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Effects of Dietary Energy Level on Growth Performances of African Giant Rats *(Cricetomys Gambianus)*

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Abstract **Original Research Article**

A study was conducted to determine the effects of dietary energy level in African giant rats growth performances. Thirty-two young African giant rats whose 16 males and 16 females averaging 293.41±19.21g were used. They were randomly distributed into 4 groups of 8 animals each (4 males and 4 females). To each group was randomly attributed a diet characterized by one of the 4 studied digestible energy levels (3600 Kcal/kg DM, 3800 Kcal/kg DM, 4000 Kcal/kg DM and 4200 Kcal/kg DM). The daily distribution of the experimental feeds last the whole study duration. Results showed no significant difference among dietary energy levels 3600, 3800, 4000 and 4200 Kcal/ kg DM which allowed the feed intake of 741.15 g, 759.41 g, 759.67 g and 753.85 g per week respectively. Though the growth rate was faster in animals receiving 3800 Kcal/kg DM, the evolution of body weight was comparable (p>0.05) among treatments. The lowest consumption index was registered in cricetoma fed 3800 Kcal/kg DM, although no significant (p>0.05) difference was obtained compared to other treatments. The carcass yield was not significantly (p>0.05) affected regardless the energy level. In view of the present results, the dietary digestible energy requirement that gave the best growth performances in African giant rat was 3800 Kcal/kg DM.

Keywords: Captivity, carcass yield, cricetoma, energy requirement, production.

INTRODUCTION

Food safety and the satisfaction of meat requirement in particular remain a challenge in most developing countries like Cameroon [1], were about 70% of the population is mostly farmers [2]. Indeed, the rapid population growth created an imbalance between the meat supply and demand, resulting in human malnutrition and a severe exploitation of wild fauna.

Due to the taste of its meat, wild cricetoma is named among the overhunted species in West Africa [3, 4]. Besides its role in human nutrition, cricetoma can be used as pet [5], because of it great intellect. The adaptation of this animal on various natural environments is a favorable condition to its domestication [6]. The mastery of its husbandry would be a great contribution to meat production and wildlife preservation [7].

The African giant rat domestication was initiated there is more than 20 years. Nowadays, it is common to notice weak production performances in cricetoma farms, as compared to those from captured wild females. Causes of those low performances could be the less mastery of productive techniques, despite the significant progress done regarding housing [7, 3].

Cricetomys gambianus is omnivorous and consequently seems easy to feed in captivity [8, 3]. Food consumed by animals provides nutrients and energy of high significance in different metabolic activities such as growth. The dietary energy level is an important variable in food use and production [9]. Thus, the dietary energy level is one of the major elements responsible of ingestion of dry matter and consequently those of nutrients used as raw material for growth. Therefore, inadequate food energy intake could negatively affect growth.

The satisfaction of energy requirements in cricetoma could allow it to optimize its growth performances in captivity. To the best of our knowledge these needs are not known. The purpose of this study is to evaluate the influence of dietary energy level on the growth of the cricetoma in captivity.

MATERIALS AND METHODS

Animal and housing

Thirty-two young African giant rats (16 males and 16 females), bred at the Teaching and Research Farm of the University of Dschang were used. They were 2 months old and weighed 293.41± 19.21g.

Cricetomas were housed individually in cages of 100 cm x 80 cm x 60 cm (length, width and height) under standard conditions with 12 h photoperiod.

Feeding

Animals had free access to feed and water. Experimental diet consisted of four diets whose composition and bromatological characteristics are summarised in Table-1.

Table-1: Centesimal composition and bromatological characteristics of diets

Ingredients	Digestible energy level (Kcal/Kg MS)			
	3600	**3800**	**4000**	**4200**
Grain corn	52.0	60.5	60.0	60.0
Brewers chaffs	15.0	8.0	11.5	9.50
Cottonseed meal	8.0	5.0	2.0	0.0
Soya bean meal	15.5	14.0	9.0	8.0
Fishmeal	2.0	4.0	5.0	6.0
Bone meal	4.0	3.0	3.0	2.5
Palm oil	2.0	3.0	5.5	8.0
Blood meal	1.0	2.0	5.0	6.0
NaCl	0.5	0.5	0.5	0.5
Total	**100**	**100**	**100**	**100**
Bromatological characteristics of diets				
Crude Proteins (% DM)	19.3	19.3	19.1	19.2
Digestible energy (Kcal/kg DM)	**3620**	**3816**	**4018**	**4208**
Crude fiber (% DM)	3.75	3.70	3.50	3.13

Assay

The 32 cricetomas previously described were randomly distributed into four groups of eight females and eight males, comparable in term of body weight. They were each allotted to an individual cage and assigned one of the four diets of Table-1. Daily, experimental feed were given to each animal. At six months of testing, four males and four females were randomly selected per treatment, deprived of food for twenty-four hours, and sacrificed for the purpose of assessing carcass characteristics.

Studied Parameters and Data Collection

Feed intake, body weight and consumption index

From the beginning to the end of the experiment, data were collected to assess feed intake (FI) and life body weight (BW). Data collection for each animal was daily and weekly respectively for FI and BW. Consumption index was obtained by dividing weekly FI by weekly BWG.

Body Measurements

Body length, tail length and chest circumference were taken weekly from the start to the 18th week of treatment. Chest circumference was measured as the circumference of the breast region just behind the forelegs. Body length was considered from below the neck to the base of the tail and tail length was measured from the base of tail to its free extremity.

Carcass yield

At the sixth month of testing (eight months old), live body weight were recorded and cricetoma were then sacrificed, trunk organs (hearth, kidney, intestine, liver) and abdominal fat removed and weighed. The carcass was also weighed and the carcass yield calculated. The length of the digestive tract segments (small intestine, caecum and colon) was taken, as well as their weight.

Ethic

Animals were handled according to ethical guidelines of the Cameroon National Veterinary Laboratory.

Statistical analysis

Results were expressed as mean±standard deviation. Differences between groups were assessed using one way ANOVA followed by the Duncan's test at 5% significance.

RESULTS

Evolution of Feed Intake

Feed intake, as well regardless of sex (Figure-1) as when sex is considered (Figure 2 and 3), increased from the beginning of the trial to the day of animals sacrifice, with an inflexion at the12th week of distribution of experimental diet.

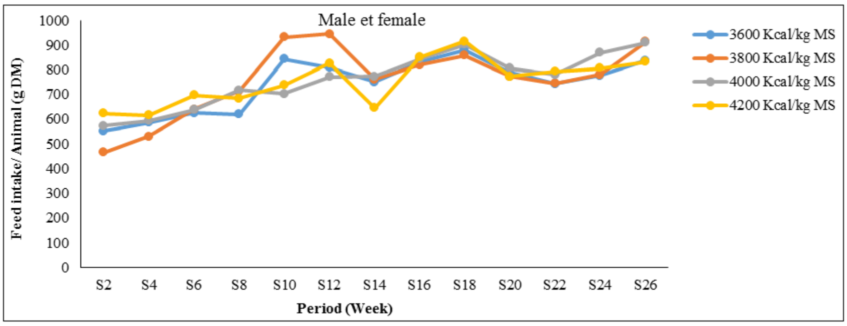

Fig-1: Evolution of feed intake in male and female cricetoma according to dietary energy level

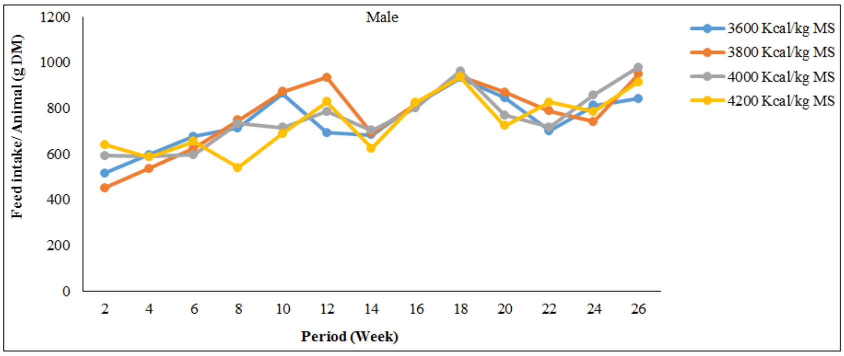

Fig-2: Evolution of feed intake in male cricetoma according to dietary energy level

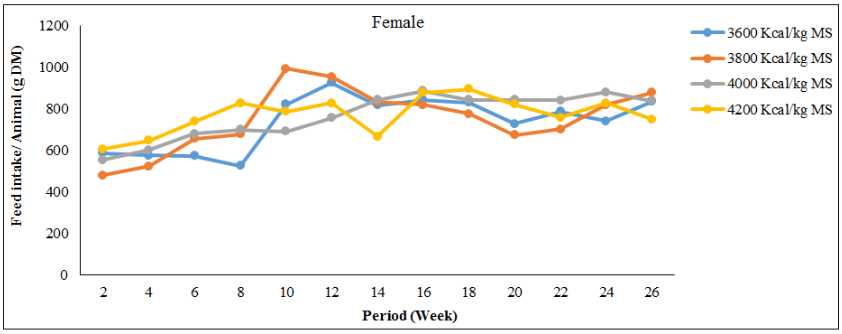

Fig-3: Evolution of feed intake in female cricetoma according to dietary energy level

Thus, from the start to the 26th week of the study, mean feed intake (FI) per week (Figure-4) was globally weaker in animals fed 3600Kcal/kg DM and higher in those receiving 4000Kcal/kg DM of digestible energy. No difference was significant ($p>0.05$) among diets.

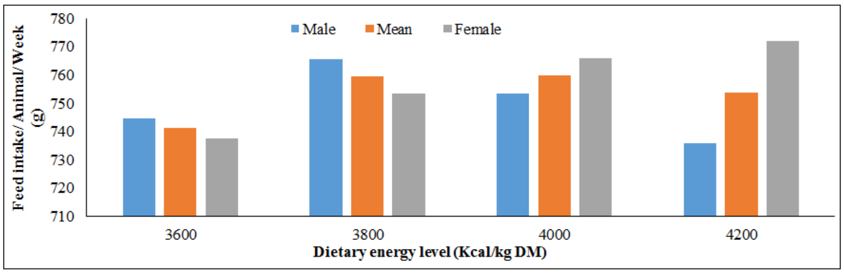

Fig-4: Effect of dietary energy level on weekly feed intake in *Cricetomys gambianus*

Body Weight

Figure 5, 6 and 7 show weekly evolution curves of African giant rat body weight (BW) under various levels of energy in the diet. Both independently (Figure-5) and when sex was considered (Figure 6 and 7), BW increased gradually from start of treatment (9th week old) to the sacrifice day (32nd week old) in any group.

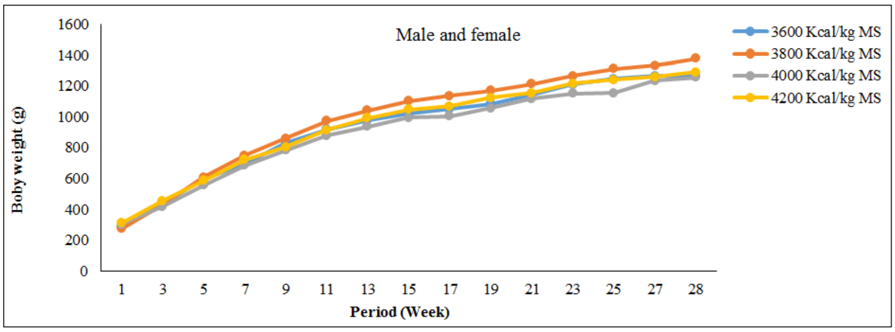

Fig-5: Evolution of body weight on male and female cricetoma according to dietary energy level

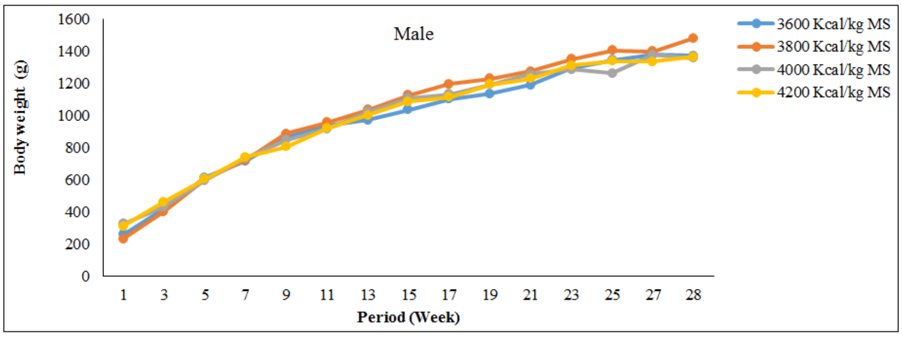

Fig-6: Evolution of body weight in male cricetoma according to dietary energy level

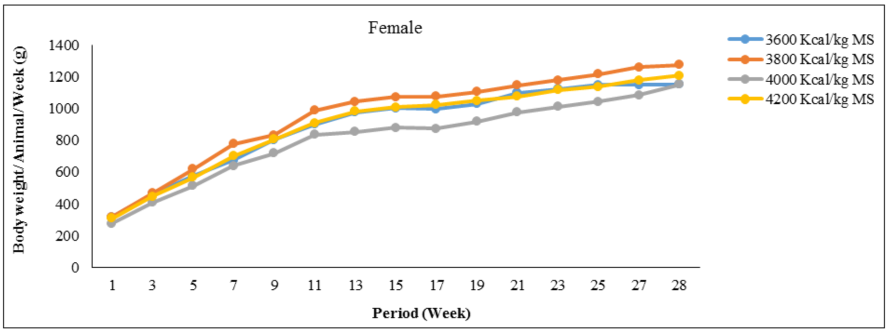

Fig-7: Evolution of body weight in female cricetoma according to dietary energy level

The mean body weight at the sacrifice of animals (Figure-8) presented no significant (p>0.05) difference among rats receiving different levels of dietary digestible energy.

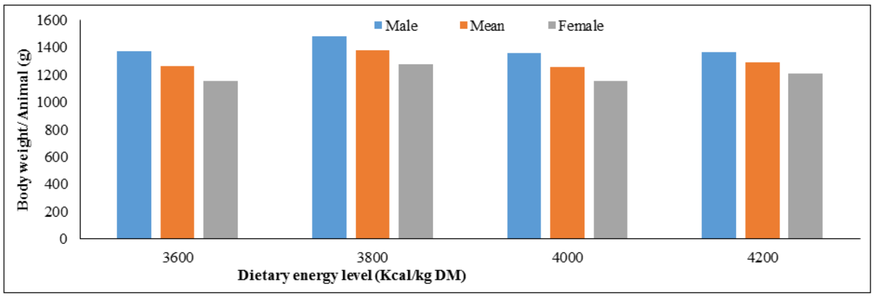

Fig-8: Effects of dietary energy level on body weight in cricetoma

Weight Gain

Daily weight gain (Figure-9) was generally higher in cricetoma receiving digestible energy 3800Kcal/kg DM. However, no significant (p>0.05) difference was registered between the different diets.

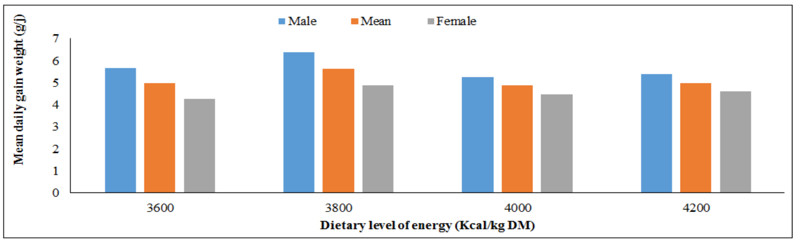

Fig-9: Effect of dietary energy level on mean daily weight gain on cricetoma

Consumption index and feed efficiency

Figure 10 and 11 show the effect of dietary energy level respectively on consumption index (CI) and feed efficiency (FE) in *Cricetoma gambianus*. It appears that CI was weaker in animals fed digestible energy 3800Kcal/kg DM compared to others. Opposite results were observed for FE. However, statistical analysis show no significant (p>0.05) effect among treatments.

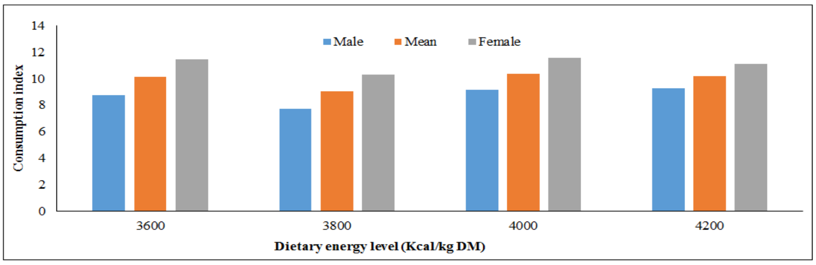

Fig-10: Effect of dietary energy level on consumption index in *Cricetoma gambianus*

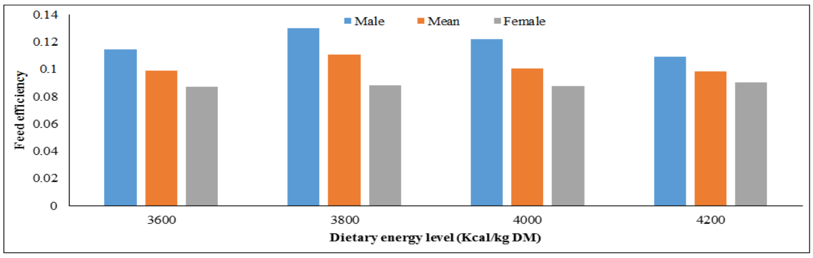

Fig-11: Effect of dietary energy level on feed efficiency in *Cricetoma gambianus*

Body Measurement

Metrical measurement of selected parts of the body (Table-2) in African giant rat at 18 weeks old tended to decrease with increased level of energy in diet, but without any significant difference (p>0.05).

Table-2: Effect of dietary energy level on body measurement in cricetoma at 18 weeks old

Measurements (cm)	Sex	Dietary energy level(Kcal/kg DM)				P
		3600	3800	4000	4200	
Trunk length	♂	24± 2.83	26 ± 1.41	22.5 ± 2.12	22 ± 1.41	0.33
	♀	22 ± 1.34	22 ± 1.53	21.3 ± 1.97	21 ± 1.58	0.42
	♂♀	23.3±0.99	24 ± 2.83	21.9 ± 0.82	21 ± 0.71	0.45
Total body length	♂	56.2 ± 7.28	63 ± 4.24	64.2 ± 2.99	62.1 ± 2.69	0.39
	♀	61.4 ± 2.86	61.4 ± 1.48	58.6 ± 4.21	57.7 ± 6.59	0.69
	♂♀	58.8±3.71	62.2 ±1.11	61.4±3.98	59.9±3.13	0.72
Tail length	♂	25.6 ± 5.11	42.6 ± 7.93	33.5 ± 2.76	32.1 ± 1.27	0.40
	♀	30.8 ± 2.64	31.3 ± 1.19	30.8 ± 2.97	29 ± 5.71	0.31
	♂♀	27.9 ± 3.99	36.7 ± 7.70	32.1 ± 1.86	30.5 ± 2.19	0.39
Breast circumference	♂	19 ± 1.41	19.5 ± 0.71	21.5 ± 0.71	20 ± 1.41	0.28
	♀	20 ± 1.58	18.8 ± 1.03	18.5±1.76	19.9 ± 1.67	0.30
	♂♀	19.5 ± 0.71	19.2 ± 0.45	20 ± 2.09	19.9± 0.07	0.86

a, b: on the same line, values affected with the same letter do not differ significantly (P>0.05). DM: Dry matter; p: probability

Table-3 resumes the effects of dietary energy level on corrected weight of some organs and on carcass yield. The corrected weight of heart, kidneys and liver, like carcass yield were varied a back-and-forth with increasing level of digestible energy on diet. This variation was non-significant (p>0.05) difference apart of heart weight which was significantly (p<0.05) difference higher on set fed 4200Kcal/kg DM of digestible energy.

Table-3: Effects of dietary energy level on organs weight and carcass yield in cricetoma

Parameters	Sex	Dietary energy level (Kcal/kg.DM)				P
		3600	3800	4000	4200	
Heart	♂	0.42±0.07[b]	0.51±0.09[ab]	0.46±0.09[ab]	0.60±0.14[a]	0.04
	♀	0.42±0.05	0.51±0.12	0.48±0.08	0.51±0.07	0.55
	♂♀	0.42±0.06[b]	0.51±0.10[ab]	0.47±0.08[ab]	0.56±0.12[a]	0.04
Liver	♂	2.68±0.34	2.18±0.16	2.56 ±0.50	2.46±0.31	0.27
	♀	2.30±0.15	2.35±0.15	2.36±0.54	1.98±0.14	0.41
	♂♀	2.52±0.33	2.26±0.17	2.47±0.48	2.25±0.35	0.36
Kidneys	♂	0.50±0.06	0.49±0.06	0.50±0.11	0.51±0.04	0.99
	♀	0.45±0.04	0.42±0.06	0.8±0.07	0.43±0.02	0.55
	♂♀	0.48±0.06	0.46±0.07	0.49±0.09	0.47±0.05	0.87
Carcasse yield	♂	73.7 ± 1.70	75.2 ± 1.51	73.1 ± 1.66	75.4 ± 1.85	0.13
	♀	78.1± 0.88	77.9 ± 7.54	77.1± 2.66	76.2 ± 1.02	0.93
	♂♀	75.3 ± 2.93	76.4 ± 4.72	74.8 ± 2.89	75.7 ± 1.48	0.81

a, b: on the same line, values affected with the same letter do not differ significantly (P>0.05). DM: Dry matter; p: probability

Metric measurements of some parts of digestive tract in cricetoma fed different energy level are presented on Table-4. Analysis of variance revealed non-significant (p>0.05) difference among treatments.

Table-4: Effects of dietary energy level on digestive tract measurement in cricetoma

Digestive tract (cm)	Sex	Dietary energy level (Kcal/kg.DM)				P
		3600	3800	4000	4200	
Small intestine	♂	132±11.11	131±12.64	119±12.43	125±7.68	0.38
	♀	115±10.25	109±15.04	112±5.13	116±19.11	0.92
	♂♀	125±13.14	121±17.15	116±10.04	121±13.25	0.69
Colon	♂	81.6±10.3	71±11.5	65.8±11.7	68.5±7.33	0.21
	♀	66.3±13.8	69.2±7.18	63.7±8.08	65.8±2.93	0.47
	♂♀	75.1±13.5	70.2±9.21	65.4±10.5	67.4±5.63	0.38
Caecum	♂	17.7±3.95	18.2±2.79	17.8±2.46	17.7±3.40	0.99
	♀	15.8±4.25	13.7±3.55	16±2	14.3±3.06	0.79
	♂♀	16.9±3.86	16.3±3.73	17.1±3.32	16.6±3.50	0.95

a, b: on the same line, values affected with the same letter do not differ significantly (P>0.05). DM: Dry matter; p: probability

Table-5 presents the effects of dietary energy level on intestine weight and growth of abdominal fat in African giant rat fed different levels of digestible energy in the diet. The weight of different portions of intestine seemed to decrease with increasing level of dietary energy. However, this diminution was not significant (p>0.05) excepted at 4000Kcal/kg DM with the caecum and the colon in male.

Abdominal fat was not significantly (p>0.05) more developed in rat fed diet containing 3800Kcal/kg DM of digestible energy followed in order by groups receiving 4000 Kcal/kg DM and 4200 Kcal/kg DM.

Table-5: Effects of dietary energy level on development of digestive tract and abdominal fat in cricetoma

Weight	Sex	Dietary energy level (Kcal/kg.DM)				P
		3600	3800	4000	4200	
Small intestine (% of BW)	♂	1.99±0.39	1.8±0.18	1.72±0.22	1.76±0.19	0.36
	♀	2.16±0.14	1.98±0.26	2.1±0.32	1.85±0.12	0.41
	♂♀	2.06±0.51	1.81±0.25	1.88±0.32	1.80±0.27	0.25
Colon (% of BW)	♂	1.26±0.14[a]	1.15±0.16[ab]	0.89±0.18[b]	0.98±0.18[ab]	0.04
	♀	1.35±0.07	1.26±0.16	1.37±0.23	1.33±0.18	0.88
	♂♀	1.30±0.12	1.20±0.16	1.09±0.32	1.13±0.30	0.43
Caecum (% of BW)	♂	1.94±0.25	1.67±0.33	1.44±0.34	1.74±0.29	0.55
	♀	1.92±0.18	1.98±0.28	1.48±0.04	1.43±0.23	0.09
	♂♀	1.92±0.21[a]	1.80±0.57[ab]	1.45±0.24[b]	1.61±0.44[ab]	0.04
Abdominal fat (g)	♂	78.7±28.4	101±38.6	147±46.1	105±31.7	0.39
	♀	50±12.3	115±36.8	51±29.1	93.7±14.1	0.16
	♂♀	66±28.8	107±43.4	106±86.5	100±24.6	0.43

a, b: on the same line, values affected with the same letter do not differ significantly (p>0.05). DM: Dry matter; p: probability

DISCUSSION

Growth of an animal is evaluated by some parameters such as feed intake, life body weight, consumption index, feed efficiency and weight gain. Corporal measurements may also be used to evaluate growth [10].

Although higher than those documented by previous studies [11, 12], feed intake in each treatment corroborated results reported by [13] on laboratory rats in which feed intake increased with increasing level of energy in diet. On the other hand, many investigations realized on rabbits showed that feed intake and level of dietary energy are negatively linked [14-16], hence the contradiction of these works with those presented by [17, 18]. Indeed, the higher the dietary energy level, the lower the feed intake. The regulation of ingestion by energy level is by the hypothalamus. Literature reported that, the hypothalamus is the regulatory center of eating behavior and consequently, is capable to stimulate or reduce feed intake depending on its energy content [19, 9, 20].

The increase in live weight throughout the trial under all dietary energy levels was predictable, the rats used being only two months old and weighing 293.41 g at the beginning of the test for an adult weight (8 months of age) ranging from 1254.88 to 1378.17 g regardless of gender. The parallelism of this increase with that of food consumption can be explained easily by the fact that during growth, it is the consumed food that is transformed into animal tissues and the nutrients needed for construction and development of new tissues, and the maintenance of existing ones increases with age.

In the present study, life body weights varied in the same interval than that reported by [21] on cricetoma. These values were higher compared to those presented by [22] who reported a final body weight of 999.7 ± 16.86 g in the same species. The variation in the energy level of the food in this study did not appear to induce significant differences ($p > 0.05$) on the final live weight of the animals. This observation could be explained by the fact that an increase in the energy content of the food leads to weight gain in the animal [18] up to a certain threshold.

The highest body measurements were obtained by the ration containing 3800 kcal/kg of digestible energy. In addition, the same trend has been noted with other growth characteristics. This result could indicate that the level of energy 3800Kcal / kg MS is closed to the need for cricetoma growth.

Globally, development of digestive tract was not significantly ($p>0.05$) affected by dietary energy level. It seems that the small intestine and colon length were greater in groups fed digestible energy 3800 and 3600 Kcal/kg DM respectively. This result could be explained by the hypothesis that intestine development depends on feed intake as reported by in rabbit [23].

Since organ weights were proportional to body weight, it was expected that the weight of the liver, kidney, reproductive organs, small intestine, and colon, as well as body weight, would not be significantly different among the four treatments. It is the same for the length of the digestive tract whose development is proportional to that of the body.

As for the carcass yield, its decrease in the cricetomas fed with the most energetic rations would be linked to the excessive fattening of their abdominal region rather than to the deposition of the muscles. Indeed, in these subjects, adipose tissue has been highly developed in the perirenal region, around the ovaries or testes and in the intestinal mesenteries. The development of adipose tissue is an expression of the storage of excess food energy in the organs or in the bloodstream as reported in laboratory rats and in mice [24, 25].

CONCLUSION

Finally, feed intake, live body weight, weight gain, feed efficiency had the tendency to increase with digestible energy 3800 Kcal/kg DM both in males and females with high carcass yield compared to those obtained with other diets.This digestible energy level could be appropriate for an optimal growth of cricetoma.

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