation of garlic powder in the ration in females (Table 4). In males, ingestion was comparable ($p>0.05$) between the R0.50 and R0.75 rations, which were significantly less ingested than the R0.25 ration, the ingestion of which was significantly lower than control ration. Regardless of gender, ingestions of rations containing garlic powder were comparable ($p>0.05$) to each other and significantly ($p<0.05$) lower than control ration. In addition, the ingestion of the different rations did not vary significantly ($p>0.05$) between males and females, whatever the ration.

The DM ingestions of rations containing garlic powder were significantly ($p<0.05$) higher than that of the control ration in females and independently of sex. On the other hand, in the males, the ingestion of the DM of the R0.25 ration was significantly higher than that of the control ration which, moreover, was comparable ($p>0.05$) to the ingestions of the R0 rations, 50 and R0.75. Gender significantly influenced DM ingestion with control diet and did not show a significant difference ($p>0.05$) with that of the other diets.

OM ingestion was comparable between R0.50 and R0.75 rations but significantly higher than R0.25 ration which, moreover, was higher than that control ration (R0) in males and independently of the sex. On other hand, in females, the ingestion of OM was comparable ($p>0.05$) between the R0.75, R0.50 and R0 rations but significantly lower than R0.25 ration. OM was comparable ($p>0.05$) between males and females, whatever the ration.

CP ingestion was comparable between the rations containing 0.50% and 0.75% garlic powder, which were significantly ($p<0.05$) less ingested than control ration whose ingestion was otherwise comparable to ration containing 0.25% garlic powder, in males and females, and independently of sex. However, no significant difference ($p>0.05$) was observed for the ingestion of CP between males and females, whatever the ration.

The ingestion of CF in ration containing 0.75% garlic powder was significantly ($p<0.05$) higher than control ration which was otherwise ingested in a similar way ($p>0.05$) to R0.25 and R0.50 rations in males, females and even regardless of gender. However, the ingestion of CF between males and females was comparable whatever the ration.

Table 2: Phytochemical composition of garlic powder

| Exctracts | Alcaloides | Phenols | Flavonoedes | Sterols | Triterpenoedes | Tannins | Saponins | Antho-cyanines | Anthra-quinones |
|---|---|---|---|---|---|---|---|---|---|
| Garlicpowder | + | + | + | + | + | + | − | − | + |

(+) present ; (-) absent

Table 3: Contents of phenols, flavonoids and tannins in garlic powder

| | **phenols(mg EAG/g of powder)** | **flavonoids (mg EQ/g of powder)** | **tannins (mg EAT/g of powder)** |
|---|---|---|---|
| **Garlic powder** | 0.166 ± 0.05 | 0.022 ± 0.002 | 0.017 ± 0.003 |

Table 4: Ingestion of rations

| Ingestion (g DM/j/animal) | Sex | Rations | | | | p |
|---|---|---|---|---|---|---|
| | | R0 | R0.25 | R0.50 | R0.75 | |
| Iingestedfeed | ♂ | 31.01±0.43$^{a}$ | 29.25±1.47$^{b}$ | 27.70±0.64$^{c}$ | 27.39±0.68$^{c}$ | 0.001 |
| | ♀ | 23.20±0.30$^{a}$ | 21.34±1.04$^{b}$ | 20.30±0.72$^{c}$ | 19.30±0.57$^{d}$ | 0.001 |
| | ♂♀ | 27.10±0.21$^{a}$ | 25.29±1.26$^{b}$ | 24.00±0.66$^{b}$ | 23.35±0.51$^{b}$ | 0.001 |
| p | | 0.36 | 0.58 | 0.88 | 0.71 | |
| **Nutriments ingested** | | | | | | |
| DM | ♂ | 88.12±0.27$^{bB}$ | 89.14±0.27$^{a}$ | 88.26±0.91$^{b}$ | 88.05±0.52$^{b}$ | 0.02 |
| | ♀ | 89.55±0.078$^{dA}$ | 92.04±1.42$^{c}$ | 93.69±0.81$^{b}$ | 94.95±0.27$^{a}$ | 0.001 |
| | ♂♀ | 88.83±0.13$^{c}$ | 90.59±0.75$^{b}$ | 90.98±0.20 $^{ab}$ | 91.50±0.33$^{a}$ | 0.001 |
| p | | 0.01 | 0.07 | 0.94 | 0.49 | |
| OM | ♂ | 81.02±0.37$^{c}$ | 83.17±1.78$^{b}$ | 85.80±1.17$^{a}$ | 86.73±0.74$^{a}$ | 0.01 |
| | ♀ | 88.12±0.27$^{b}$ | 89.14±0.27$^{a}$ | 88.26±0.91$^{b}$ | 88.05±0.52$^{b}$ | 0.01 |
| | ♂♀ | 84.57±0.26$^{c}$ | 86.16±0.91$^{b}$ | 87.03±0.25$^{a}$ | 87.39±0.26$^{a}$ | 0.02 |
| p | | 0.51 | 0.07 | 0.60 | 0.48 | |
| CP | ♂ | 28.79±0.15$^{a}$ | 28.69±0.40$^{a}$ | 27.16±0.70$^{b}$ | 27.14±0.15$^{b}$ | 0.01 |
| | ♀ | 28.75±0.19$^{a}$ | 28.65±0.36$^{a}$ | 27.20±0.74$^{b}$ | 27.18±0.19$^{b}$ | 0.01 |
| | ♂♀ | 28.77±0.17$^{a}$ | 28.67±0.38$^{a}$ | 27.18±0.72$^{b}$ | 27.16±0.17$^{b}$ | 0.01 |
| p | | 1.11 | 1.21 | 1.45 | 1.33 | |
| CF | ♂ | 35.10±0.38$^{b}$ | 35.59±0.94$^{b}$ | 35.54±0.40$^{b}$ | 37.29±0.84$^{a}$ | 0.01 |
| | ♀ | 35.14±0.34$^{b}$ | 35.55±0.98$^{b}$ | 35.58±0.46$^{b}$ | 37.25±0.88$^{a}$ | 0.01 |
| | ♂♀ | 35.12±0.36$^{b}$ | 35.57±0.96$^{b}$ | 35.56±0.43$^{b}$ | 37.27±0.86$^{a}$ | 0.01 |
| p | | 1.04 | 1.30 | 1.17 | 1.42 | |

*a, b, c and d: Values with the same letter on the same row do not differ significantly (p>0.05). A and B: Values with the same letter on the same column do not differ significantly (p>0.05). P = Probability; R0 (control diet); R0.25 (Ration containing 0.25% garlic powder); R0.50 (Ration containing 0.50% garlic powder; R0.75 (Ration containing 0.75% garlic powder)*

*Evaluation of the in vivo digestibility according to the levels of incorporation of garlic powder in the ration*

The DM of ration containing 0.75% garlic powder was significantly less digested than control rations (R0), R0.25 and R0.50 whose aDUC were comparable (p>0.05) between them, in males and regardless of sex (Table 5). On other hand, the digestibility of this nutrient in females was comparable (p>0.05) between the R0.50 and R0.75 rations, which were also better digested (p<0.05) than the R0 and R0. R0.25 whose aDUC were comparable (p>0.05). The aDUC of DM between males and females did not vary significantly (p>0.05), whatever the ration. The digestive utilization of the OM of ration containing 0.75% garlic powder was significantly lower than control ration (R0) which, moreover, was better digested than the OM of the R0.25 and R0.50 rations in males and regardless of sex. However, females showed an opposite trend with respect to the digestibility of this nutrient in the R0.75 ration whose aDUC was significantly higher (p<0.05) compared to R0.25 and R0.50 rations which were comparable to each other and significantly (p<0.05) higher than control diet. However, sex significantly influenced the digestion of the OM of the rations containing 0.25% and 0.50% garlic powder, but had no significant effect (p>0.05) on those of the control rations and R0.75.

Table 5: Digestibility of rations

| CUDa(%) | Sexe | Rations | | | | p |
|---|---|---|---|---|---|---|
| | | R0 | R0.25 | R0.50 | R0.75 | |
| aDUCDM | ♂ | 85.96±0.37$^{a}$ | 85.41±0.58$^{a}$ | 85.64±0.41$^{a}$ | 83.91±1.03$^{b}$ | 0.01 |
| | ♀ | 84.87±0.29$^{b}$ | 85.03±0.34$^{b}$ | 85.84±0.36$^{a}$ | 85.67±0.34$^{a}$ | 0.01 |
| | ♂♀ | 85.41±0.24$^{a}$ | 85.22±0.22$^{ab}$ | 85.74±0.30$^{a}$ | 84.79±0.60$^{b}$ | 0.01 |
| p | | 0.61 | 0.32 | 0.73 | 0.18 | |
| aDUC OM | ♂ | 84.54±0.21$^{a}$ | 83.14±0.84$^{bB}$ | 83.95±0.40$^{abB}$ | 81.90±0.82$^{c}$ | 0.01 |
| | ♀ | 83.11±0.28$^{c}$ | 83.79±0.31$^{bA}$ | 84.03±0.02$^{abA}$ | 84.39±0.38$^{a}$ | 0.01 |
| | ♂♀ | 83.83±0.24$^{ab}$ | 83.46±0.35$^{bc}$ | 83.99±0.20$^{a}$ | 83.14±0.47$^{c}$ | 0.01 |
| p | | 0.41 | 0.07 | 0.01 | 0.30 | |
| aDUC CP | ♂ | 94.12±0.04$^{bc}$ | 94.98±1.12$^{ab}$ | 96.27±0.55$^{a}$ | 93.19±1.76$^{c}$ | 0.01 |
| | ♀ | 92.60±0.25$^{a}$ | 92.73±0.26$^{a}$ | 93.20±0.43$^{a}$ | 93.09±0.46$^{a}$ | 0.08 |
| | ♂♀ | 93.36±0.10$^{b}$ | 93.86±0.55$^{ab}$ | 94.73±0.08$^{a}$ | 93.14±1.07$^{b}$ | 0.01 |
| p | | 0.06 | 0.15 | 0.39 | 0.12 | |
| aDUC CF | ♂ | 89.84±0.14$^{a}$ | 89.49±0.57$^{ab}$ | 90.08±0.51$^{a}$ | 88.09±1.89$^{bB}$ | 0.04 |
| | ♀ | 88.11±0.71$^{c}$ | 88.57±0.32$^{bc}$ | 88.97±0.59$^{ab}$ | 89.34±0.38$^{aA}$ | 0.01 |
| | ♂♀ | 88.98±0.38$^{a}$ | 89.03±0.31$^{a}$ | 89.53±0.51$^{a}$ | 88.71±0.83$^{a}$ | 0.18 |
| p | | 0.15 | 0.10 | 0.92 | 0.01 | |

*a, b, c: Values with the same letter on the same row do not differ significantly (p>0.05). A and B: Values with the same letter on the same column do not differ significantly (p>0.05). P = Probability. aDUC: Apparent digestive utilization coefficient; DM: Dry matter; OM: Organic matter; CP: Crude protein; CF: Crude fibre, R0 (control diet); R0.25 (Ration containing 0.25% garlic powder); R0.50 (Ration containing 0.50% garlic powder; R0.75 (Ration containing 0.75% garlic powder)*

The aDUC of the Crude protein (CP) of the R0.25 and R0.50 rations were comparable to each other and significantly higher ($p<0.05$) than those of the R0 and R0.75 rations whose aDUC were otherwise comparable ($p>0.05$) between them in males and independently of sex. In females, on the other hand, no significant difference ($p>0.05$) was recorded between the aDUC of these rations. The aDUC CF of the R0, R0.25 and R0.50 rations were comparable ($p>0.05$) to each other and significantly ($p<0.05$) higher than that of the R0.75 ration in males. However, the digestion of this nutrient in females presented an opposite effect with the R0.75 ration whose aDUC of CF was comparable ($p>0.05$) to that of the R0.50 ration and significantly ($p<0.05$) higher than those of the R0 and R0.25 rations whose aDUC CF were otherwise comparable ($p>0.05$) between them. Irrespective of sex, CF was digested in the same way in males and females whatever the ration. Except for the R0.75 ration where significant digestion ($p<0.05$) of CF was noted in females compared to that of males, sex did not significantly influence the digestion of this nutrient in the others rations.

Feed intake decreased significantly with the increase in garlic powder in the ration. This decrease in intake compared to the control ration could be justified by the fact that the garlic powder would have increased the bulking power and satiety of the ration. Indeed, garlic contains insoluble fibers such as cellulose and hemicellulose which absorb water and swell in the digestive tract, causing the effect of satiety (Senninger, 2009; Colin, 2016). However, these results are different from those obtained by Fogang *et a*l. (2021) who found that the ingestion of the ration containing 1% garlic powder was comparable to that of the control ration in cavies. Similarly, Hossian *et al*. (2015) reported that the ingestion of rations containing 0.25% and 0.50% garlic powder was comparable to that of the control ration in rabbits. Karangiya *et al*. (2016) had made the same observation in broilers with a ration containing 1% garlic powder and they reported that there was no repellent effect of the smell and taste of garlic on the palatability of this ration in these animals. Furthermore, Makwana *et al*. (2019a) and Makwana *et al*. (2019b) reported that adding 0.1 or 0.5% garlic powder to the diet significantly improved feed intake in broilers. In the same vein, the work of Djoumessi *et al*. (2021) noted that the ingestions of DM, OM, CP and CF were similar between rations containing 0.25, 0.50 and 1% *Curcuma longa* powder which were also significantly better ingested than the nutrients in the control diet in the cavies. They pointed out that the presence of curcumin and its derivatives gave these rations a pronounced taste or smell which made them more palatable than the control ration. However, the ingestion of the different rations, OM, CP and CF, did not vary significantly between

males and females. These results are in agreement with those obtained by Fogang *et al*. (2021), but differ in the level of ingestion of DM from the control diet, which was significantly better ingested in females compared to males in our study.

The CF digestive utilization coefficients of the R0, R0.25 and R0.50 rations were comparable to each other and significantly higher than that of the R0.75 ration in males. This low digestibility of the CF of the R0.75 ration could be explained by the fact that the incorporation of the additive at a rate of 0.75% would have disturbed the development and the bacterial balance in the cecum by exerting a bactericidal action on both pathogenic bacteria and commen sal flora. Indeed, the sulfur compounds of garlic, in particular allicin, can be classified among the sulfonamides which are antibiotics with a broad spectrum of action. Torché and Bensegueni (2020) illustrate this phenomenon by reporting that antibiotics such as sulfonamides can be bacteriostatic at low doses and bactericidal at higher doses. Digestion of CF in females presented an opposite effect with the R0.75 ration, the aDUC of which for this nutrient was comparable to that of the R0.50 ration and significantly higher than the aDUC CF of the R0 and R0.25 rations, otherwise comparable to each other. However, the females had ingested more of the R0.75 ration than the R0, R0.25 and R0.50 rations, the CF ingestions of which were otherwise comparable to each other. These observations show that the incorporation of 0.75% and 0.50% garlic powder in the corresponding rations would have significantly improved the development of cellulolytic bacteria in female cavies which digested CF better than males. Indeed, Makwana *et al*. (2017), Makwana *et al*. (2019a) and Makwana *et al*. (2019b) noted that the increase in aDUC of nutrients from rations supplemented with garlic powder was due to the control of the growth and colonization of various pathogenic microorganisms in the intestinal tract in order to enhance the efficiency of the feed digestive utilization of nutrients. In addition, the inulin contained in garlic has a stimulating effect on the selective growth of lactobacilli, the majority and useful bacteria of the healthy caecal microflora of cavies (Varga, 2013; Blas and Wiseman, 2010). The level of fermentable fibers provided by the additive in the R0.25 and R0.50 rations would be sufficient to act as an energy substrate for the caecal flora by producing volatile fatty acids in the desired proportions, making it possible to obtain an optimal pH for the development of endogenous flora (Quesenberry and Carpenter, 2012). However, the results of the present work differ from those of Fogang *et al*. (2021) on cavies, from Karangiya *et al*. (2016a) on broilers, from Hossian *et al*. (2015) and Hossian *et al*. (2020) on rabbits, which reported that the aDUC CF of the supplemented diets were comparable to that of the unsupplemented diet.

With the exception of the Organic matter(OM) of the R0.25 and R0.50 rations as well as the CF of the R0.75 ration, the digestion of which was strongly influenced by sex in favor of females, the digestion of other nutrients in the other rations did not undergo the effect of sex. These results are in agreement with those of Miégoué *et al*. (2018) and Miégoué *et al*. (2019) who had noted that the digestive use of nutrients was more affected by the food than by the animal.

## Conclusion

Evaluation of the effect of the incorporation of different levels of garlic powder in the ration on the ingestion and *in vivo* digestibility of food in cavies concluded that control ration (R0) was the best ingested. However, the best ingestion of DM was obtained with the R0.25 ration in males and R0.75 in females that of OM with R0.50 and R0.75 rations in males and R0.25 in females. That of the PB with the R0 and R0.25 rations in the males as well as in the females. Finally that of the CF with the R0.75 ration in the males as in the females. The best digestive uses of nutrients (DM, OM, CP and CF) were obtained with the ration containing 0.50% garlic powder, both in males and in females. Thus, the rate of incorporation of garlic powder at 0.50% in the ration could allow the cavies to better utilize the nutrients.

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