JSM Veterinary Medicine and Research

Research Article

Effect of spirulina level on post-weaning growth of guinea pig *Cavia porcellus* in western Cameroon

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Abstract

For post-weaning growth performance evaluation in Guinea pig (*Cavia porcellus)*, an 8-week trial was conducted in West Cameroon. 59 weaned animals (3 weeks of age) from a breeding trial were used. After identification and weighing, animals were submitted on the same treatment as their mothers. Each animal receives daily between 8 and 9 am, an experimental food corresponding to its group. Animals of TS0 group received *Trypsacum laxum* and the concentrate with 0% spirulina, while others received in their diets 2% (TS2), 4% (TS4) and 6% (TS6) spirulina. Food refusal was collected and weighed before the new distribution, for feed intake determination. During the growth period, *T. laxum*, concentrate and nutrients (Dry Matter (DM), Organic Matter (OM), Crude fiber (CF) and Crude Protein (CP)) intake was significantly affected by treatments. Highest animal average weight (407.0g) was obtained with treatment TS2 and the lowest (396.64g) with control (TS0). The same tendency was observed with total (TWG) and daily weight gain (DWG). Thus, the highest TWG and DWG (222.06 g and 6.34 g / day) were obtained in TS2 treatments while the lowest (194.82 g and 5.57 g / day) was obtained with TS0. At 8 weeks regardless of the birth type, highest average weight, total and daily weight gain was obtained with treatment TS6. At the same period for the same parameters, no significant difference was observed between treatments TS0, TS2 and TS4. Based on the result, food intake as animal body weight can be improved by 2% of spirulina in the diet but at 6%, growth performance can be improved mostly for the twin's births.

Keywords: Growth performance; Post-weaning growth; *Trypsacum laxum*; Spirulina level; Ingestion; *Cavia porcellus*.

Introduction

Food security in general and come over the animal protein shortage is a real challenge in developing countries [1,2]. Mini-livestock farming, particularly caviaculture, seems to be an alternative solution to face this gap of animal protein [3]. In addition, this livestock, easy to breed, is an important source of income for the poor revenues farmers in general and those in Cameroon in particular. Despite the importance or advantages of guinea pig, its productivity remains low. In fact, this traditional breeding, practiced by women and children, suffers from a lack of follow-up and technicality [4]. Most of their food comes from kitchen waste and crop residues, which are qualitatively and quantitatively deficient, and do not allow the animal to externalize its genetic potential [5,6]. This is as true as food remain the main factor of animal production [7]. Among nutrients used in guinea pig diets, protein is the main limiting factor because they are fed mostly on protein poor grasses. So, diet containing in quantity and quality an optimal protein level can really improve the growth and reproduction performances of guinea pigs [5,8,9]. Unfortunately, the high cost of conventional supplements and their scarcity make them inaccessible to small farmers [4]. On the other hand, the presence of antinutritional factors in legumes which are accessible and less expensive alternative source protein, limits their use [2,10]. It became necessary to look for other alternative resources of protein easily used by animals. Spirulina contains a high amount of high quality protein (60-70%), containing most essential amino acids, essential fatty acids, vitamins A, B and E and available iron [11]. On the other hand, spirulina has a high nutritional value compared to soy in terms of crude protein, minerals, metabolizable energy and amino acids [26]. It can be used as an alternative source of protein that can improve production performance thanks to its optimum supply of essential amino acids and the fact that it is easy to produce. Thus the objective of this work is to improve animal nutrition by diversifying proteins sources.

Submitted: 04 May 2019 | **Accepted:** 22 May 2019 | **Published:** 24 May 2019

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Citation: Emile M (2019) Effect of spirulina level on post-weaning growth of guinea pig *Cavia porcellus* in western Cameroon. JSM Vet Med Res 1: 9.

Study Site

The study was conducted between April 2017 and January 2018 in the animal nutrition and production research unit of the Faculty of Agronomy and Agricultural Sciences (FAAS) of the

University of Dschang. Dschang is a part of the western highlands of Cameroon with an altitude of 1450 m above sea. This locality is located at the 15° of the eastern meridian at latitude 5 ° 26 '27 "North and longitude 10 ° 26' 29" East. It has an equatorial climate of Cameroonian type modified by altitude. Dschang has two seasons: a short dry season mid-November to mid-March and a long rainy season that corresponds to the growing season (mid-March to mid-November). The months of February and March are generally the hottest, and the months of July and August the coldest, rainfall varies between 1500 and 2000 mm per year. The average annual temperature is around 20 °C, the annual total insolation is 1800 hours and the average relative humidity range between 40 and 90%. The original vegetation of the region is a shrub savannah with some gallery forests. Apart from commercial activities, the area is strongly agro-pastoral. Dschang is a part of the western highlands of Cameroon an altitude of 1450 m above sea.

Animal Material and Housing

A total of 59 young weaning guinea pigs, 3 weeks old, were used for the test. They were housed in fattening boxes according to the ethics and rules of such animals. These boxes made of plywood (1.25 mx 0.6 mx 0.8 m), were mounted on the floor. Each was equipped with a lighting device, two wooden feeders, two concrete drinkers and a small wire mesh cover, which prevented the intrusion of mice or other possible predators. All animals used in this trial were from mothers submitted to the same diet during gestation and pre-weaning growth period

Experimental Diets and Conducting the Trial

On the basis of the bibliographic data, four iso-caloric (2800 kcal) and iso-Nitrogenous (19% PB) experimental diet, R0, R1, R2, R3 of different spirulina level (0, 2, 4 and 6% respectively) were formulated. These diets were then allocated to batches TS0, TS2, TS4 and TS6 to evaluate growth performance from the 3rd to the 8th weeks. For this study, the grass (*Trypsacum laxum)* was harvested (stem and leaves) from the forage plots of the Dschang University farm, pre-dressed by soon dry for two hours before being fed to animals. Spirulina was purchased in the surrounding markets of Lake Chad and transported to Dschang to be dried, milled and incorporated at different levels to form the experimental rations.

Other ingredients (corn, wheat bran, cottonseed cake, soybean meal, palm kernel meal, fishmeal, fish meal, premix and palm oil) came from the Dschang market, from the by-product resellers. A sample of 100 g of each experimental diet and forage

Table 1: Composition of formulated concentrate feeds with grades levels of spirulina.

Ingredients	R0	R1	R2	R3
Corn	26	26	28	37
Wheat bran	48	48	45.5	36
Soybean seed cake	6	4	2	0
Cotton seed cake	3	3	2.5	1.5
Palm kernel cake	7	7	8	8
Fish meal	6	6	5	6
Bone meal	2	2	2	2
Cooking salt	1	1	1	1
Premix (2%)	1	1	1	1
Spirulina	0	2	4	6
Palm oil	0	0	1	1.5
Total	100	100	100	100
Chemical Composition (% DM)				
DM	93.97	94.12	94.47	94.90
OM	88.83	89.81	86.29	88.78
CP	19.30	19.46	19.10	19.20
CF	9.00	8.96	8.65	7.95
Ash	09.17	08.21	11.82	09.32
Metabolisable energy	2870	2820	2804	2812
Lysine	1.02	1.02	0.94	0.9
Methionine	0.46	0.46	0.47	0.46

Different treatments were prepared as follows:
TS0: 40/ animal / day of R0 + *Trypsacum laxum ad libitum*
TS2: 40g / animal / day of R1 + *Trypsacum laxum ad libitum*
TS4: 40g / animal / day of R2 + *Trypsacum laxum ad libitum*
TS6: 40g / animal / day of R3 + *Trypsacum laxum ad libitum*

was taken and transported in Animal Production and Nutrition research unit (LAPRONAN) to be dried in an oven at 60 ° C. for 12 hours (up to constant weight) and then ground using 1-mm mesh screen and kept in plastic bags for evaluation of their dry matter (DM), organic matter (OM), crude protein (CP) and crude fiber (CF) content according to the AOAC [12] method.

Proportion of experimental diets and their nutritional value are recorded in Table 1.

At weaning (3 weeks of age), young guinea pigs, from mothers receiving respectively one of the above treatments were sexed, identified and weighed. They were then assigned to boxes corresponding to their mother's diet. From the beginning of this trial, the numbers of females and males were recorded. Each morning between 8am and 9am, each young guinea pig received 40g of an experimental ration (R1, R2, R3, or R4) corresponding to its batch (TS0, TS2, TS4 or TS6). Fodder (*Trypsacum laxum*) was prefilled for 2 hours on the sun, weighed and served *ad libitum* in such a way that each group receives the same quantity. Vitamin C was distributed in a drinking water and served at will to animals and renewed every day. Food leftover were weighed each morning before new distributions of known quantity of food to evaluate food intake. The monitoring of each young guinea pig was done individually. Thus, each of them was weighed every seven days up to 8 weeks of age and their weights recorded for evaluating the post-weaning weight gain from the 3rd to the 8th week as well as their weight gains (TWG and DWG) at the 8th week. The cleaning of the boxes was done every two days to avoid any accumulation of feces and urine. All the weighing process was carried out using an electronic balance of capacity 7 kg and precision 1g.

Statistical Analysis

Post-weaning growth parameters were submitted to two-factor analysis of variance according to spirulina level and animal sex or type of birth. Those on the feed intake were submitted to one-factor of analysis of variance (spirulina level). When differences existed between treatments, the means were separated by the Waller Duncan test at the 5% significance level [13]. The separation of the means between the sexes (male and female) on the one hand and between the types of birth (double and single) on the other hand was done using Student's t-test. SPSS 20.0 software was used.

Results

Effect of spirulina level on food intake in young post-weaning guinea pigs

The intake of *T. laxum,* concentrate and nutrients was significantly ($p < 0.05$) influenced by the spirulina level of the ration (Figure 1). In fact, *T. laxum* intake of TS2 and TS6 treatment was comparable ($p > 0.05$), but significantly ($p < 0.05$) higher than that of TS0 and TS4 animals, which also remained comparable with each other. The concentrate intake was significantly ($p < 0.05$) higher in the animals of the treated groups (TS2, TS4 and TS6) compared to those of the control group. Dry matter (DM), organic matter (OM), crude fiber (CF), and crude protein (CP) intake was significantly ($p < 0.05$) influenced by the level of spirulina. In fact, the DM and OM intake significantly ($p < 0.05$) higher was observed with animals from TS2 and TS6 batches. However, the intake of the two other treatments remained comparable ($p > 0.05$). The highest crude fiber (CF) intake was observed in animals of batch TS2, followed by those of group TS6. That of animals from TS0 and TS4 groups was comparable ($p > 0.05$) between them. The same trend has been observed for crude protein intake.

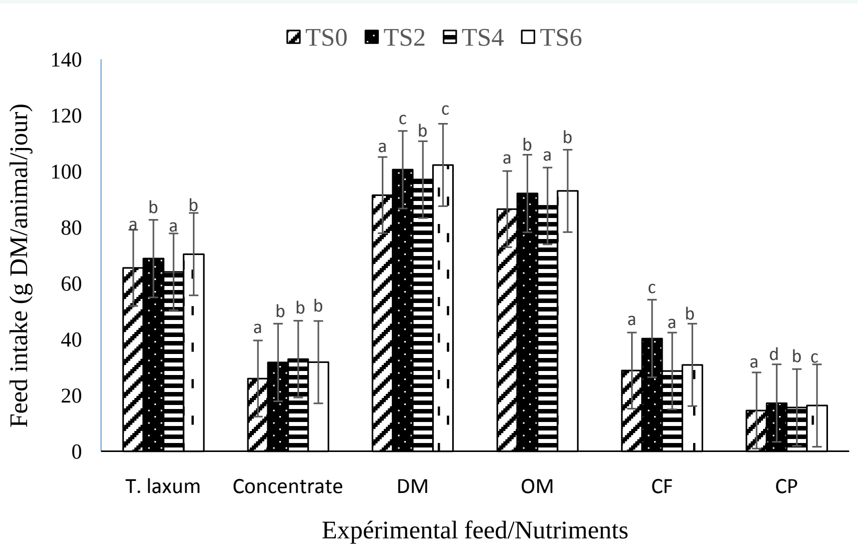

Figure 1 T. laxum, compound feed and nutrients intake depending on the spirulina level in the diet
Post-weaning growth performances.
a, b, c, d: means with the same letters on the same treatment are not significantly different at the 5% level. DM: Dry Matter; OM: Organic Matter; CF: Crude Fiber; CP: Crude Protein.

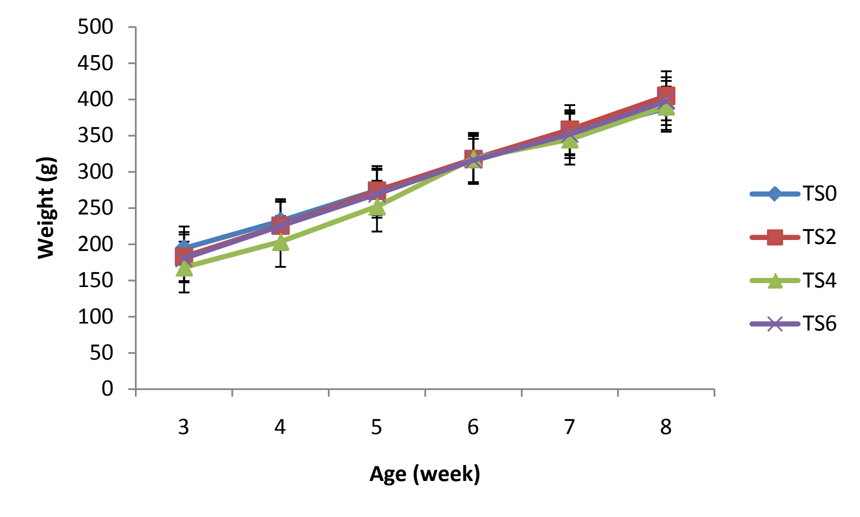

Figure 2 Post-weaning weight evolution of young guinea pigs according to different treatment.

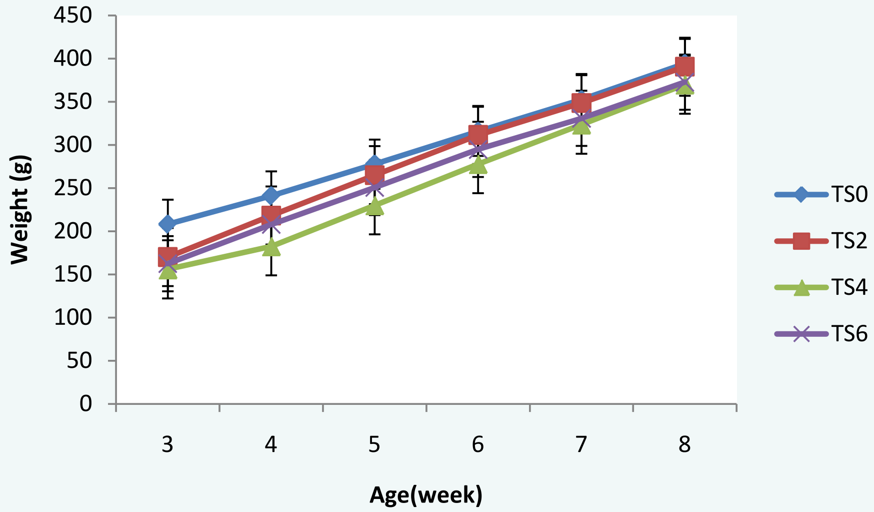

Figure 3 Post-weaning weight evolution of young male guinea pigs according to different diets. The weight of young males increased steadily from weaning to week 8 (figure 3). During the 3rd, 4th, 5th and 6th week of age, young males in the control group (TS0) showed higher weights than animals in the other lots. From the 7th to the 8th week, the weight of the animals of the control group (TS0) and those of TS2, TS4 and TS6 batches were identical to each other..

The weight of young weaning guinea pigs at eight weeks independently on sex has increased steadily in different groups (figure 2). From the 3rd to the 5th week, the average weight in TS0, TS2 and TS6 groups of animals was higher than that of the TS4 animals. From the 7th to 8th week, the average weights of animal from different batches (TS0, TS2, TS4 and TS6) remained comparable to each other.

Effect of spirulina level on weight at 8 weeks and weight gains of post-weaning guinea pigs

The weight at 8 weeks of young males decreased with the spirulina level of the diet (Table 2). In fact, the highest weight of the young males (394.20 g) was observed in the animals of the batch TS0 while the lowest (369.67 g) was observed in the animals of the lot TS4. However no significant difference ($p > 0.05$) was observed between treatments. The weight of young females post-weaned was significantly ($p < 0.05$) influenced by the spirulina level of the diet. The highest weight (416.56 g) of young females was observed in TS6 animals group while the lowest (397.88 g) was observed in TS4 animals group. However, no significant difference ($p > 0.05$) was observed between animals of the control group and those of group TS4 on the one hand, and those of lots TS2 and TS6 on the other hand. By the way, regardless of sex, the average weight of young guinea pigs has evoluate to sawtooth way with the spirulina level in the ration. Indeed, the highest average weight (407.03 g) of the young guinea pigs was

Table 2: Average weight, total and daily weight gain of young post-weaning guinea pigs according to the diet.

Caracteristics	Treatements				SEM	P
	TS0	TS2	TS4	TS6		
Weaning weight						
♂	208.00ᵃ(6)	170.00ᵇ(7)	161.67ᵇ(5)	162.29ᵇ(7)	11.02	0.04
♀	185.88ᵃ(8)	192.67ᵃ(9)	174.50ᵃ(8)	194.22ᵃ(9)	10.51	0.44
♂♀	189.39ᵃ(14)	184.97ᵃ(16)	169.65ᵇ(13)	183.95ᵃ(16)	7.78	0.02
Post-weaning weight (g)						
♂	394.20ᵃ(5)	390.43ᵃᵇ(7)	369.67ᵇ(3)	372.57ᵇ(7)	14.64	0.00
♀	399.63ᵇ(8)	415.89ᵃ(9)	397.88ᵇ(8)	416.56ᵃ(9)	6.93	0.00
♂♀	396.64ᵇ(13)	407.03ᵃ(16)	397.10ᵇ(11)	402.59ᵃ(16)	8.99	0.00
Total weight gain (g)						
♂	186.20ᵇ	220.43ᵃ	208.00ᵃ	210.73ᵃ	6.13	0.01
♀	213.75ᵇ	223.22ᵃ	223.37ᵃ	222.33ᵃ	5.75	0.02
♂♀	194.82ᵇ	222.06ᵃ	203.02ᵃᵇ	218.64ᵃ	4.46	0.03
Daily weight gain (g/day)						
♂	5.32ᵇ	6.30ᵃ	5.94ᵃ	6.01ᵃ	0.18	0.01
♀	6.10ᵇ	6.38ᵃ	6.38ᵃ	6.35ᵃ	0.16	0.02
♂♀	5.57ᵇ	6.34ᵃ	5.80ᵃᵇ	6.25ᵃ	0.13	0.03

a, b, c: Averages with the same letters on the same line are not significantly different at the 5% level; SEM: Standard Error on the Mean; p: Probability, (x): number of animals; ♂: male; ♀: female; ♂♀: male and female

obtained in the animals of the TS2 lot and the lowest (396.64g) in the control group. However, no significant difference ($p < 0.05$) was observed between treatments. Total weight gain (TWG) and daily weight gain (DWG) were significantly ($p < 0.05$) influenced by the spirulina level of the ration. In fact, the TWG of the animals of the treated lots (TS2, TS4 and TS6) remained significantly ($p < 0.05$) higher than those of the control (TS0). These TWG and DWG at the 8th week were comparable ($p > 0.05$) in the animals of the treated groups irrespective of the treatment and regardless of the sex. The TWG and the DWG of TS0 group were significantly ($p < 0.05$) lower than that of the other groups.

Figure 5 and 6 and shows that at weaning, males and females had comparable TWG and DWG regardless of treatment. A significant difference ($p < 0.05$) was observed between males and females in TS0; females being heavier than males. However, no significant differences ($p > 0.05$) were observed between males and females of the other groups.

Effect of spirulina level on weaning weight at 8 weeks and weight gain of post-weaning pigs by type of birth

Table 3 shows the effect of spirulina level on weight and the weight gains of young post-weaned guinea pigs at 8 weeks at different spirulina level.

This table shows that the inclusion of spirulina significantly influenced ($p < 0.05$) the weight of young guinea pigs from single births to 8 weeks. It also significantly influenced ($p < 0.05$) total weight gain and daily weight gain of these animals regardless of the type of birth. In fact, the highest (458.83g) average weight of animals born from single birth was observed in batch TS6 while the lowest (368.17g) was observed in batch TS4. The statistical analysis showed that the weight of the subjects of lots TS0, TS2 and TS6 was comparable ($p > 0.05$), but significantly higher than that of lot TS4. The same trend has been observed in animals born from double births. However, the animals of lots TS0, TS2 and TS4 had comparable ($p > 0.05$) weights, but significantly ($p < 0.05$) lower than that of lot TS6. It was the same for TWG and DWG regardless of the type of birth. Indeed, the highest GT and GMQ (271.17g and 270.10g) and (7.75g / d and 7.72g / d) respectively for single and double births, were observed in the lot TS6. The animals in lots TS0, TS2 and TS4 had comparable GT and GMQ ($p < 0.05$), but significantly ($p < 0.05$) lower than those in lot TS6.

Discussion

Effect of spirulina level on food intake of young post-weaned guinea pigs

Compared to the control diet, the intake of *T. laxum* was significantly higher with the supplemented diet. This forage is very popular with guinea pigs [14]. In addition, the protein intake of spirulina would have increased the palatability of guinea pigs. In fact, several works illustrate this observation [10,15,16]. The best ingestion of this grass obtained with the ration containing 6% spirulina is explained by the fact that protein supplements promote a sufficient proliferation of intestinal microorganisms involved in digestion in guinea pigs. This would favor the increase of food fermentation and digestive transit which would thus de-clutter the caecum with the consequent increase in food intake [15,17].

In guinea-pigs fed *T. laxum,* the high intake of the compound feed containing spirulina compared to the control diet, is explained by the fact that supplementation with spirulina would have improved acceptability, palatability and digestibility as shown by Marie-Christine [18] in poultry, pork and horses even if their digestive system is different of that of guinea pigs. The high ingestion of the compound feed of TS4 batch animals is explained by the substitution phenomenon [19]. In fact, these authors

Table 3: Weight at 8 weeks, Total weight gain and average daily earnings of young post-weaning guinea pigs at different spirulina level and type of birth.

Caracteristics		Traitements				SEM	p
		TS0	TS2	TS4	TS6		
Poids au sevrage (g)							
Single		203.67ª(9)	187.40ªᵇ(10)	167.50ᵇ(6)	187.67ªᵇ(6)	9.74	0.00
Double		172.50ª(4)	184.17ª(6)	172.00ª(8)	192.50ª(10)	8.14	0.39
Postweaning gain (g)							
Single		422.78ª(9)	412.10ª(10)	368.17ᵇ(6)	458.83ª(6)	16.77	0.01
Double		392.00ᵇ(4)	406.33ªᵇ(6)	380.00ᵇ(5)	462.60ª(10)	10.60	0.00
Total weight gain (g)							
Single		219.11ᵇ	224.70ᵇ	200.67ᵇ	271.17ª	12.21	0.00
Double		219.50ᵇ	222.17ᵇ	208.00ᵇ	270.10ª	10.35	0.00
Daily weight gain (g/j)							
Single		6.26ᵇ	6.42ᵇ	5.73ᵇ	7.75ª	0.35	0.00
Double		6.27ᵇ	6.34ᵇ	5.94ᵇ	7.72ª	0.30	0.00

a, b, c: Averages with the same letters on the same line are not significantly different at the 5% level; ESM: Standard Error of mean; p: probability, (): effective

reported that, when feed supplementing forage consumed at will is distributed separately, part of the supplement is substituted for the staple and occupies part of the digestive tract of the animal.

The level of intake of total dry matter (DM), organic matter (OM), crude fiber (CF), and crude protein (CP) from spirulina-containing diets, was higher in guinea pigs compared to that of control, corroborates with the observations of Fotna [20] who showed that the incorporation of 10% spirulina into the stubble improves significantly the ingestion of DM and OM in african dwarf goat. The greatest value of ingestion (102.28 gMS / animal / day) of the recorded dry matter is greater than that obtained by Kouakou et *al*. [15] (74.30 gMS / animal/day), Zougou [21] (59.97 gMS /animal/day), Noumbissi et *al.* [8] (58.12 gMS / animal / day), Mweugang et *al*. [22], (43.72 gMS /animal / day) and Miégoué et *al.* [10] (24.6 gMS /animal / day). However, it is less than 115.80 gMS /animal/ day obtained by Egena et *al.* [23]. These differences in intake would probably be related to the experimental foods used in each of these studies. Indeed, Kouakou et *al*. [15], showed that the ingestion of forage depends on the type of supplement associated with it. They could also be explained by the absence of antinutritional factors in the spirulina and its chemical composition, including the quality of its protein, its polyunsaturated fatty acids and its pleasant taste that would stimulate acceptability and appetite in these animals [24]. Indeed, Razafindrajaona et *al*. [25], reported that spirulina can be used as a feed enhancer to increase livestock production. It would also be related to the Energy / Protein ratio of the ration. Indeed, Egena et *al.* [23] showed that herbivorous mammals regulate their intake as a function of the digestible energy (ED) content of the diet. Indeed, an increase in the fiber content of the diet is equivalent to a decrease in digestible energy.

Effect of spirulina level on weight gain in young post-weaned guinea pigs during the fattening test

From the 3rd to the 8th week, the weight of the young guinea pigs has significantly increased with the level of spirulina. During this period, the weight of animals fed 6% spirulina increased from 183.25g to 402.59g. Those animals subjected to TS4, TS2 and TS0 increased from 169.65 to 397.10; from 184.97 to 407.02 and from 189.39 to 396.64 g respectively, a total weight growth of 219.34 g; 228,1g; 222.05g and 227.45g. At 8 weeks the highest average weight (407.02 g) was recorded in animals of batch TS2. This weight was higher than those obtained by many authors [2,9]. These differences could be explained by the chemical composition of spirulina, in particular its high protein value, which provides an optimal supply of essential amino acids [26] which would stimulate growth, but could also be explained by the rapid growth of young guinea pigs. The high value of weight at 8 weeks of age is also explained by the fact that spirulina 2% would have ensured a good energy / protein balance and even mineral that would stimulate growth. Indeed, Egena et *al*. [27], showed that growth from birth to weaning, then weaning until the 6th week after weaning; young guinea pigs double and even more at the 8th week of age. Females were heavier than males. This is contrary to the observations made by Zougou et *al.* [3]. who reported that males grow faster than females from birth to adulthood. This observation, however, corroborates that made by Miegoué et *al.* [9] and Pamo et *al*. [28], who showed that females grow faster than males and that made by.

At the 8th week of age, the inclusion of 2% spirulina in the young guinea pig diet resulted in the highest weights. The significant increase in mean weight with spirulina level recorded in this study is consistent with the observation made by Razafindrajaona et al. [25], in rats treated with aqueous extracts of spirulina at doses of 2 and 8 mg / kg body weight. It would be related to the chemical composition of rations, the valuation of spirulina food proteins by these young guinea pigs. Thus, proteins is a growth factors and, when it quality can meet the need of some essential amino acids of the animal; it can be very

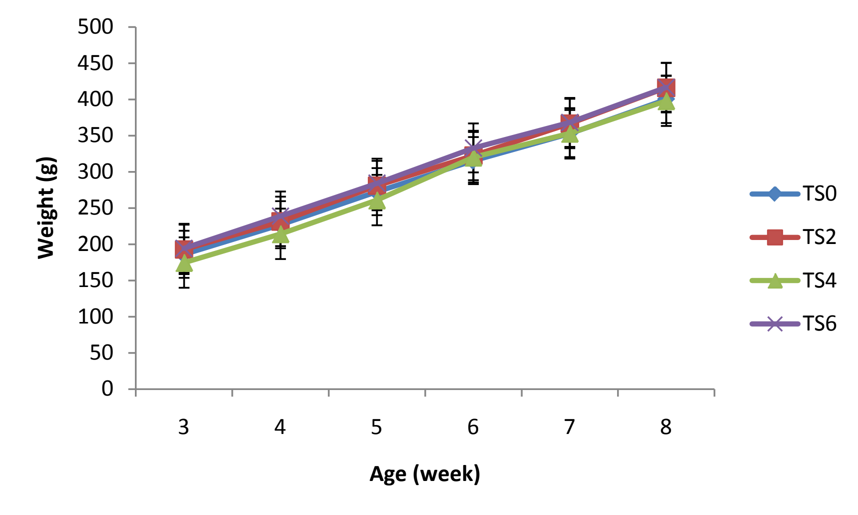

Figure 4 Post-weaning weight evolution of young females according to different treatment. The weight of young weaning females guinea pigs increased steadily from weaning to the 8th week of age regardless of the treatment (figure 4). From the 3rd to the 6th week, all the young females had similar weights regardless of the treatment. From the 6th to the 8th week, the young females of the TS0, TS2 and TS6 groups were higher than those of the TS4 group.

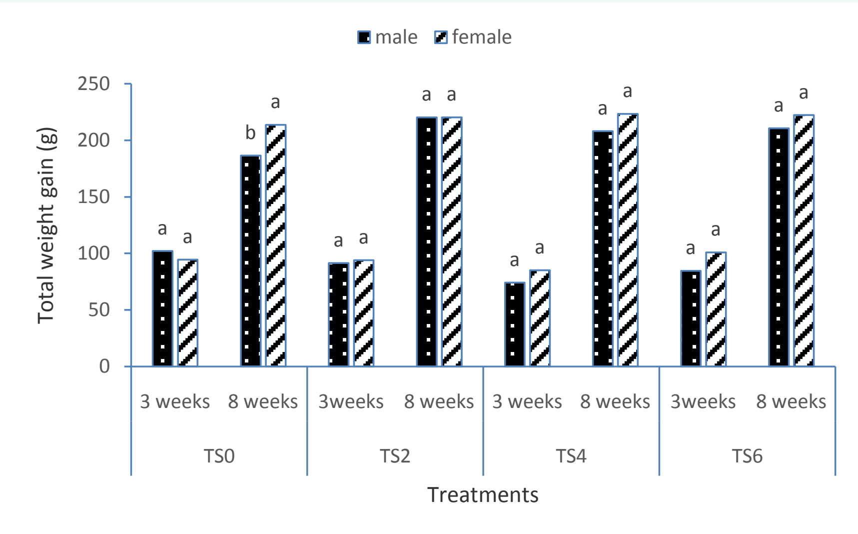

Figure 5 Total weight gain compared between males and females at week 3 (weaning) and week 8 (post-weaning), based on dietary rations.
a,, b, c: Mean bearing the same letters on the same line are not significantly different at the 5% level; SEM: standard error on meam; p: Probability; TS0, TS2, TS4, TS6: Trypsacum laxum+ Compound feed containing 0, 2, 4 and 6% of spirulina..

benefic on growth performances and other related parameters. This observation also corroborates that of Pirette and Meineri [29] and Mamoud et al. [24], who have shown that the inclusion of spirulina in the diet of rabbits stimulates their weight growth. Indeed, Alvarenga et al. [13], and Mamoud et al. [24], have shown that Spirulina contains 60 to 70% protein with optimal intake of essential amino acids and minerals. Proteins are the most important macromolecules for living organism. Thus, they play a vital role in architecture, cell physiology and cellular metabolism. However, the low weight value observed in young animals of batch TS4 can be explain by the balance between nutrients. Thus without equilibrium between nutrients, animals performances can be disturb even when the level of some essentials nutrients are higher. At 8 weeks of age, the significantly higher TWG were obtained in treated groups (TS2, TS4, TS6). It was the same for DWG. The DWG values of this study (6.34g / day) (6.80g / day) are higher than those obtained by Zougou et *al.* [3] (2.02, 1.78, 0.9 and 0.6g / day) when guinea pigs received 14% CP, 16% CP and 18% CP in their diet. The highest DWG value (6.80g / day) in this study is also greater than that obtained by Miégoué et *al.* [9] (3,56g/day) when guinea pigs fed 20g of *Calliandra calothyrsus* as supplement. This could due to the fact that, *C.*

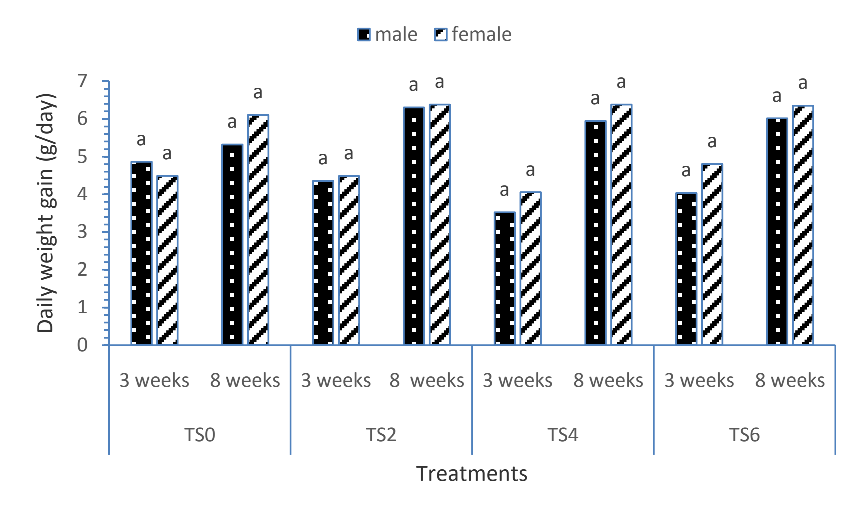

Figure 6 Compared daily weight gain (DWG) between males and female at 3rd and 8th week years old, based on dietary rations.
a,, b, c: Mean bearing the same letters on the same line are not significantly different at the 5% level; SEM: standard error on meam; p: Probability; TS0, TS2, TS4, TS6: Trypsacum laxum+ Compound feed containing 0, 2, 4 and 6% of spirulina.

calothyrsus as some others legumes contains antinutritional factors such as tannins and mimosine that would have reduced the use of dietary protein by herbivorous monogastrics. In the other hand, the quality of protein contain in the spirulina could have improved the metabolism of the animal and favored the growth rate. Indeed, Quigley and Poppi [30] have shown that 20% of dietary spirulina bypasses the protein degradation in the rumen and makes it available for direct absorption into the abomasum. The inclusion of spirulina in the ration of these post-weaning animals has resulted in a significant increase in average weights, total weight gain (TWG) and daily weight gain (DWG). Animals fed 6% spirulina from single births had higher TWG and DWG than those from double births. This result corroborates that obtained by Zougou et *al.* [3], Miégoué et *al.* [16], and could be explained by the fact that animals from low litters are heavier at birth than those born from multiple births, and that high litter sizes increase competition for resources food. By the same way, animals of twin's birth value better the diet containing 6% of spirulina than other diet. This shown that from the twins birth, animals require more protein especially higher quality protein. Thus, 6% of spirulina have met the need of animals and improved their growth performances.

Conclusion

The effect of graded level of spirulina level on post-weaning growth performance of guinea pig (*Cavia porcellus*) was evaluated. From this study, it appears that the levels of spirulina in the diet have:

- Improved intake of *T. laxum,* the compound feed, the dry matter (DM), the organic matter (OM), the crude fiber (CF) and the crude protein (CP) intake.
- Not affect the average weight of guinea pigs regardless of sex.
- Improved total weight gain (TWG) and daily weight gain (DWG) of young guinea pigs.
- Improved the average weights, TWG and DWG of the guinea pigs according to the type of birth.

It appears that 2% spirulina can really affect growth performances of guinea pig in the growth stage but, for twin's birth 6% is suitable. Spirulina can then be used for post-weaned growth of young guinea pigs in West Cameroon.

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