

Effects of Thyme and Garlic Powder on Ingestion and *in vivo* Digestibility of Nutriment in Guinea Pig

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Abstract - In order to study the effects of thyme and garlic powder on ingestion and *in vivo* digestibility of nutrients in guinea pigs, a study was carried out at the Teaching and Research Farm (TRF) of the University of Dschang. The trial was done according to a factorial design (ration and sex) in four batches of 5 males and 5 females each. Thus, 40 guinea pigs weighing 450 ± 50 g, and four rations (T0, T1, T2 and T3) were used. The control ration allocated to the animals in batch 0 contained no additive. The animals of batches 1, 2 and 3 respectively received 1% thyme powder; 1% garlic powder and 0.5% thyme + 0.5% garlic powder in their rations. Forage, *Trypsacum laxum* was given *ad libitum* as basal feed. From this study it was recorded that regardless of sex and for any sex combined, feed intake of dry matter, organic matter, crude protein and crude fiber remained comparable. Likewise, the ingestion of composed feed was comparable between females receiving T0 (21.93 g DM / d / animal), T1 (23.20 g DM / d / animal) and T2 (23, 46 g DM / d / animal), but significantly higher than that of females subjected to the T3 ration (12.20 g DM / d / animal). In addition, females receiving T3 ration significantly ingested dry matter and organic matter better than the males. Regarding a DC, those of crude fiber were on one hand comparable in males subjected to T0 (90.92%) and T1 (89.83%) rations, but significantly better than those of males subjected to T2 (86.28%) and T3 (86.18%) rations in which these a DC were also comparable. According to the results obtained, the ingestion and *in vivo* digestibility of nutrients in guinea pigs can be improved by using thyme powder at the level of 1% in the ration.

Keywords: *Allium sativum*, *Thymus vulgaris*, *Caviaporcellus*, Ingestion, *in vivo* digestibility, weight gain.

I. INTRODUCTION

Africa endures poverty, malnutrition and other related social illnesses, particularly in farming landscapes where lack of capital and necessary experience prevent intensive

production of animal proteins. Due to this situation, mini-agriculture, too often forsaken, must be considered (Ndebi *et al.*, 2015). Caviaculture that is raising of guinea pigs, presents itself as one the opportunities to seize to help poor households come out of the situation of food insecurity to which they are submitted (Noumbissi *et al.*, 2014). Indeed, it constitutes a non-negligible source of proteins (Zougouet *et al.*, 2017). Pamoet *al.* (2005) and Miegouet *al.* (2018) underlined that caviaculture seems to be one of the solutions to answer protein needs. The high growth rate of guinea pig, its skinny and rich meat in proteins constitutes major assets for its production. The feed of this animal species is essentially kitchen remains which don't allow the animal to express its potential genetics (Nibaet *al.*, 2004; Zougou *et al.*, 2017). Its optimal use like source of proteins and income, requires an increase in its productivity that necessarily passes on one hand by the improvement of the raising strategies and of better production management methods on the other hand (Miegouet *al.*, 2018; Fokomet *al.*, 2020). Following this idea, numerous plants rich in nitrogen as *Manihot esculanta* (Mweuganget *al.*, 2014), *Desmodium intortum*, *Arachis glabrata*, *Calliandracalothyrsus* (Miégoué *et al.*, 2016), *Arthrospira platensis* (Nguedia *et al.*, 2019) saw the use to develop them. Besides these sources of non-conventional proteins, proved to be very efficient in animal feeding. Recent studies showed that some spices have a positive impact on the productive performances of house pets. The compounds present in this spices act indirectly by their antimicrobial, antioxidant effects and regulating intestinal flora of the animals (Alloui, 2011).

Originates from the Mediterranean basin, thyme is famous since thousands of years for its culinary, cosmetic and medicinal uses. Today its use is recognized again, to calm cough and inflammations present in the respiratory tract. It also permits to relieve minor digestive and gastro-intestinal unrests; besides, the essential oil of thyme presents some remarkable antioxidant, anti-bacterial and antiseptic properties. Amongst rodents, it has been observed that the essential oil of thyme could block the sensations of pain (Takaki *et al.*, 2008), which is favorable to the well-being of

animals. On the other hand, garlic contains different compounds such as flavonoids and tocopherols, in addition to the sulphurized compounds that contribute to its antioxidant activity. Works led by Arukwe *et al.* (2012) showed that cool garlic consumption (raw or cooked) increased antioxidant activity in plasma among rats.

In spite of all these known advantages mentioned, these two plant species were not exploited enough in animal feed in general and specifically in guinea pigs. It is in this logic that the present work was done with the main objective of evaluating the effects of in-feed inclusion of thyme and garlic powder as feed additive, on the ingestion and *in vivo* digestibility in guinea pigs.

II. MATERIALS AND METHODS

Site of study

This study was done in the Animal Production and Nutrition Research Unit of the Faculty of Agronomy and Agricultural Science (FASA) of the University of Dschang. The city of Dschang is located at the 15th degree of the Eastern meridian, at latitude 5°26'27''North and longitude 10°26'27''East. The climate of the region is equatorial of Cameroonian type modified by the altitude. In the locality, the precipitation varies between 1500 and 2000 mm per year. The yearly annual temperature is around 20°C, the total yearly sunshine is 1800 hours and an average relative humidity varying between 40 and 90%.

Animal material and lodging

Forty (40) guinea pigs of local breed (20 males and 20 females) of middleweight 450 ± 50 g were used to assess the effects of thyme and garlic powder on ingestion and *in vivo* digestibility of nutriment. They were placed in individual cages (40) of measurements: 80 cm length, 50 cm width and 30 cm height. Each of the cages was equipped with a device of fecal matter collection, as well as of a water trough of capacity 0.5 l.

Plant material

The plant material was thyme and garlic bought in the township of Santchou (West Cameroon) and then of *Trypsacum laxum*, harvested in the fodder field of the farm the eve, kept in one dwellings of the building and before being served *ad libitum* the following day to the animals.

Manufacture of the composed feed

The proportions of the different by-products used to manufacture the composed feed were bought in the city of

Dschang as well as their nutritional values are presented in Table 1. The feed formula was established from a ration (T0). The animals of treatments 1 (T1); 2 (T2) and 3 (T3) respectively received 1% thyme powder; 1% garlic powder and 0.5% thyme + 0.5% garlic powder in their rations. The gramineous *T. laxum* was served *ad libitum*.

Assessment of feed ingestion and *in vivo* digestibility of the rations

Digestibility was determined according to the modified European method of *in vivo* digestibility measurements established for rabbits (Tatsinkou *et al.*, 2020, Miégoués *et al.*, 2018). According to this method, *in vivo* digestibility required at least 8 animals per ration, the fecal collection period lasted at least 4 days and must be preceded with an adaptation period of at least 7 days. The animals were distributed following a factorial design (ration and sex) in four groups and placed in individual cages. Feed was served for a period of 15 days, divided in 2 periods: the adaptation of the animals to the digestibility cages and to the feed for 10 days during which every animals received water containing vitamins *ad libitum* and the corresponding experimental ration.

This period was followed directly with digestibility that lasted 5 days, corresponding to the data collection phase. During these 5 days, every animal still received of the water containing vitamins *ad libitum* and the corresponding experimental ration.

During the 5 days of collection, every morning, before all new service, the feed leftover or refusals was collected and weighed, there by evaluating daily feed ingestion in every experimental unit [feed ingestion = Quantity of feed served - non consumed Quantity (refusal)]. Then, the stool of every animal was collected and weighed. A sample of 100 g of these fecal matter (stool) was taken and dried until constant weight in a ventilated oven, it was then ground to powder and kept in plastic bags for the determination of its chemical composition (dry matter, organic matter, crude proteins and crude cellulose) as stipulated by the A.O.A.C. (2000).

The apparent coefficients of digestibility of dry matter (CUDaMS), organic matter (CUDa MO), crude proteins (CUDa PB) and crude cellulose (CUDa CB) were calculated according to the formula adapted by Miégoués *et al.* (2018).

Table1: Formulation of the different experimental rations

I n g r e d i e n t s	D i f f e r e n t r a t i o n s			
	T 0	T 1	T 2	T 3
M o d u l a t e	32	32	32	32
Maize	30	30	30	30
Cotton seed meal	11	11	11	11
Palm kernel meal	15	15	15	15
Soybeans meal	1.5	1.5	1.5	1.5
Fish meal	2	2	2	2
Oyster shell	2	2	2	2
Premix 5%	0.5	0.5	0.5	0.5
Oil	3	3	3	3
Garlic	-	1	-	0.5
Thyme	-	-	1	0.5
Total	100	100	100	100
Chemical composition				
MetabolisableEnergy(%MS)	2846	2805	2818	2777
Crudeprotein (% MS)	1 8 . 3 2	1 8 . 1 6	1 8 . 1 3	1 7 . 9 8
Raw cellulose (% MS)	1 0 . 0 9	1 2 . 8 9	9 . 9 9	1 2 . 7 6
C a / P (% M S)	1 . 9 6	4 1 . 9 8	1 . 9 7	1 . 9 9
F a t s (% M S)	5 . 8 6	7 . 2 4	5 . 8 7	1 7

Statistical analysis

Data on feed ingestion and *in vivo* digestibility were submitted to an analysis of variance of 2 factors (ANOVA) (ration and sex) according to the general linear model. In case of statistical difference, means were compared by the Waller Duncan’s multiple range tests at the significance level of 5% (Steel and Torrie, 1980). The software of analysis SPSS 21.0 was used.

Results

Effects of in-feed inclusion of thyme and garlic powder in the ration on feed ingestion. The ingestion of the different rations according to the sex among guinea pigs (Table2) showed that, whatever the sex and for all combined sex, the ingestion of dry matter, organic matter, crude proteins and crude cellulose remained comparable ($p > 0.05$). In the same line, the ingestion of composed feed was comparable between females receiving the rations T0, T1, and T2 but significantly ($p < 0.05$) higher than females submitted to the T3 ration.

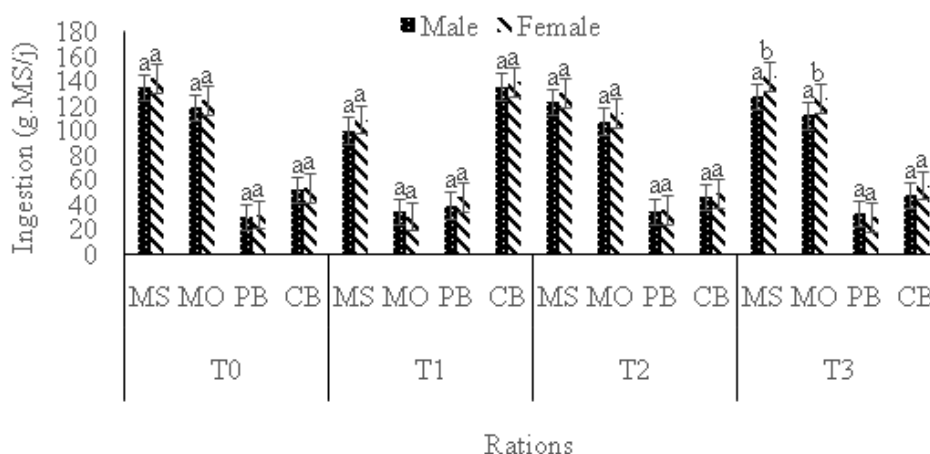
Table 2: Feed ingestion of the different rations according to sex in guinea pigs fed on *Trypsacum laxum*

F e e d i n g e s t i o n (g MS/d/animal)	T r e a t m e n t s				S E M P
	T 0	T 1	T 2	T 3	
E x p e r i m e n t a l					f e e d

	♂ (5)	127.73 ^a	93.26 ^a	111.53 ^a	112.20 ^a	7 . 3 3	0 . 8 5 1
<i>T. laxum</i> (MS)	♀ (5)	132.13 ^a	112.33 ^a	118.80 ^a	137.20 ^a	5 . 8 2	0 . 7 1 5
	♂♀(10)	129.93 ^a	102.79 ^a	115.16 ^a	124.70 ^a	6 . 5 7	0 . 7 8 3
Composed feed(MS)	♂ (5)	19.40 ^a	31.20 ^a	22.53 ^a	27.06 ^a	1 . 7 7	0 . 2 2 0
	♀ (5)	21.93 ^b	23.20 ^b	23.46 ^b	19.20 ^a	1 . 9 1	0 . 0 4 9
	♂♀(10)	20.66 ^a	27.20 ^a	22.99 ^a	23.13 ^a	1 . 8 4	0 . 1 3 4
T o t a l N u t r i m e n t s							
Dry matter	♂ (5)	135.47 ^a	113.99 ^a	123.22 ^a	127.85 ^a	6 . 3 4	0 . 8 7 6
	♀ (5)	141.82 ^a	124.47 ^a	130.77 ^a	143.90 ^a	4 . 7 7	0 . 8 6 3
	♂♀(10)	138.64 ^a	119.23 ^a	126.99 ^a	135.87 ^a	5 . 5 5	0 . 8 6 9
Organic matter	♂ (5)	118.92 ^a	100.63 ^a	107.90 ^a	112.65 ^a	5 . 5 1	0 . 8 7 5
	♀ (5)	124.56 ^a	109.46 ^a	114.50 ^a	126.32 ^a	4 . 1 6	0 . 8 6 8
	♂♀(10)	121.74 ^a	105.04 ^a	111.20 ^a	119.48 ^a	4 . 8 3	0 . 8 7 1
Crudeproteins	♂ (5)	29.88 ^a	34.62 ^a	34.78 ^a	32.94 ^a	1 . 7 4	0 . 0 5 1
	♀ (5)	32.33 ^a	30.84 ^a	36.53 ^a	30.20 ^a	1 . 7 0	0 . 0 5 5
	♂♀(10)	31.10 ^a	32.73 ^a	35.65 ^a	31.57 ^a	1 . 7 2	0 . 0 5 3
crudecellulose	♂ (5)	52.14 ^a	39.96 ^a	46.55 ^a	48.03 ^a	2 . 7 0	0 . 8 3 6
	♀ (5)	54.28 ^a	46.06 ^a	49.48 ^a	55.98 ^a	2 . 0 9	0 . 7 5 3
	♂♀(10)	53.21 ^a	43.01 ^a	48.01 ^a	52.00 ^a	2 . 3 9	0 . 7 9 4

a,b,c: The averages carrying the same letters on the same line are not significantly different at the threshold of 5%; SEM: Standard Error of the Mean; p: Probability.

Figure 1 shows the compared effects of thyme and garlic powder levels in the ration on feed ingestion and nutrients digestibility in male and female guinea pigs. It is seen that, whatever the considered ration, the ingestion of the nutrients remained comparable ($p > 0.05$) for all sexes. However, the females receiving the T3 ration ingested better ($p < 0.05$) dry matter (MS) and organic matter (MO) with respect to the males.



a,b,c: The averages carrying the same letters on bar charts are not significantly different at the threshold of 5%

Figure 1: Compared feed ingestion of MS, OM, PB and CB of male and female guinea pigs according to rations

Apparent coefficients of digestibility (CUDa) of nutriment in guinea pigs according to the level of inclusion of powdered thyme and garlic in the ration.

The apparent coefficients of digestibility of dry matter (CUDaMS), of organic matter (CUDaMO), of crude proteins (CUDaPB) and of crude cellulose (CUDaCB) according to thyme and garlic powder level in the ration and animalsex (Figure3) reveals that, the digestive use dry matter, organic matter and crude protein remained comparable among males, females and for all combined sexes whatever the considered ration. On one hand the apparent coefficients of digestibility of crude cellulose (CUDaCB) were comparable amongst males submitted to T0 and T1 rations, but significantly higher than those of males submitted to T2 and T3 rations on the other hand.

Table 3: Apparent coefficients of digestibility (CUDa) of MS, MO, PB and CB according to the rations and the sex in guinea pigs

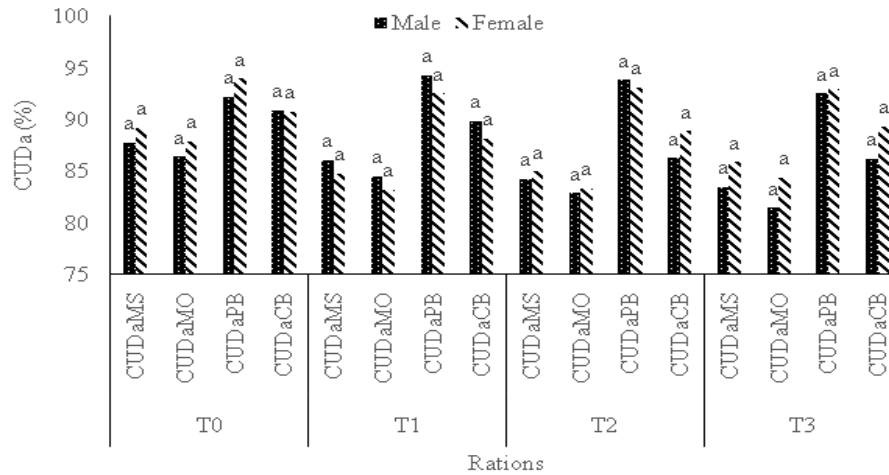
a,b,c: The averages carrying the same letters on the same line is not significantly different to the threshold of 5%; SEM: Standard

CUDa (%)		T r e a t m e n t								S	E	M	P
		T	0	T	1	T	2	T	3				
CUDaMS	♂ (5)	87.78 ^a	86.06 ^a	84.27 ^a	83.48 ^a	0.69	2.0	1.7	2.0				
	♀ (5)	89.21 ^a	84.78 ^a	84.97 ^a	85.87 ^a	0.90	0.8	0.4	3.8				
	♂♀(10)	88.49 ^a	85.42 ^a	84.72 ^a	84.67 ^a	0.80	0.0	0.3	0.5				
CUDaMO	♂ (5)	86.41 ^a	84.54 ^a	82.87 ^a	81.45 ^a	0.78	0.1	1.5	5.5				
	♀ (5)	87.93 ^a	83.24 ^a	83.31 ^a	84.39 ^a	1.10	0.4	0.8					
	♂♀(10)	87.17 ^a	83.89 ^a	83.09 ^a	82.92 ^a	0.89	0.3	1.7					
CUDaPB	♂ (5)	92.20 ^a	94.27 ^a	93.85 ^a	92.52 ^a	0.55	0.1	1.7	5.5				
	♀ (5)	93.94 ^a	92.54 ^a	93.09 ^a	92.93 ^a	0.49	0.2	7.5					
	♂♀(10)	93.07 ^a	93.40 ^a	93.47 ^a	92.72 ^a	0.52	0.2	2.5					
CUDaCB	♂ (5)	90.92 ^b	89.83 ^b	86.28 ^a	86.18 ^a	0.62	0.0	4.0	4.0				
	♀ (5)	90.77 ^a	88.17 ^a	88.86 ^a	89.35 ^a	0.70	0.6	5.4					
	♂♀(10)	90.84 ^a	89.00 ^a	87.57 ^a	87.76 ^a	0.66	0.3	4.7					

Error of the Mean; p: Probability.

Compared apparent coefficients of digestibility (CUDa) of MS, MO, PB and CB between males and females according to the rations in guinea pigs fed *Trypsacum laxum*.

Figure 2 shows the compared apparent coefficients of digestibility (CUDA) of the nutriments between males and females according to the rations in guinea pigs fed *Trypsacum laxum*. It is observed that, whatever the considered ration, the CUDA of all nutriments were comparable between sexes.



a,b,c: The averages carrying the same letters on the same bar charts are not significantly different at the threshold of 5%.

Figure 2: Compared apparent coefficients of digestibility (CUDA) of MS,MO, PB and CB between males and females with respects to the rations in guinea pigs fed *Trypsacum laxum*

III. DISCUSSION

During this study, the ingestion of the nutriments remained comparable between rations. These results oppose those gotten by Tatsinkou *et al.* (2020), which showed that the ingestion of rations increased with the inclusion of aqueous extract of pear seeds in the ration of guinea pigs. Otherwise, the females receiving the T3 ration have ingested less composed feed compared to those receiving the T0, T1, and T2 rations. It could be due to the taste and odour which is more pronounced in garlic (due to the molecule of alliinine), this dose might have decreased feed intake by the animals. Indeed, when the garlic is cut, ground or crushed, the sulphurized compounds are freed. To this moment, the alliinine is an inactive and odorless molecule of garlic, which turns into alliinine responsible for the characteristic odor of garlic Guessan *et al.* (2009).

The apparent coefficients of digestibility of dry matter (CUDaMS), organic matter (CUDaMO), crude proteins (CUDaPB) and crude cellulose (CUDaCB) with respect to thyme and garlic powder levels in the ration and the sex revealed that, the digestibility dry matter, organic matter and crude proteins remained comparable amongst males, females and for all combined sex, whatever the considered ration. These results are similar to those gotten by Foko *et al.* (2020), who had not gotten any significant difference between the different treatments as concerns CUDA of MS, OM, and CB amongst guinea pigs. But these results are in contrary to those gotten by Tatsinkou *et al.* (2020). Indeed, these last authors showed that the extract of pear seeds improved the digestion

of nutriments of the ration, due to the presence of phenol in the aqueous extract.

IV. CONCLUSION

It is evident from this study that:

The in-feed inclusion of thyme and garlic powder in the ration didn't influence the ingestion of nutriments of the ration. However, the females receiving the T3 ration ingested dry matter and organic matter significantly better compared to males.

The inclusion of thyme and garlic powder allowed the males of T0 and T1 rations to digest crude cellulose better compared to the males of T2 and T3 rations.

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