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Research Article

Effects of Cloves (*Syzygium aromaticum*) Ration Supplementation on Growth Parameters in Guinea Pigs

Nkana Kontchiachou J Gwladys[1]*, Kouamo Justin[2], Vemo Bertin Narcisse[3], Mweugang Ngouopo Nathalie[4], Wang-baa Temoa Christophe[1], Awantu christian[1], Semi Yam Alphonsius[1], Kenne Christèle[5] and Tendonkeng Fernand[5]

[1]*Agronomic Research Institute for Development (IRAD), Mankon, Bamenda, Bamenda, Cameroon*

[2]*School of Sciences and Veterinary Medicine, University of Ngaoundéré, Ngaoundéré, Cameroon*

[3]*Department of Animal Science, Faculty of Agriculture and Veterinary Medicine, University of Buea, Buea, Cameroon*

[4]*Department of Biological Sciences, Faculty of Sciences, University of Ngaoundéré, Ngaoundéré, Cameroon*

[5]*Department of Animal Science, Faculty of Agronomy and Agricultural Sciences, University of Dschang, Dschang, Cameroon*

***Corresponding Author:** Nkana Kontchiachou J Gwladys, Agronomic Research Institute for Development (IRAD), Mankon, Bamenda, Bamenda, Cameroon.

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Abstract

Because of the antibiotics growth promoters restriction in livestock farming, there is a growing interest in plant feed additives. This study was designed to evaluate the effects of supplementing cloves (*Syzygium aromaticum*) powder on growth parameters in guinea pigs. For this purpose, 60 adult female guinea pigs, with an average weight of 450 ± 50g were randomly allocated to three experimental groups (20 females per group). Experimental diets consisted of incorporating clove powder in the control ration at 0.5% (CG0.5) and 0.75% (CG0.75) of feed. These female guinea pigs were given experimental diets, from mating to weaning at 3 weeks after parturition. Their weaned piglets too received the respective experimental diets, from weaning to 8 weeks post-partum. The feed intake of reproductive females and piglets, the live weight, weight gain, carcass yield and relative weights of liver, kidney and spleen were evaluated as growth parameters. Results showed that the ingestion of dry matter, organic matter, crude protein and crude fibres of reproductive female guinea pigs were significantly ($p < 0.05$) higher with the inclusion of *Syzygium aromaticum* powder at 0.75% when compared to the control group. The ingested dry matter, organic matter, crude fibres and minerals of young guinea pigs were not significantly ($p > 0.05$) affected by this spice, but the crude protein intake decreased significantly ($p < 0.05$) with the inclusion of *Syzygium aromaticum* powder. The dietary treatments had no significant effect ($p > 0.05$) on the carcass yield, relative weights of the liver, kidney and spleen of piglets, referring to the control diet. In conclusion, *Syzygium aromaticum* powder can be used up to 0.75% in reproductive female guinea pigs and 0.5% in piglets as feed supplement without any adverse effects on the growth parameters.

Keywords: *Animal Feed; Growth Parameters; Guinea Pigs; Supplementation; Syzygium aromaticum*

Introduction

In order to improve diet in animal production and to circumvent the increasing public concern about antibiotics residues in animal products, research has been focused to find natural alternatives to antibiotics feed additives. Many natural additives are used in animal

feed as growth promoters [1]. They aimed to improved, directly or indirectly, the efficiency of rations. Feed additives are synthesised or natural substances which, when combined with feed, perform various functions (colourings, preservatives, binders, emulsifiers, flavourings, etc). These include natural plants, probiotics, prebiotics, symbiotics, organic acids [2] and spices such as cloves [3].

Cloves (*Syzygium aromaticum*) are considered one of the most versatile spices. They contain a large number of biologically active compounds, such as eugenol, eugenol acetate, and β-caryophyllene [4]. Eugenol is the most biologically active compound in cloves and makes up 70 - 90% [5,6]. Clove has been used as an antiseptic, antimicrobial, analgesic and local anesthetic [7]. Many studies have evaluated the effects of clove powder on growth performances, immune response, blood parameters, and lymphoid organs in broiler chickens [8,9].

It was confirmed by [10], that inclusion of 0.50% clove powder in the diet can be used as a growth promoter in Japanese quail. [11] reported a positive effect on growth performances, feed efficiency and changes in the intestine epithelium of broiler chickens when clove powder (0.1 - 2.5 g/kg diet) is supplemented in their feed. On the other hand, the inclusion levels of 1.0 and 1.5g of clove powder/kg diet did not affect growth performances, but improved the health of broiler chickens [9]. To the best of our knowledge, studies on guinea pigs showing the effects of clove powder on their performances are scarce. The use of cloves at levels higher than these levels may have minimal effect on growth rate through a reduction in feed palatability or may affect the intestinal epithelium and liver cells that alter digestion, absorption and metabolism. However, the clove is a safe plant when consumed in concentrations lower than 1.5 g/kg of diet [12]. Thus, it is important to establish appropriate inclusion levels of cloves as growth promoter [13]. The aim of this study was to contribute to the improvement of the productivity of the guinea pig through the use of natural substances as a food additive. More specifically, it is a question of evaluating in guinea pigs, the effect of incorporation of cloves powder in the ration on pre and post-weaning growth performances of guinea pigs.

Materials and Methods

Site of study

The study was conducted at the Teaching and Research Farm of the Faculty of Agronomy and Agricultural Sciences, and the Animal Production and Nutrition Laboratory (LAPRONAN), University of Dschang, Cameroon. This farm is located at an altitude of 1420m above sea level, between latitude 5°26'N and longitude 10°26'E with an equato-guinean climate.

Animals and housing

For this study, 75 adult pigs (15 males and 60 females) with a mean weight of 450 ± 50g were used. They were housed in pens made of plywood, measuring 1.25 x 0.60 x 0.30m, equipped with light facilities. Each lodge was protected by a wire mesh cover preventing any threat of animals by predators. The animals were raised on the ground, on a bedding made of untreated dry white wood chips combined with wood ash about 5 cm thick, renewed every week. Each lodge was equipped with feeder and drinker.

Plant material

The plant material consists of clove seeds (*S. aromaticum*). These seeds were bought in a local market, sun dried, then ground into powder. The powdered spice was then stored in air-tired bags for use in the experimental rations.

Experimental rations

The formulation of the experimental rations took into account the nutritional needs of guinea pigs [20-22]. Therefore, *Pennisetum purpureum* was harvested around the farm in the campus, pre-sized, quantified and tightened to the animals of each batch. A basic ration

was formulated (Table 1) and from that basic diet (control ration), two experimental rations were formulated by adding *S. aromaticum* powder as followed:

Ingredients	% of inclusion
Maize	30
Re-molding	33
Fish meal	2
Soybean meal	2
Palm kernel cake	25
Cotton seed cake	5
Sea shell	2
*Premix 0.5	1
Total	100
Analysed chemical composition of the basic ration	
Dry matter (%)	94.92
OM (% DM)	85.99
Ash (% DM)	8.64
CP (% DM)	16.012
ME (Kcal/kg DM)	2427.78
CF (% DM)	13.14

***Table 1**: Percentage composition and analysed chemical composition of the basic diet.*

**Composition of the 0.5 premix: vit A: 3.000.000 IU, vit D: 50.0000 IU, vit E: 6.000 mg, vit K: 600 mg, vit B1: 600 mg, vit B2: 800 mg, vit B3: 1800 mg, vit B6: 400 mg, Vit12: 6 mg, folic acid: 250 mg, niacin: 600 mg, Cl: 86.500 mg, Fe: 12.000 mg, Cu: 1200 mg, manganese: 12.000 mg, Zn: 10.000 mg, I: 100 mg, Se: 40 mg, magnesium: 3397 mg, Na: 283 mg, CA: 215.166 mg, Methionine: 130.000 mg, lysine: 50.000 mg. 00 mg, Se: 40 mg, magnesium: 3397 mg, Na: 283 mg, CA: 215.166 mg, Methionine: 130.000 mg, lysine: 50.000 mg. RSM: rubber seed meal. DM= Dry Matter, OM= Organic Matter, CP: Crude Protein, CF: Crude Fiber.*

- Control ration: Basic diet without additive (*S. aromaticum*) + *P. purpureum*;
- CG 0.5% ration: Basic diet + *P. purpureum* + 0.5% of *S. aromaticum* powder;
- CG 0.75% ration: Basic diet + *P. purpureum* + 0.75% of *S. aromaticum* powder.

Conduct of the experiment

For this study, 60 females were identified using earring, and divided into 3 sets of 20 animals, each set having 5 subsets of 4 females. All the subsets were comparable in terms of live weight, and were randomly assigned to cages. Females of group one received the control (basic) ration, while those of the two other groups were fed with the basic ration supplemented respectively with 0.50% and 0.75% of cloves powder. For mating, 1 male was introduced into each cage. After 30 days of cohabitation, males were removed to allow females to complete the end of their gestation. After parturition, piglets were weaned at 3 weeks old. Piglets of each batch were then fed with the respective ration until 8 weeks old. At this last age, they were slaughtered and data were collected.

Data collection

Feed intake (g)

The feed was quantified and daily served to animals. Left overs were collected and weighed every morning before serving new feed. Feed intake (FI) was calculated by subtracting the left-over from the quantity served, according to the following formula: FI (g) = Quantity of feed served - Left over feed.

The ingested nutrients were determined according to the procedures described by [14].

Evaluation of weight and weight gain (g)

Each piglet was weighed at parturition, weaning (3 weeks) and 8 weeks old, using an electronic scale of 5000g capacity and 1g precision. The weight gain (WG) was calculated using the following formula: WG (g) = Wn-Wn-1, Where WG: Is the weight gain, Wn: Weight at 8 weeks and Wn-1: Weight at birth.

Carcass characteristics

At 8 weeks old, 10 (5 males and 5 females) guinea pigs per treatment were randomly selected, staved for 12 hours, stunned and slaughtered for carcass evaluation according to [15].

Carcass yield: Carcass yield was calculated as the ratio of the dressed carcass weight to the live weight (after fasting) and multiplied by hundred.

Carcass yield (%) = Weight of carcass/Live weight x 100.

Relative weight of organs

The relative of the liver, kidneys and spleen) were calculated as the ratio of the weight of organ to the live body weight.

Relative organs weight (%) = Weight of organs/Live weight x 100.

Statistical analysis

Data on feed intake were subjected to one-way analysis of variance (ANOVA), while those on live weight, weight gain, carcass yield and organs weight were subjected to two-ways ANOVA, using SPSS 20.0 software. Where there was a significant difference, Duncan's test at 5% significance was used to separate the means.

Results

Feed intake in reproductive females

Ingested dry matter

The total ingested dry matter is presented in figure 1. The ingested dry matter increased significantly ($p < 0.05$) in guinea pigs fed with ration supplemented 0.75% of cloves powder, when compared to the control group.

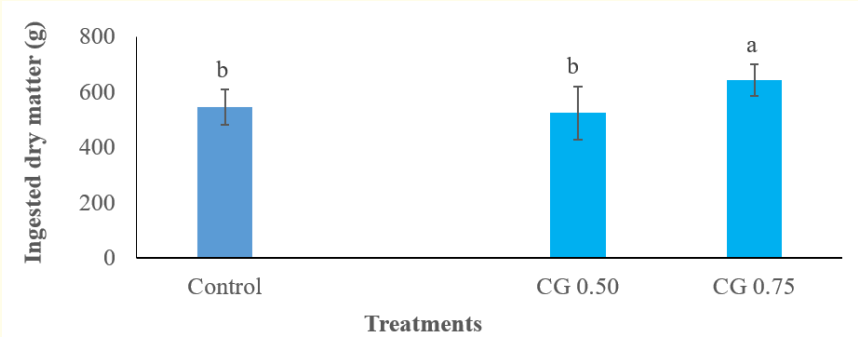

Figure 1: *Effects of cloves powder supplementation on ingested dry matter in reproductive female guinea pigs.*
a, b: Bars with different superscripts are significantly different (p < 0.05). CG 0.5 and CG 0.75: rations supplemented with cloves powder at 0.5 and 0.75% respectively.

Ingested organic matter

The ingested organic matter (Figure 2) of feed containing 0.75% cloves powder increased insignificantly (p > 0.05) with reference to the control diet, but significantly (p < 0.05) compared to the feed containing 0.5% cloves powder.

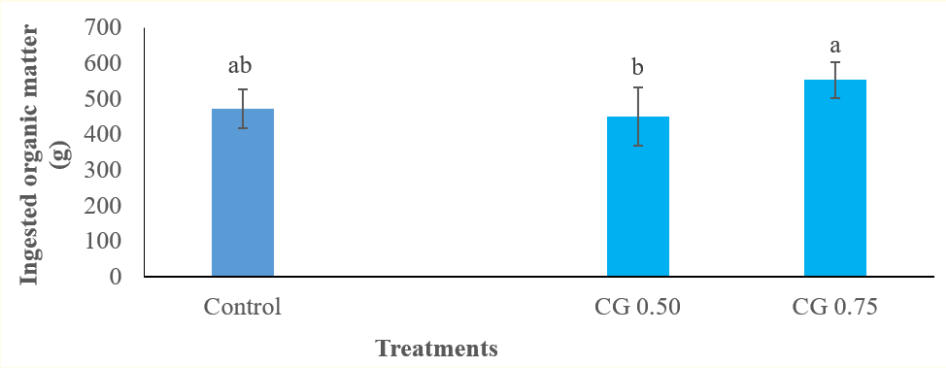

Figure 2: *Effects of cloves powder supplementation on ingested organic matter in reproductive female guinea pigs.*
a, b: Bars with different superscripts are significantly different (p < 0.05). CG 0.5 and CG 0.75: rations supplemented with cloves powder at 0.5 and 0.75% respectively.

Ingested crude protein

The crude protein intake (Figure 3) of the diet supplemented at 0.75% cloves powder increased insignificantly (p > 0.05) compared to the control diet, but significantly (p < 0.05), referring to the ration containing 0.5% cloves powder.

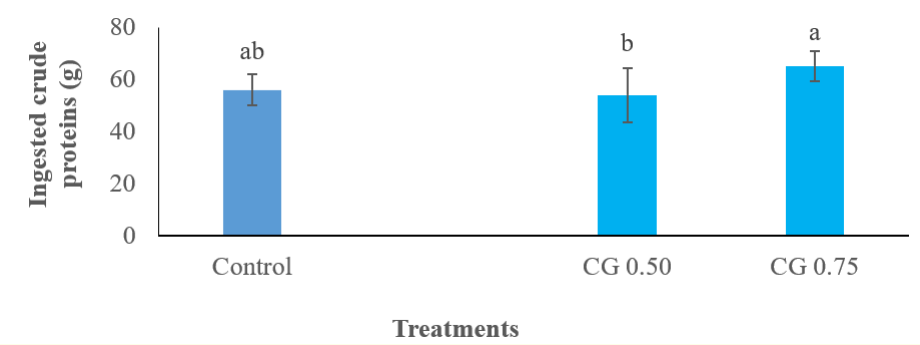

Figure 3: *Effects of cloves powder supplementation on ingested crude protein in reproductive female guinea pigs.*
a, b: Bars with different superscripts are significantly different (p < 0.05). CG 0.5 and CG 0.75: rations supplemented with cloves powder at 0.5 and 0.75% respectively.

Ingested crude fibres

The intake of crude fibres is shown in figure 4. The ingested crude fibres increased significantly ($p < 0.05$) in guinea pigs fed with ration supplemented 0.75% of cloves powder, as compared to the control diet.

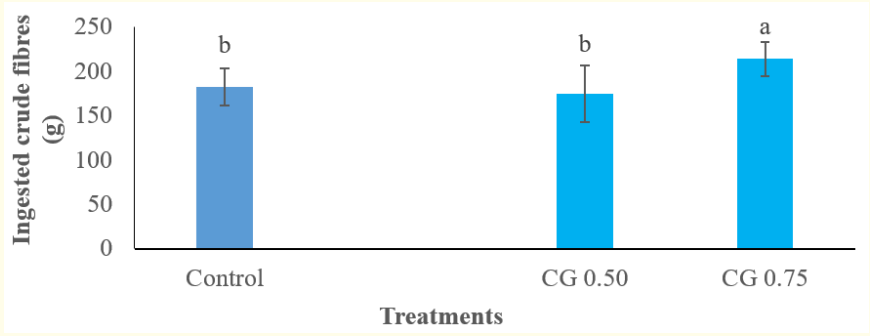

Figure 4: *Effects of cloves powder supplementation on ingested crude fibres in reproductive female guinea pigs.*
a, b: Bars with different superscripts are significantly different (p < 0.05). CG 0.5 and CG 0.75: rations supplemented with cloves powder at 0.5 and 0.75% respectively.

Ingested minerals

Figure 5 illustrates the minerals ingestion in breeding females. The minerals intake of the diet supplemented at 0.75% cloves powder increased insignificantly ($p > 0.05$) compared to the control diet.

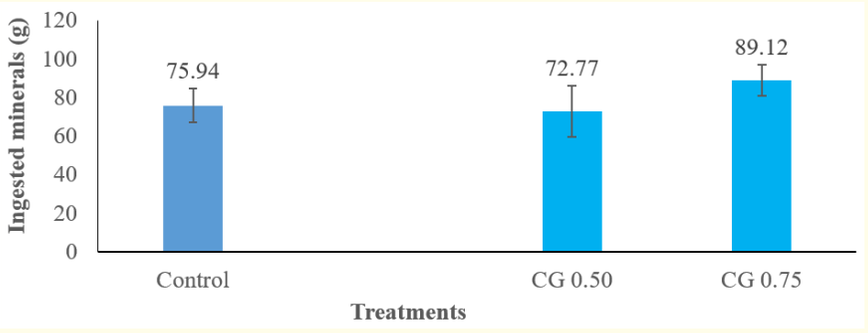

Figure 5: *Effects of cloves powder supplementation on ingested minerals in reproductive female guinea pigs.*

Feed intake in piglets

Ingestion of dry matter, organic matter, crude fibres and minerals

The ingested dry matter (Figure 6), organic matter (Figure 7), crude fibres (Figure 8) and minerals (Figure 9) increased in piglets fed with the ration supplemented at 0.5% cloves powder, and dropped in those receiving the feed containing 0.75% cloves powder. Meanwhile, no significant difference ($p > 0.05$) was registered among rations for these nutrients intakes.

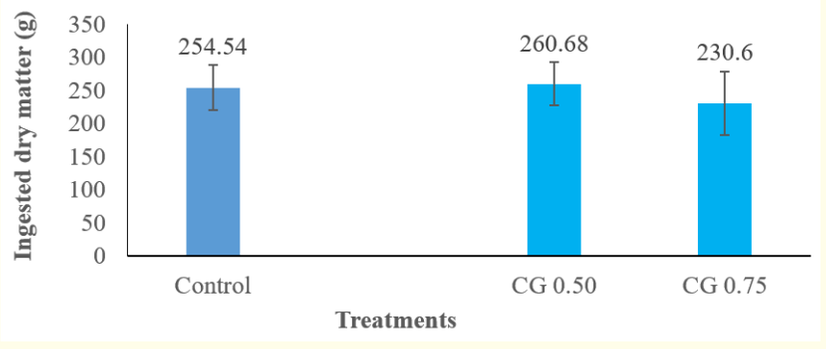

Figure 6: *Effects of cloves powder supplementation on ingested dry matter in piglets.*

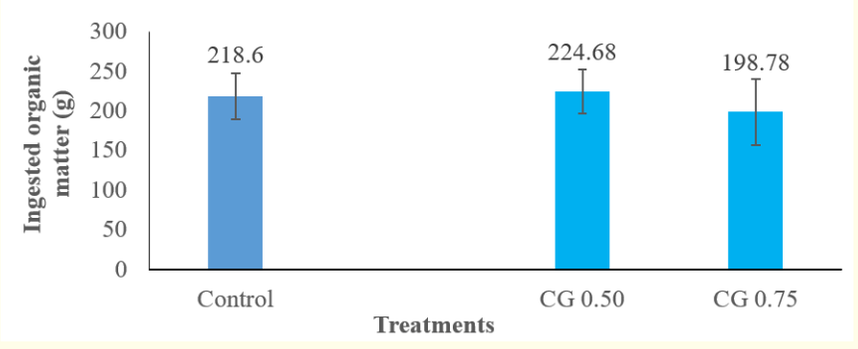

Figure 7: *Effects of cloves powder supplementation on ingested organic matter in piglets.*

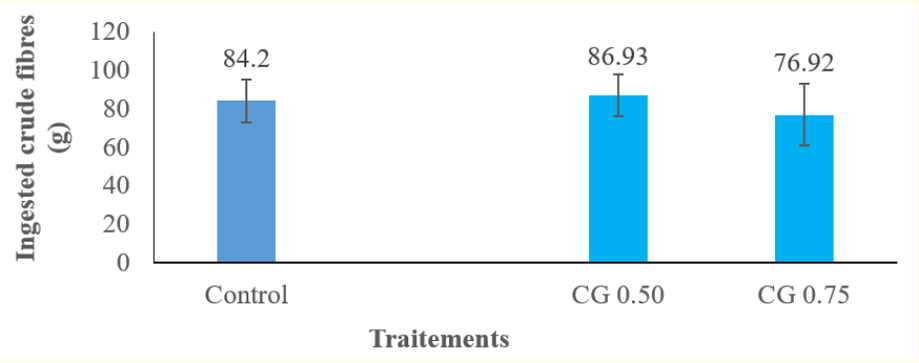

Figure 8: *Effects of cloves powder supplementation on ingested crude fibres in piglets.*

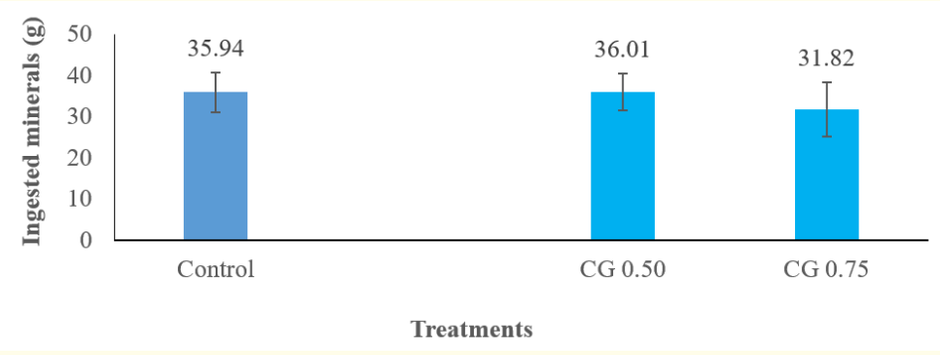

Figure 9: *Effects of cloves powder supplementation on ingested minerals in piglets.*

Ingestion of crude proteins

The intake of crude proteins is illustrated in figure 10. The ingested crude proteins decreased significantly ($p < 0.05$) in guinea pigs fed

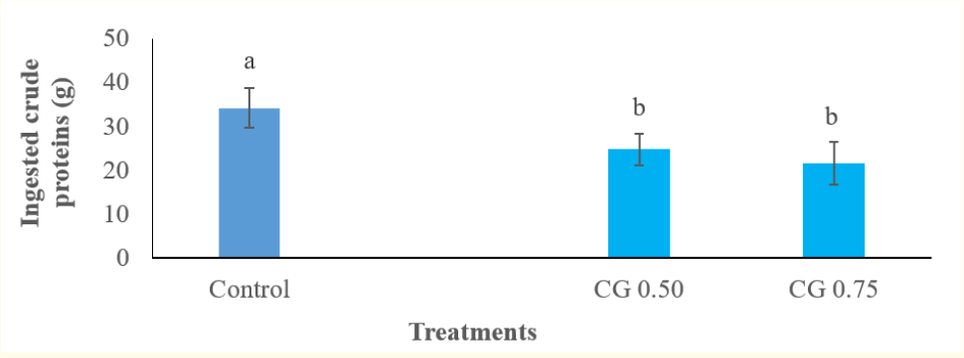

Figure 10: *Effects of cloves powder supplementation on ingested crude proteins in piglets.*

a, b: Bars with different superscripts are significantly different ($p < 0.05$). CG 0.5 and CG 0.75: rations supplemented with cloves powder at 0.5 and 0.75% respectively.

with rations supplemented with cloves powder, as compared to the control diet.

Live weight and weight gain

The live weights, total weight gain and daily weight gain of piglets according to rations and sex are presented in table 2. Overall, no significant difference ($p > 0.05$) was observed among rations, no matter the sex considered. Independently and when the sex is considered, the live weights, weight gain and daily weight gain increased insignificantly ($p > 0.05$) in piglets fed with the ration supplemented at

Growth Parameters	Sex (n)	Control	Clove		p
			0.50%	0.75%	
LW at birth (g)	♀ (5)	91.50 ± 9.04	92.00 ± 11.05	88.75 ± 22.04	0.753
	♂ (5)	99.00 ± 14.35	91.40 ± 22.55	98.80 ± 7.15	0.696
	♀♂ (10)	95.25 ± 11.81	91.67 ± 17.32	94.33 ± 15.41	0.712
p		0.411	0.963	0.365	
LW at weaning (3 weeks) (g)	♀ (5)	146.50 ± 37.44	180.25 ± 32.48	168.00 ± 19.61	0.205
	♂ (5)	188.00 ± 20.12	205.40 ± 41.78	190.60 ± 30.22	0.563
	♀♂ (10)	167.25 ± 35.58	194.22 ± 38.00	179.30 ± 22.30	0.355
p		0.099	0.358	0.239	
LW at 8 weeks old (g)	♀ (5)	204.00 ± 44.29	225.80 ± 46.35	217.75 ± 57.25	0.570
	♂ (5)	222.75 ± 20.60	228.40 ± 59.37	207.60 ± 20.80	0.723
	♀♂ (10)	213.38 ± 33.51	227.11 ± 50.70	212.11 ± 35.07	0.594
p		0.472	0.939	0.695	
Total WG (g)	♀ (5)	112.50 ± 36.93	133.50 ± 38.73	129.00 ± 21.97	0.571
	♂ (5)	123.75 ± 7.27	137.00 ± 48.06	108.80 ± 19.15	0.320
	♀♂ (10)	118.13 ± 25.36	135.44 ± 41.48	117.78 ± 23.03	0.415
p		0.572	0.910	0.210	
DWG (g/day)	♀ (5)	2.01 ± 0.56	2.38 ± 0.69	2.30 ± 0.38	0.363
	♂ (5)	2.21 ± 0.13	2.45 ± 0.42	1.94 ± 0.34	0.236
	♀♂ (10)	2.11 ± 0.39	2.42 ± 0.52	2.10 ± 0.38	0.269
p		0.514	0.871	0.176	

***Table 2**: Effects of cloves powder supplementation on live weight, weight gain and daily weight gain in piglets*

LW: Live Weight; WG: Weight Gain; DWG: Daily Weight Gain; p: Probability; (n): Sample Number.

0.5% cloves powder, referring to the control. For almost all parameters, males revealed insignificant ($p > 5.05$) higher values compared to females.

Carcass yield and relative weights of liver, kidney and spleen

Growth Parameters (%)	Sex (n)	Control	Clove		p
			0.50%	0.75%	
Carcase yield	♀ (5)	31.06 ± 2.90	30.90 ± 3.04	31.36 ± 3.00	0.911
	♂ (5)	31.56 ± 1.54	33.59 ± 3.92	32.13 ± 5.29	0.726
	♀♂ (10)	31.31 ± 2.17	31.31 ± 3.63	31.79 ± 4.18	0.895
p		0.771	0.298	0.803	
RLW	♀ (5)	2.43 ± 0.26	2.61 ± 0.26	2.85 ± 0.37	0.285
	♂ (5)	2.64 ± 0.21	2.62 ± 0.27	2.65 ± 0.24	0.640
	♀♂ (10)	2.53 ± 0.24	2.62 ± 0.25	2.74 ± 0.30	0.100
p		0.273	0.959	0.377	
RKW	♀ (5)	0.74 ± 0.09	0.82 ± 0.08	0.80 ± 0.02	0.452
	♂ (5)	0.86 ± 0.14	0.80 ± 0.15	0.79 ± 0.06	0.272
	♀♂ (10)	0.80 ± 0.13	0.81 ± 0.12	0.79 ± 0.04	0.855
p		0.196	0.850	0.841	
RSW	♀ (5)	0.14 ± 0.00	0.15 ± 0.03	0.16 ± 0.01	0.220
	♂ (5)	0.17 ± 0.03	0.17 ± 0.06	0.15 ± 0.02	0.242
	♀♂ (10)	0.16 ± 0.02	0.16 ± 0.05	0.15 ± 0.01	0.353
p		0.146	0.688	0.782	

Table 3*: Effects of cloves powder supplementation on carcase yield and relative weights of liver, kidney and spleen.*

RLW: Relative Liver Weight; RKW: Relative Kidney Weight; RSW: Relative Spleen Weight; p: Probability; (n): Sample Number.

Table 3 shows the carcass yield and relative weights of liver, kidney and spleen in piglets fed with rations supplemented cloves powder. The inclusion of cloves powder in the ration had no significant ($p > 0.05$) effect on the carcass yield and relative weights of liver, kidney and spleen in the piglets, no matter the sex.

Discussion

The ingestion of dry matter, organic matter, crude protein, crude fibres and minerals of reproductive female guinea pigs increased with the inclusion of clove powder at 0.75%. These responses at the inclusion level of clove powder could be justified by the hypothesis that, at that percentage, cloves powder might have increase digestion of protein, cellulose and fat [16]. This could be attributed to the enhancement of the palatability of the feed [17]. These effects could also be attributed to the appetizing effect of the active compound such as eugenol present in cloves [4]. It was reported that clove herbs possess antioxidant, antispasmodic, anti-inflammatory, antimicrobial and immune effect. There by so it can be used as natural feed additive. Moreover, spices are not just appetite and digestion stimulants, but they have an impact on other physiological function, help to sustain good health and welfare of the animals and improve their production performances [18] such as reproductive and growth performances. Consequently, spices help to increase the resistance of the animals and the absorption of essential nutrients, thus improving the growth of the animals [19].

The ingested dry matter, organic matter, crude protein, crude fibres and minerals of young guinea pigs increased with the inclusion of clove powder at 0.5% in the ration. The current results agree with those of [10], who found that inclusion of 0.50g cloves powder/kg diet can be used as a growth promoter in Japanese quail. The overall live weights, weight gain and daily weight gain of piglets were improved with supplementation of clove powder at 0.5%. This improvement might be due to active molecules such as eugenol, eugenol acetate,

and β-caryophyllene [4] in cloves, especially eugenol that have digestive effects. Moreover previous review mentioned that essential oil derived from cloves has antimicrobial and Antioxidant [7]. Similar results were reported by [10], who recommended that inclusion of 0.50g cloves powder/kg diet can be used as a growth promoter in Japanese quail. [11] reported a positive effect on growth performances and feed efficiency of broiler chickens when cloves powder (0.1 - 2.5 g/kg diet) was supplemented in their feed. On the other hand, the inclusion levels of 1.0 and 1.5 g of cloves powder/kg diet did not affect growth performance parameters of broiler chickens [9]. The use of cloves at levels higher than these levels may have minimal effect on growth rate through a reduction in feed palatability or might affect the intestinal epithelium and liver cells that alter digestion, absorption and metabolism.

The way the growth performances of young guinea pigs in the present study declined at 0.75% inclusion of cloves powder, let think about its possible toxicity at this inclusion level in young guinea pigs. Almost all the growth performances were higher in male compared to females. This observation could be explained by the sexual dimorphism in term of body weight, which is in favour of male in guinea pigs.

Conclusion

This study revealed that the use of *Syzygium aromaticum* up to 0.75% in reproductive females and 0.5% in piglets as feed supplement, improves growth performances.

Conflict of Interest

The authors declare they have no conflict of interest.

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