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Research Reports

Effect of Two Pepper Powders (*Piper nigrum* and *Piper guineense*) as a Feed Additive in the Ration on Intake and In Vivo Digestibility in Cavies (*Cavia porcellus L.*)

Pengaruh Dua Bubuk Lada (*Piper nigrum* dan *Piper guineense*) Sebagai Aditif Pakan Dalam Ransum Terhadap Asupan dan Kecernaan In Vivo Pada Cavia (*Cavia porcellus L.*)

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ABSTRACT

Background: Cavies are an essential element in a rural landscape in some African countries as food resources or income sources. **Purpose:** To study the effects of two peppers (*Piper nigrum* and *Piper guineense*) as a feed additive in ration on feed intake and In vivo digestibility of nutrients in cavies in order to improve their productivity. **Methods:** The Experiment consisted of a completely random design of four groups of 5 males and five females per group (40 cavies with weights of 450±50g). The control diet was given to group 1 animals (T0) containing no pepper. The cavies in groups 2 (T1), 3 (T2), and 4 (T3) were fed 0.5% *Piper nigrum* powder, 0.5% *Piper guineense* powder, and 0.25% *Piper nigrum* powder + 0.25% *Piper guineense* powder respectively. Similarly, *Trypsacum laxum* grass was weighed before being served. **Results:** The study showed that although not significantly (p>0.05), Dry matter (DM), Organic Matter (OM), crude protein (CP), and crude fiber (CF) were higher in animals fed the T0 control ratio compared to the other groups (37.94 g DM/d/animal; 33.71 g DM/d/animal; 5.28 g DM/d/animal and 6.45 g DM/d/animal respectively). In addition, the incorporation of the two peppers (*Piper nigrum* and *Piper guineense*) as a feed additive in the ration non-significantly (p>0.05) increased the apparent digestive utilization coefficients (aDUC) of food constituents (DM, OM, CP, and CF) in the cavies. **Conclusion:** Based on these results, the use of pepper powder in the ration can be considered at an incorporation rate of 0.5 % for good feed intake and up to 0.5% for better digestive utilization of nutrients in guinea pigs. The use of a synergy (0.25% of *Piper nigrum* + 0.25% of *Piper guineense*) can be considered.

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ABSTRAK

Latar Belakang: Cavies adalah elemen penting dalam lanskap pedesaan di beberapa negara Afrika sebagai sumber makanan atau sumber pendapatan. **Tujuan:** Untuk mempelajari efek dari dua bubuk lada (P*iper nigrum* dan Piper *guineense*) sebagai aditif pakan dalam ransum pada asupan pakan dan In vivo kecernaan nutrisi cavies untuk meningkatkan produktivitas mereka. **Metode:** Eksperimen terdiri dari desain acak dari empat kelompok yang terdiri dari 5 jantan dan 5 betina per kelompok (40 cavies dengan bobot 450±50g). Diet kontrol diberikan pada kelompok 1 hewan (T0) yang tidak mengandung lada. Cavies pada kelompok 2 (T1) diberi bubuk *Piper nigrum* 0,5%; 3 (T2) diberi 0,5% bubuk *Piper guineense* dan 0,25% bubuk, dan 4 (T3) diberi *Piper nigrum* + 0,25% bubuk *Piper guineense*. Demikian pula, rumput *Trypsacum laxum* ditimbang sebelum diberikan. **Hasil:** Penelitian menunjukkan bahwa meskipun tidak signifikan (p>0,05), Bahan kering (BK), Bahan Organik (BO), Protein Kasar (PK) dan Serat Kasar (SK) lebih tinggi pada hewan yang diberi ransum kontrol T0 dibandingkan dengan kelompok lain (37,94 g BK/hari/hewan; 33,71 g BK/hari/hewan; 5,28 g BK/hari/hewan dan 6,45 g BK/hari/hewan). Selain itu, penggabungan dua bubuk lada (*Piper nigrum* dan *Piper guineense*) sebagai aditif pakan dalam ransum secara tidak signifikan (p>0,05) meningkatkan koefisien pemanfaatan pencernaan nyata (aDUC) konstituen makanan (BK, BO, PK dan SK) dalam cavies. **Kesimpulan:** Penggunaan bubuk lada dalam ransum dapat dipertimbangkan pada tingkat penggabungan 0,5% untuk asupan pakan yang baik, dan hingga 0,5% untuk pemanfaatan nutrisi pencernaan yang lebih baik pada marmut. Penggunaan sinergi (0,25% *Piper nigrum* + 0,25% *Piper guineense*) dapat dipertimbangkan.

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Kata kunci: Asupan Pakan; Cavi; Kecernaan; In Vivo; Lada

INTRODUCTION

The development of mini-farming is currently an essential solution to combat protein malnutrition and food insecurity for future generations (Metre, 2012). Cavia culture or Cavy farming, the breeding of cavies, appears to be an opportunity to be seized (Metre, 2012). Cavy is a monogastric herbivore whose major interests lie in its prolificity, its high growth rate, its protein-rich meat (approximately 21%), and its inexpensive feed (Egena *et al.,* 2010). Cavy farming is widely practiced in Cameroon, especially in low-income families where it constitutes an important source of protein (Noumbissi *et al.,* 2014). In village farming, these animals feed on kitchen waste and harvest residues, which often have deficiencies in essential nutrients, resulting in low production and early mortality (Nguedia *et al.,* 2019). However, its optimal utilization as a protein source requires efficient feeding to improve productivity (Zougou *et al.,* 2017).

Moreover, one of the solutions would be to maximize the contribution of forage, including legumes, to the feed of these animals (Miégoué *et al.,* 2016). Unfortunately, these forage species are mainly composed of cellulose, hemicellulose, and lignin, and only microorganisms can hydrolyze and ferment if the cecal environment is healthy (Michelland *et al.,* 2012). The cavy can digest fibrous foods in the same way as polygastrics because of its very large cecum (8 to 10 times the volume of the stomach), which harbors a bacterial population that is very active in digesting plant fibers (Fuss, 2002; Picron *et al.,* 2013) but to do however, the balance of this bacterial population is crucial (Fuss, 2002). Chemicals, including broad-spectrum antibiotics used to sanitize digestive environments, have developed enteropathies in animals, such as diarrhea and constipation or meteorism problems (Miégoué *et al.,* 2016). In response to these dysfunctions, many natural plant additives have seen a strong increase in their use because of their great diversity and varied biological activities (Aouadi and Ben Salem, 2012). This is the case in studies by (MBA Tene *et al.,* 2021), (Djoumessi *et al.,* 2020), and (Tatsinkou *et al.,* 2020), with ginger (*Zingiber officinalis*) powder, Curcuma longa and avocado (*Persea americana*) kernel extracts, respectively, with direct consequences of improved female reproductive parameters with ginger and Curcuma longa powder and improved average weights and total gains of animals at birth and weaning with rations containing avocado kernel extracts. Associated with these additives Some peppers, such as black peppers (*Piper nigrum* and *Piper guineense*), also have effective properties that can be exploited.

According to (Cardenas *et al.,* 2017), these species are digestive stimulants that promote salivation and gastric juice production. It also contains an enzyme, piperine, which has antioxidant, anti-inflammatory, and antibacterial properties, and stimulates the production of endorphins by promoting the secretion of gastric juices that help digestion. According to (Juliani *et al.,* 2013), the piperine content of *Piper guineense* seeds is lower (sweetness that of aroma) than *Piper nigrum* seeds (very pungent). On the other hand, *Piper guineense* contains higher levels of volatile oils (especially linalool), which are responsible for the pleasant floral aroma. This aroma is spicy and woody in the seeds of *Piper nigrum*. When used as a feed additive, the synergistic effect of these two peppers could effectively improve the digestibility of feed provided to livestock. It is in this context that this work was initiated with the objective of contributing to the improvement of the production of cavy and, more precisely, feed intake and digestibility through the use of black pepper powder in ration.

MATERIAL and METHODS

Study Area

The experiment was conducted during February 2022 in the Animal Production and Nutrition Research Unit (URPRONAN) of the Faculty of Agronomy and Agricultural Sciences (FAAS) of the University of Dschang, with the following characteristics: 15th degree of the eastern meridian, 5° 36'–5° 44' northern latitude and 09° 85'-10° 06' eastern longitude. The climate is equatorial to the Cameroonian type, which is modified by altitude. In this locality, rainfall varies between 1500 and 2000 mm per year, with an average annual temperature of approximately 20°C. The total annual insolation is at 1800 h, with an average relative humidity that varied between 40 and 90%.

Plant Material

The plant materials were two black peppers (*Piper nigrum* and *Piper guineense*) purchased from the Bafoussam market in the West Cameroon region. These peppers were ground using a mechanical machine and stored in hermetically sealed plastic bags until they were gradually incorporated into the feed rations. The fodder (*Trypsacum laxum*) was harvested in the forage plot of the University of Dschang Application and Research Farm the day before, kept in one of the boxes of the rearing building, and pre-milled before being served to the animals the next day. A quantity of 100 g of the powder from each spice was taken for chemical composition analysis (Table 1) performed in the Biochemistry Laboratory of the University of Dschang.

Table 1.
Phytochemical screening of the *Piper nigrum* and *piper guineense*

Phytochemical Screening	*Piper nigrum*	*Piper guineense*
Alkaloids	+	+
Flavonoids	+	+
Saponins	+	+
Tannins	+	+
Polyphenols	+	+
Terpenoids	+	+
Steroids	+	+

Note: + : présent.

Animal Material and Housing

Forty (40) English breed cavy (20 males and 20 females) from the University of Dschang Application and Research Farm, with an average weight of 450 ± 50 g, were used in this study.

The animals were individually placed in wire cages with the following dimensions:80 cm length, 50 cm width, and 30 cm height. Each cage had feces collection disposal, a feeder and a 0.5 liter capacity waterer. During the trial, Vitamin C was added to the drinking water (1 tablet per 10 liters of water) ad libitum daily.

Preparation of Rations

Various portions of the different ingredients purchased from feed mills in the town of Dschang for compound feed production and their nutritional values are presented in Table 2. The formula for feed was based on the theoretical requirements of the cavy reported by (Numbela and Valencia, 2003). The formulation of the rations was preceded by the preparation of pepper powder. The latter was obtained from pepper seeds previously crushed with a mechanical machine to obtain a powder that was introduced at different rates as feed additives in the compound feed to constitute the different experimental rations. T0: basic ration without spice; T1: basic ratio containing 0.5% of *Piper nigrum* powder; T2: basic ration containing 0.5% of *Piper guineense* powder; T3: basic ration containing 0.25% of *Piper nigrum* powder + 0.25% of *Piper guineense* powder. The compound and pelleted feed and *Trypsacum laxum* grass were weighed before service.

Evaluation of Feed Intake and Digestibility

For the evaluation of feed intake and digestibility, the cavies were distributed according to a completely randomized design into four groups of five animals per sex and placed in individual cages. Digestibility tests were performed over a 15 days period, divided into two sub-periods: a 10-day adaptation sub-period to the cage of digestibility and the experimental ration, during which each animal received free-flowing vitamin water and the experimental ration corresponding to its group. The second sub-period was of 5 days called "digestibility," which corresponds to the phase of data collection. Throughout this period, each animal was given free-flowing vitamin water and an experimental diet corresponding to its group. Every morning, the weight of each ration was recorded (40 g compound feed + 100 g *T. laxum*) before being served. At the beginning and end of the trial, the animals were weighed with an empty stomach to determine their weight gain and calculate the average daily gain for the period of the experiment.

During data collection, each morning, before any new service, leftovers were gathered and weighed to evaluate the daily feed consumption in each experimental unit (feed intake = daily quantity of feed served–quantity left). The feces of each animal were collected and weighed. For each treatment, a sample of 100 g of feces was collected and dried at 60°C until a constant weight was obtained in a ventilated oven, crushed, and stored in plastic bags to determine its chemical composition (dry matter, organic matter, crude protein, and crude cellulose) according to A.O.A.C. (2000). The apparent digestive utilization coefficients of Dry Matter (aDUCDM), Organic Matter (aDUCOM), Crude Protein (aDUCCP), and Crude Fiber (aDUCCF) were calculated using the Roberge and Toutain (1999) formula.

Table 2.
Centesimal Composition and Nutritional Value of The Experimental rations

Ingredients	T0	*Trypsacum laxum*
Maize	26	
Wheat bran	48	
Soyabean meal	6	
Cotton cake	3	
Palm kernel cake	7	
Fish meal	6	
Bone meal	2	
Cooking salt	1	
Premix (2%)	1	
Total	**100**	
Chemical composition		
DM	93 .97	94.28
OM	88.83	84.63
CP	19.30	13.26
CF	9.00	37.77
Ash	09.17	10.28
Digestible Energy	2870	405.10

Note: Premix 2% flesh: Vit. A= 30000 IU/kg, Vit. D3= 600000 IU/kg, Vit. E= 4000mg/kg, Vit. K3= 500mg/kg, Vit. B1= 200mg/kg, Vit. B2= 1000mg/kg, Vit. B3= 2400mg/kg, Biotin= 10mg/kg, Vit. PP= 7000 mg/kg, Folic Acid= 200 mg/kg, Choline Chloride= 10000 mg/kg, Ferrous Sulfate= 8000 mg/kg, Cupric Sulfate (II)= 2000 mg/kg, Manganous Oxide= 1400 mg/kg, Calcium Iodate= 200 mg/kg, basic Cobalt Carbonate= 200 mg/kg, Sodium Selenite= 20 mg/kg, Methionine = 20, 000 mg/kg, Lysine=78000 mg/kg, DM: Dry matter, OM: Organic Matter, CP: Crude Protein, CB: Crude Cellulose

RESULTS

Effects of The Inclusion of Pepper Powder in The Diet on Feed intake in Cavies

The inclusion of pepper powder in the diet did not significantly affect the feed intake of cavies compared with that of animals fed the control diet (Table 3). Although comparable ($p > 0.05$) to the intake of animals fed other diets, the feed intake of cavies fed the control diet remained higher during this study.

Table 3.
Effects of Pepper Powder to The Feed Intake of Cavies

Feed Intake (g/DM/day/animal)	Treatments				P
	T0	T1	T2	T3	
Dry Matter (DM)	37.94±4.28	34.70±6.82	35.01±7.07	34.15±7.80	0.85
Organic Matter (OM)	33.71±3.78	30.84±6.03	30.99±6.30	30.31±6.86	0.84
Crude Protein (CP)	5.28±0.59	4.83±0.95	4.87±0.98	4.75±1.08	0.85
Crude Fiber (CF)	6.45±0.71	5.84±1.31	6.51±1.20	5.94±1.72	0.83

Note: p : Probability, T0 : ration without piper, T1 : ration containing 0.5 % of *Piper nigrum*, T2 : ration containing 0.5 % *Piper guineense* , T3 : ration containing 0.25% of *Piper nigrum* + 0.25% of *piper guineense*.

Effects of The Inclusion of Pepper Powder in The Diet on The Digestive Utilization Coefficients In Cavia

Although they remained comparable in guinea pigs ($p > 0.05$) regardless of the level of inclusion of pepper powder in the ration, the coefficients of digestive utilization of nutrients increased with the inclusion of pepper powder in the ration (Table 4).

Table 4.
Effects of Pepper Powder on The Apparent Digestive Utilization Coefficient (ADUC) of The Feed In Cavy

aDUC (%)	Treatements				p
	T0	T1	T2	T3	
DM	75.75±3.43	78.04±302	76.44±5.41	76.97±5.86	0.86
OM	75.40±33.45	77.80±3.02	76.09±5.28	77.59±5.95	0.85
CP	72.02±6.60	77.12±4.15	76.36±6.35	77.83±6.36	0.53
CF	68.64±3.08	73.11±4.40	75.28±5.84	78.63±6.34	0.09

Note: p : Probability, T0 : Ration without spice (control), T1 : Ration containing 0.5% *Piper nigrum*, T2 : Ration containing 0.5% *Piper guineense*, T3 : Ration containing 0.25% *Piper nigrum* + 0.25% *Piper guineense*, CUDa : Coefficient of Apparent Digestive Utilization (CUD), % : Percentage

DISCUSSION

During this study, the feed intake was comparable for all animals in all rations. Although comparable to the intake of animals fed other rations, the feed intake of cavies fed the control group remained higher during this study. This result could be attributed to the acrid taste of peppers due to the presence of piperine (pungent taste) contained in these peppers, which would be the origin of the decrease in food intake when they are incorporated in the feed of cavies. Compared to *Piper guineense*, the inclusion of *Piper nigrum* seed powder in the cavy feed reduced feed intake more. This could be due to the lower piperine content of *Piper guineense* seeds (sweetness of the aroma) than that of *Piper nigrum* seeds (very pungent). *Piper guineense* on the other hand, contains higher levels of volatile oils (especially linalool), which are responsible for the pleasant floral aroma. This aroma is spicy and woody in Piper nigrum seeds (Juliani *et al.,* 2013). This result is in agreement with that of (MBA Tene *et al.,* 2021), who noted a significant reduction in food intake in cavies receiving 0.5; 0.75 and 1% of ginger powder in the ration due to the accretion of this spice, this in comparison with the results obtained from animals in the control batch. This observation is consistent with those of (Doley *et al.,* 2009) and (Ademola *et al.,* 2009), who found no significant difference in feed intake in chickens receiving rations containing ginger and garlic. Nevertheless, results of in this work differ from those of (Al-Kassie and Kardirvel R, 2012), who had noted that, in broilers, the inclusion of 1% black pepper powder in the ration, had improved feed intake. This was attributed to the presence of active compounds in pepper, such as capsaicin, which is rich in Vitamin C, which would have a positive impact on the ingestion of nutrients by the animals. Indeed, these authors also obtained an improvement in the food intake in quails receiving rations containing 0.5%, 0.75% and 1% of *Piper nigrum* powder in comparison with animals submitted to the control group. This difference could be explained by the fact that the intake of pepper-containing feed varies according to the animal species.

The coefficients of digestive use of nutrients increased with the association of peppers with the ration. Black pepper is a digestive stimulant that promotes salivation and the production of gastric juices, which helps digestion by acting on the stomach and increasing the secretion of hydrochloric acid (Cardenas *et al.,* 2017). This result is consistent with that of (Hosseini, 2011), who reported that black pepper (*Piper nigrum*) increased digestion by stimulating the digestive fluids of the stomach and promoting the eradication of infectious bacteria. According to these authors, this spice affects the absorption of nutrients, simultaneously decreasing the transit speed of materials while increasing the secretion of digestive enzymes. All This could explain the improvement in nutrient digestion observed in animals receiving the T1 ration (0.5% *Piper nigrum*).

CONCLUSION

At the end of the trial, the effect of two pepper powders (*Piper nigrum* and *Piper guineense*) as a feed additive in the diet on intake and In vivo digestibility in cavies (*Cavia porcellus L.*) showed that inclusion of pepper powder did not improve the feed intake of cavies. Also, the apparent digestive utilization coefficients of food components were improved by 0.5% of pepper powder in the ration owing to their power as digestive stimulants. The use of a synergy (0.25% of *Piper nigrum* + 0.25% of *Piper guineense*) is not beneficial for feed intake or for apparent digestive utilization coefficients of food components. Finally, taken individually, the use of *Piper nigrum* and *Piper guineense* powder in the ration can be considered at an incorporation rate of 0.5% for a better apparent digestive utilization coefficients of food components.

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CONFLICT of INTEREST

The author declares no conflict of interest.

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ETHICAL APPROVAL

Permission for the study was obtained fom the required authorities and local ethical commitees in West region, Cameroon including the regional delegation of Livestock; Fisheries and animal industries, Regional Delegation of public health, Department of Animals Sciences of the Faculty of Agronomy and Agricultural Sciences of the University of Dschang and Dschang Annex Regional Hospital.

AUTHORS' CONTRIBUTIONS

Conception an design of the study: ME, Acquisition of data: MSN. Analysis and interpretation of data: FWD, KNC, MA. Drafting the manuscript: KNC, DTF-G. Revision manuscript: DFH, NMNB.

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