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Mineral Contents of Guinea Pigs' (*Cavia porcellus* L.) Meat Fed Cassava (*Manihot esculenta* Crantz) Leaf Meal as Protein Source

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Abstract **Original Research Article**

A study was conducted on 48 guinea pigs (24 females: 522.21±28.88g and 24 males: 566.75±43.13g) of local breed of Cameroon to evaluate the mineral content of their meat. Animals were fed with *Pennisetum purpureum ad libitum* supplemented with one of the experimental diets: ML 0% (Control), ML 8%, ML 10% and ML 12% containing respectively 0, 8, 10 and 12 % of cassava leaf meal (CLM). Each of the 4 diets was assigned to 4 groups of animals corresponding to the 4 treatments/Diets and these animals were distributed in a completely randomized design with 12 replicates per ration, six of which were per sex and per group. After sacrifice of animals at 22nd weeks, the meat from the Loin, Thigh and Shoulder, were analyzed. Results revealed that mineral contents of females meat were higher than those of males: Sodium content was highest ($p<0.05$) in the Shoulder (48.34%) of females fed Control diet; Females fed ML 12% diet registered at Shoulder's level higher ($p<0.05$) concentrations of Calcium and Iron (14.64 and 46.78 % respectively) just like in the same part, Potassium and Zinc contents were the most ($p<0.05$) abundant (9.49 and 4.11% respectively). This study revealed that guinea pig's meat is particularly poor in Magnesium (0.95%). The greatest ($p<0.05$) Iron content was at shoulder's level (46.78 mg / gDM) of females receiving ML 12%. These results suggest that CLM can improve mineral content of guinea pig's meat.
Keywords: *Pennisetum purpureum*, *Manihot esculenta* leaf meal, mineral contents, guinea pig meat, Cameroon.

INTRODUCTION

Domestic cavies commonly known as guinea pigs (*Cavia porcellus* L.) are widely distributed throughout western highlands and southern forest zones of Cameroon and are integrated component of nearly all rural households. The meat from cavies is perceived to be tastier probably due to the fact that guinea pig is usually fed with fodders and vegetal residues from crops. Guinea pigs are prolific animals expressing non-seasonal estrus, have a gestation length that allows for multiple litters per year, and produce multiple young per birth event. Guinea pigs grow and reproduce on a flexible diet and are adaptable to a wide range of climates. They are also herd animals that respond favorably to husbandry and management [1-3]. Guinea pig production could be a cheap option to meet the growing needs for protein in developing countries, especially for low income population groups.

Regarding to its use as a tasty and expensive regional dish in the western highlands (Cameroon) and its high protein and low fat contents [4] compared with beef, chicken, lamb and pork [5], consistent and desirable quality of local guinea pigs' meat in Cameroon need to be addressed. As factors affecting meat quality, in addition to genotype, Castellini et al. [6] and Batkowska et al. [7] mentioned nutrition, sex, age at slaughter and motor activity.. Even though, little works have been done concerning meat chemical qualities of guinea pigs [4, 8], mineral contents on their side have received little attention and as a result, knowledge of its composition and quality is then limited when compared to other meats. This study therefore aimed at investigating the effect of replacing soya bean meal with cassava (*Manihot esculenta* Crantz) leaf meal in the diet of guinea pigs on mineral characteristics of its meat.

MATERIALS AND METHODS

Study area

The study was carried out at the Animal Experimental Farm, the "Biochemistry Laboratory of Medicinal Plants, Food Science and Nutrition" (LABPMAN) and at the Soil science laboratory of the University of Dschang. This town is found in the Western region of Cameroon (Central Africa) and it falls within the Soudano-Guinean zone (latitude 5º26'N, longitude 10º26'E). The annual temperature varies between 16 and 27ºC while the relative humidity is 40-97%. There are two main seasons: the rainy season (April to October) and the dry season (November to March). The altitude is at 1400 m above sea level while the mean annual rainfall is about 2000 mm.

Animals and Housing

Forty eight adult guinea pigs (24 males and 24 females) of 22 weeks old of average weight of 522.21±28.88g (females) and 566.75±43.13g (males) were used for this experiment. They were born and raised in pens (12 animals /pen) at the research farm and allow growing until 22 weeks. Each of the 4 pens was heated by an electric bulb and the floor was covered with saw dust which was replaced every two days. Animals were identified using small metallic ear tags bearing numbers.

Feeding Rations and Experimental Design

Cassava leaves were collected from cassava plants in farms surrounding the University, sun dried, ground and stored in bags until used [2]. Four diets: ML 0% (Control), ML 8%, ML 10% and ML 12% (Table 1) were formulated by gradually increasing the proportion of CLM (0, 8, 10 and 12%) in replacement of soybean meal in the control ration. Each of the 4 diets/treatments was assigned to one of the 4 groups of animals with 12 replicates per ration, six of which were per sex and per group in a completely randomized design. Prior to service, the weight of experimental diets was recorded; water and *P. purpureum* were served *ad libitum*. Feed was administered once daily (between 6 and 8 a.m.), the water provided, contained vitamin C and was renewed every morning (1 g of drug / 10 L of water).

Table-1: Calculated chemical composition of experimental diets and *P. purpureum*

Characteristics of the diets	Concentrates with graded levels of CLM				Forage
	ML 0% (Control)	ML 6%	ML 8%	ML 12%	*P. purpureum*
Dry matter (%)	90.85	90.38	91.50	90.61	90.30
Organic matter (% DM)	89.52	86.95	87.69	86.46	86.32
Crude protein (% DM)	19.00	18.75	18.81	18.15	7.89
Crude fats (% DM)	4.66	4.27	6.19	6.13	2.20
Crude fiber (% DM)	7.74	8.51	9.71	10.69	33.46
Ash (% DM)	10.48	13.05	12.31	13.54	9.68
ME (Kcal/Kg DM)	2915.65	2896.00	2837.29	3045.51	407.18

DM= Dry matter; ME= Metabolizable energy; ML 0% (Control) = Diet with no M. esculenta leaf meal; ML 8%= Diet containing 8% M. esculenta leaf meal; ML 10%= Diet containing 10% M. esculenta leaf meal; ML 12%= Diet containing 12% M. esculenta leaf meal; P. purpureum.

Sampling and measurements

After 22 weeks of feeding, 12 animals (6 males and 6 females) of comparable average body weight per treatment were starved (for 12 hours) and slaughtered by cervical dislocation. After bleeding was complete, carcasses were eviscerated and dressed. Meat was collected from the Loin, Thigh and Shoulder and used for chemical analysis. After incineration (605°C) of meat samples, total ashes were determined and mineral fraction of theses ashes were measured out by atomic absorption spectrophotometry [9].

Chemical Analysis

In ashes, the mineral traits of guinea pig's meat such Ca, I, Na, K, Mg and Zn contents as well as chemical composition of experimental diets were determined [9].

Statistical analyses

The data were subjected to 3-way (diet, sex and meat of the different muscles) analysis of variance following the general linear model (GLM) as follows:

$$Y_{ijhl} = \mu + \alpha_i + \beta_j + \delta_h + \gamma_l + (\alpha\beta)_{ij} + (\delta\gamma)_{hl} + e_{ijhl}$$

Where,

Y_{ijhl} = observation on animal h of sex j subjected to factors i (diet) and l (part of the muscle)

μ= overall mean

α_i = effect of diet i

β_j = effect of sex j

δ_h = effect of animal

γ_l = effect of the part of the muscle

$(\alpha\beta)_{ij}$ = effect of the interaction between factors i and j

$(\delta\gamma)_{hl}$ = effect of the interaction between factors h and l

e_{ijhl} = residual error on animal h subjected to factors i, j and l

Means were separated for significant differences ($P<0.05$) using Duncan's multiple range test [10].

RESULTS

Effect of dietary Cassava leaf meal level on Ash content of some muscle parts of guinea pigs' meat

Regardless of the ration, sex and different parts, the ash content of meat was comparable ($P<0.05$) (Table 2).

Table-2: Ash content (% DM) of some muscle parts of cavy's meat according to graded level of CLM in the diet

Studied parts	Sexes	Dietary Cassava Leaf Meal levels			
		ML 0%	ML 8%	ML 10%	ML 12%
Loin	♂	$5.17 \pm 0.94^{a}_{A}$	$4.11 \pm 0.93^{a}_{A}$	$5.43 \pm 0.74^{a}_{A}$	$4.63 \pm 0.38^{a}_{A}$
	♀	$5.00 \pm 0.42^{a}_{A}$	$3.90 \pm 1.27^{a}_{A}$	$5.03 \pm 0.25^{a}_{A}$	$4.93 \pm 0.26^{a}_{A}$
Thigh	♂	$5.64 \pm 0.69^{a}_{A}$	$4.27 \pm 0.03^{a}_{A}$	$5.33 \pm 0.49^{a}_{A}$	$4.34 \pm 0.62^{a}_{A}$
	♀	$5.79 \pm 0.30^{a}_{A}$	$5.77 \pm 0.19^{a}_{A}$	$5.50 \pm 0.71^{a}_{A}$	$5.30 \pm 0.42^{a}_{A}$
Shoulder	♂	$5.50 \pm 1.34^{a}_{A}$	$4.56 \pm 1.49^{a}_{A}$	$5.43 \pm 0.68^{a}_{A}$	$5.70 \pm 0.63^{a}_{A}$
	♀	$5.11 \pm 0.28^{a}_{A}$	$4.85 \pm 0.35^{a}_{A}$	$4.99 \pm 0.01^{a}_{A}$	$4.32 \pm 1.87^{a}_{A}$

a: averages of the same line affected by the same letter are not significantly different at P>0.05; A: averages with the same letters in the same column are not statistically different (P>0.05). ML 0% (Control)= Diet with no M. esculenta leaf meal; ML 8%= Diet containing 8% M. esculenta leaf meal; ML 10%= Diet containing 10% M. esculenta leaf meal; ML 12%= Diet containing 12% M. esculenta leaf meal.

Effect of dietary Cassava leaf meal level on Calcium content of some muscle parts of guinea pigs' meat

The values of calcium in all rations, presented a significant difference ($p <0.001$) between the sexes (Table 3). Females recorded higher calcium levels ($P<0.05$) than males whatever the considered diet and studied part except females of ML 8% and ML 12% diets at Thigh level. Whatever the studied part, highest calcium content ($P<0.05$) was recorded with males and females of ML 12% (Shoulder). Calcium levels in males' meat were comparable ($P<0.05$) between the control and ML 8% diets (Shoulder). It appears that at the Loin level, females ML 8% (30.87 mg / 100g) and males (22.02 mg / 100 g) showed the highest ($p<0.05$) calcium content, while females (3.37 mg / 100g) and males (3.40 mg / 100g) of ML 10% diet showed the lowest ($p<0.05$) calcium contents. With regard to the thigh, the most important calcium level ($p<0.05$) was recorded in males (21.99 mg / 100g) and females (19.35 mg / 100g) of ML 12% diet, while the lowest ($p<0.05$) value was recorded in males of ML 8% (14.31 mg / 100g) and ML 10% (8.20 mg / 100g). At shoulders' level, females (36.95 mg / 100g) and males (22.15 mg / 100g) of ML 12% diet presented higher ($p<0.05$) calcium contents and lower ($p<0.05$) values by males (7.24 mg / 100g) and females (20.07 mg / 100g) of ML 10% diet.

Table-3: Calcium content (mg / gDM) of some muscle parts of cavy's meat according graded level of CLM in the diet

Studied parts	Sexes	Dietary Cassava Leaf Meal levels			
		ML 0%	ML 8%	ML 10%	ML 12%
Loin	♂	$14.95 \pm 0.06^{c}_{B}$	$17.77 \pm 2.18^{b}_{B}$	$3.37 \pm 0.01^{d}_{B}$	$22.02 \pm 2.93^{a}_{A}$
	♀	$20.75 \pm 1.42^{b}_{A}$	$30.87 \pm 0.01^{a}_{A}$	$3.40 \pm 0.15^{c}_{A}$	$18.39 \pm 0.23^{b}_{B}$
Thigh	♂	$16.7 \pm 1.87^{c}_{B}$	$14.31 \pm 0.12^{d}_{A}$	$18.90 \pm 0.11^{b}_{A}$	$21.99 \pm 0.28^{a}_{A}$
	♀	$18.6 \pm 0.48^{a}_{A}$	$8.40 \pm 0.02^{c}_{B}$	$8.20 \pm 1.14^{b}_{B}$	$19.35 \pm 2.04^{a}_{B}$
Shoulder	♂	$20.02 \pm 0.35^{a}_{A}$	$22.19 \pm 0.15^{a}_{A}$	$7.24 \pm 0.31^{b}_{B}$	$22.15 \pm 0.12^{a}_{B}$
	♀	$22.68 \pm 0.29^{b}_{A}$	$21.10 \pm 0.12^{b}_{A}$	$20.07 \pm 2.31^{b}_{A}$	$36.95 \pm 0.75^{a}_{A}$

a, b, c, d: averages of the same line affected by the same letter are not significantly different at P>0.05; A, B: averages with the same letters in the same column are not statistically different (P>0.05); ML 0% (Control)= Diet with no M. esculenta leaf meal; ML 8%= Diet containing 8% M. esculenta leaf meal; ML 10%= Diet containing 10% M. esculenta leaf meal; ML 12%= Diet containing 12% M. esculenta leaf meal.

Effect of dietary Cassava leaf meal level on Iron content of some muscle parts of guinea pigs' meat

Considering the diet and the cutting parts, females recorded significantly higher ($P<0.05$) iron levels than males except for diets ML 8% and ML 10% (Table 4). Considering the cutting parts and each sex, at Loin's level, males of ML 8% (87.87 mg / g) and females of ML 12% (91.66 mg / g) diets showed higher levels ($P<0.05$) in iron content. With regard to the Thigh part, females of ML 12% (85.8 mg / g) and comparatively males of ML 10% (76.84 mg / g) and ML 8% (78.25 mg / g) batches obtained significantly higher iron contents ($P<0.05$). At Shoulder's level, higher iron levels ($P<0.05$) were found in females of

ML 12% (118.08 mg / g) and comparatively males of ML 8% (82.51 mg / g) and those of ML 10% (76.26) diets.

Table-4: Iron content (mg / gDM) of some muscle parts of cavy's meat according to graded level of CLM in the diet

Studied parts	Sexes	Dietary Cassava Leaf Meal levels			
		ML 0%	**ML 8%**	**ML 10%**	**ML 12%**
Loin	♂	$74.13 \pm 0.32^{b}_{B}$	$87.87 \pm 0.04^{a}_{A}$	$84.77 \pm 0.15^{c}_{A}$	$2 \pm 0.23^{d}_{B}$
	♀	$86.39 \pm 0.30^{b}_{A}$	$86.39 \pm 0.30^{b}_{B}$	$7.33 \pm 0.26^{c}_{B}$	$6 \pm 0.86^{a}_{A}$
Thigh	♂	$15.75 \pm 0.30^{b}_{B}$	$78.25 \pm 1.19^{a}_{A}$	$76.84 \pm 2.59^{a}_{A}$	$2 \pm 0.09^{c}_{B}$
	♀	$43.29 \pm 0.22^{b}_{A}$	$40.29 \pm 5.18^{a}_{B}$	$8.65 \pm 0.05^{d}_{B}$	$\pm 0.00^{c}_{A}$
Shoulder	♂	$56.68 \pm 0{,}06^{c}_{B}$	$82.51 \pm 0.50^{a}_{A}$	$76.26 \pm 0.77^{b}_{A}$	$8 \pm 0.44^{d}_{B}$
	♀	$89.30 \pm 0{,}18^{b}_{A}$	$66.79 \pm 0.48^{c}_{B}$	$6.11 \pm 0.40^{d}_{B}$	$08 \pm 0.64^{a}_{A}$

a, b, c, d: averages of the same line affected by the same letter are not significantly different at P>0.05; A, B: averages with the same letters in the same column are not statistically different (P>0.05);ML 0% (Control)= Diet with no M. esculenta leaf meal; ML 8%= Diet containing 8% M. esculenta leaf meal; ML 10%= Diet containing 10% M. esculenta leaf meal; ML 12%= Diet containing 12% M. esculenta leaf meal.

Effect of dietary Cassava leaf meal level on Sodium content of some muscle parts of guinea pigs' meat

Regardless of the studied parts, males registered significant (P<0.05) high sodium values than females except at Thigh (ML 10%) and Shoulder (ML 8% and ML 0%) levels (Table 5). Within sexes, whatever the cutting parts, males of the Control ration (143.38 mg / g) and those of ML 8% (127.58 mg / g) presented comparable but statistically higher (P<0.05) Loin sodium values as well as females (134.13 mg / g) of the same diet. The same tendency was observed in males at Thigh's level (150.3 mg / g) but females (148.01 mg / g) of ML 10% diet presented higher (P<0.05) sodium value. Males of ML 12% (161.95 mg / g) and females of ML 8% (147.21 mg / g) diets registered higher sodium contents (Shoulder).

Table-5: Sodium content (mg / gDM) of some muscle parts of cavy's meat according to graded level of CLM in the diet

Studied parts	Sexes	Dietary Cassava Leaf Meal levels			
		ML 0%	**ML 8%**	**ML 10%**	**ML 12%**
Loin	♂	$143.38 \pm 2.70^{a}_{A}$	$127.58 \pm 13.70^{a}_{A}$	$122.87 \pm 0.50^{b}_{A}$	$107.97 \pm 0.13^{c}_{A}$
	♀	$134.13 \pm 0.27^{a}_{B}$	$97.16 \pm 1.92^{b}_{B}$	$89.07 \pm 0.27^{c}_{B}$	$66.93 \pm 0.15^{d}_{B}$
Thigh	♂	$150.03 \pm 1.04^{a}_{A}$	$130.21 \pm 0.01^{b}_{A}$	$100.31 \pm 0.13^{c}_{B}$	$108.42 \pm 1.22^{d}_{A}$
	♀	$128.47 \pm 4.64^{a}_{B}$	$119.26 \pm 0.36^{b}_{B}$	$148.01 \pm 4.77^{c}_{A}$	$103.22 \pm 1.13^{d}_{A}$
Shoulder	♂	$68.77 \pm 0.30^{d}_{B}$	$139.18 \pm 1.26^{c}_{B}$	$141.84 \pm 0.31^{b}_{A}$	$161.95 \pm 0.00^{a}_{A}$
	♀	$144.63 \pm 0.04^{b}_{A}$	$147.21 \pm 1.24^{a}_{A}$	$139.68 \pm 2.18^{c}_{B}$	$95.21 \pm 0.23^{d}_{B}$

a, b, c, d: averages of the same line affected by the same letter are not significantly different at P>0.05; A, B: averages with the same letters in the same column are not statistically different (P>0.05);ML 0% (Control)= Diet with no M. esculenta leaf meal; ML 8%= Diet containing 8% M. esculenta leaf meal; ML 10%= Diet containing 10% M. esculenta leaf meal; ML 12%= Diet containing 12% M. esculenta leaf meal.

Effect of dietary Cassava leaf meal level on Potassium content of some muscle parts of guinea pigs' meat

Potassium content of the studied muscles varied significantly (P<0.05) regardless of the diets and between sexes (Table 6). Apart from the Thigh and Shoulder contents of this mineral in females of the ML 12% ration where greater (p<0.05) values were registered contrary to males, the contents were sometimes higher in males fed Control and ML 10% (Loin), ML 8% (Thigh) and ML 0% and ML 8% (Shoulder) diets, sometimes higher in females (ML 8%) (Loin), control and ML 10% (Thigh) and ML 10% (Shoulder). Concerning the different parts studied and the gender, identical values of males of Control (17.73 mg / g) and ML 12% (20.76 mg / g) diets and females (21.51 mg / g) of ML 12% diet (Loin), comparative contents of males of Control (16.72) and ML 8% (16.92 mg / g) diets and females (22.38 mg / g) of Control (Thigh) and males of Control (20.28 mg / g) and females of ML 12% (23.95 mg / g) diets (Shoulder) recorded all higher (P<0.05) potassium contents.

Table-6: Potassium content (mg / g DM) of some muscle parts of cavy's meat according to graded level of CLM in the diet

Studied parts	Sexes	Dietary Cassava Leaf Meal levels			
		ML 0%	ML 8%	ML 10%	ML 12%
Loin	♂	$17.73 \pm 0.21^{a}_{A}$	$13.12 \pm 0.49^{b}_{B}$	$4.60 \pm 0.12^{c}_{A}$	$20.76 \pm 0.03^{a}_{A}$
	♀	$14.82 \pm 2.21^{c}_{B}$	$18.06 \pm 0.56^{b}_{A}$	$3.03 \pm 0.10^{d}_{B}$	$21.51 \pm 0.14^{a}_{A}$
Thigh	♂	$16.72 \pm 0.05^{a}_{B}$	$16.92 \pm 4.64^{a}_{A}$	$4.17 \pm 0.06^{b}_{B}$	$3.89 \pm 0.07^{c}_{B}$
	♀	$22.38 \pm 0.74^{a}_{A}$	$7.02 \pm 0.19^{b}_{B}$	$5.88 \pm 0.05^{c}_{A}$	$4.04 \pm 0.09^{d}_{A}$
Shoulder	♂	$20.28 \pm 0.89^{a}_{A}$	$13.84 \pm 0.25^{b}_{A}$	$9.35 \pm 0.06^{d}_{B}$	$10.86 \pm 0.07^{c}_{B}$
	♀	$17.17 \pm 0.28^{b}_{B}$	$8.07 \pm 1.19^{d}_{B}$	$10.24 \pm 0.16^{c}_{A}$	$23.95 \pm 0.25^{a}_{A}$

a, b, c, d: averages of the same line affected by the same letter are not significantly different at P>0.05; A, B: averages with the same letters in the same column are not statistically different (P>0.05);ML 0% (Control)= Diet with no M. esculenta leaf meal; ML 8%= Diet containing 8% M. esculenta leaf meal; ML 10%= Diet containing 10% M. esculenta leaf meal; ML 12%= Diet containing 12% M. esculenta leaf meal.

Effect of dietary Cassava leaf meal level on Magnesium content of some muscle parts of guinea pigs' meat

As well as the potassium content, the studied muscles varied significantly (P<0.05) regardless of the diets and the gender (Table 7). Considering the studied parts, the mineral values were sometimes higher in males of Control (Loin), ML 8% and ML 12% (Thigh) and ML 8% diets (Shoulder) sometimes higher in females (ML 12%) (Loin) and Control, ML 10% and ML 12% (Shoulder). Considering the different parts studied and the gender, identical values in the Loin in males were recorded whatever the treatment. Females fed ML 12% (2.58 mg / g) diet presented higher (P<0.05) value. Greater values (P<0.05) were observed in males of ML 8% (2.43 mg / g) while no significant difference were reported in females (Thigh). Males (2.14 mg / g) and females (2.95 mg / g) of Control (Shoulder) recorded highest (P<0.05) magnesium contents.

Table-7: Magnesium content (mg / gDM) of some muscle parts of cavy's meat according to graded level of CLM in the diet

Studied parts	Sexes	Dietary Cassava Leaf Meal levels			
		ML 0%	ML 8%	ML 10%	ML 12%
Loin	♂	$2.03 \pm 0.01^{a}_{A}$	$1.91 \pm 0.49^{a}_{A}$	$2.04 \pm 0.06^{a}_{B}$	$1.83 \pm 0,03^{a}_{B}$
	♀	$1.92 \pm 0.03^{c}_{B}$	$1.66 \pm 0.04^{d}_{A}$	$2.06 \pm 0.05^{b}_{A}$	$2.58 \pm 0.07^{a}_{A}$
Thigh	♂	$1.82 \pm 0.02^{b}_{A}$	$2.43 \pm 0.19^{a}_{A}$	$1.90 \pm 0.07^{b}_{A}$	$2.16 \pm 0.03^{b}_{A}$
	♀	$1.90 \pm 0.09^{a}_{A}$	$1.54 \pm 0.19^{a}_{B}$	$1.81 \pm 0.03^{a}_{A}$	$1.66 \pm 0.02^{a}_{B}$
Shoulder	♂	$2.14 \pm 0.00^{a}_{B}$	$1.99 \pm 0.05^{b}_{A}$	$1.65 \pm 0.03^{c}_{B}$	$1.99 \pm 0.05^{b}_{B}$
	♀	$2.95 \pm 0.15^{a}_{A}$	$1.69 \pm 0.02^{d}_{B}$	$2.37 \pm 0.03^{c}_{A}$	$2.40 \pm 0.07^{b}_{A}$

a, b, c, d: averages of the same line affected by the same letter are not significantly different at P>0.05; A, B: averages with the same letters in the same column are not statistically different (P>0.05);ML 0% (Control)= Diet with no M. esculenta leaf meal; ML 8%= Diet containing 8% M. esculenta leaf meal; ML 10%= Diet containing 10% M. esculenta leaf meal; ML 12%= Diet containing 12% M. esculenta leaf meal.

Effect of dietary Cassava leaf meal level on Zinc content of some muscle parts of guinea pigs' meat

Regardless of the analyzed cutting parts, the gender and the different diets, significant variation was observed in Zinc content (Table 8). Apart from the rations ML 0% (all suited parts) and ML 8% (Loin) who recorded comparable values between sexes, Zinc contents were sometimes higher in males of ML 10% (Loin) and ML 12% (Shoulder) diets, sometimes higher in females (ML 12%) (Loin), ML 8%, ML 10% and ML 12% (Thigh) and in females of ML 12%) (Shoulder) diets. As for the different parts studied and the different sexes, whatever the diet, males (8.15 mg / g) and females (8.20 mg / g) of ML 12% diet presented higher Zinc (P<0.05) values in Loin part; Greater values (P<0.05) were observed in males of ML 10% (4.06 mg / g) and in females of ML 8% (8.27 mg / g) in Thigh part; males (9.27 mg / g) and females (10.38 mg / g) of ML 12% diet (Shoulder) recorded higher (P<0.05) Zinc contents.

Table-8: Zinc content (mg / gDM) of some muscle parts of cavy's meat according to graded level of CLM in the diet

Studied parts	Sexes	Dietary Cassava Leaf Meal levels			
		ML 0%	**ML 8%**	**ML 10%**	**ML 12%**
Loin	♂	$3.41 \pm 0.00^{d}_{A}$	$5.50 \pm 0.02^{c}_{A}$	$6{,}53 \pm 0{,}11^{b}_{A}$	$8.15 \pm 0.01^{a}_{B}$
	♀	$4.01 \pm 0.00^{b}_{A}$	$3.50 \pm 0.03^{c}_{A}$	$3{,}12 \pm 0{,}17^{d}_{B}$	$8.20 \pm 0.02^{a}_{A}$
Thigh	♂	$3.57 \pm 0.02^{b}_{A}$	$3.13 \pm 0.02^{d}_{B}$	$4.06 \pm 0.07^{a}_{B}$	$3.29 \pm 0.02^{c}_{B}$
	♀	$3.35 \pm 0.43^{d}_{A}$	$8.27 \pm 0.11^{a}_{A}$	$7.80 \pm 0.00^{c}_{A}$	$8.35 \pm 0.11^{b}_{A}$
Shoulder	♂	$3.28 \pm 0.02^{c}_{A}$	$2.93 \pm 0.03^{d}_{B}$	$7.22 \pm 0.26^{b}_{A}$	$9.27 \pm 0.04^{a}_{B}$
	♀	$3.64 \pm 0.22^{d}_{A}$	$6.81 \pm 0.00^{b}_{A}$	$6.01 \pm 0.08^{c}_{B}$	$10.38 \pm 0.11^{a}_{A}$

a, b, c, d: averages of the same line affected by the same letter are not significantly different at P>0.05; A, B: averages with the same letters in the same column are not statistically different (P>0.05);ML 0% (Control)= Diet with no M. esculenta leaf meal; ML 8%= Diet containing 8% M. esculenta leaf meal; ML 10%= Diet containing 10% M. esculenta leaf meal; ML 12%= Diet containing 12% M. esculenta leaf meal.

DISCUSSION

Ash content provides a measure of the total amount of minerals, including calcium, phosphorus, sodium, potassium, and magnesium [11]. Assessment of these minerals which are considered as macronutrients play vital roles in various human physiological processes and thus constitute an important diet component [12]. The ash content (3.90 to 5.79%) of this study were lower to values 2.5-7% reported by Zougou et al. [13] in guinea pigs' meat and higher than the values 0.8-1.8% in wild grasscutters's meat reported by Ella Nteme et al.[14]. The high ash content of this study indicates that guinea pig's meat is a significant source of mineral salts.

Minerals are essential for animal growth, and are involved in many physiological and biosynthetic processes in the body [15]. They function primarily as catalysts in enzyme systems, and are constituents of hundreds of proteins involved in intermediary metabolism, hormone secretion pathways, and immune defense systems [16, 17]. Calcium is required for bone ossification, regulation of skeletal and cardiac muscle activity, activation of several enzymes, transmission of nerve impulses, hormone mediation, membrane permeability, blood coagulation and maintenance of osmotic pressure [18, 19]. Considered as the most prevalent mineral in the body, Ca is required in the diet in a greater amount than any other mineral since it provides structural strength and support (bones and eggshell) and plays vital roles in many of the biochemical reactions in the body [18]. In general, Ca content varied significantly (P>0.05) between diets and cutting portions of muscles. Compared to other rations, guinea pigs receiving ML 12% diet recorded significantly higher (P<0.05) calcium values in the different meat parts studied. This confirms the high content of calcium in cassava leaves as reported by Udo and John [20] and their incorporation at 12% in the diet has improved calcium content of this diet. With an average content of 7.77 mg / gDM (0.90-14.64 mg / gDM), guinea pig meat is less rich in calcium than rabbit meat (16 mg / gDM) [21].

Iron is an essential constituent of the heme portion of hemoglobin. As the hemoglobin in aged erythrocytes is broken down, iron is recycled and fresh hemoglobin is synthesized [22]. Iron deficiency is a major problem in women's diets in the developing world, particularly among pregnant women, and especially in Africa [23, 12]. The iron content varied significantly (P>0.05) according to the diet, the sex and the different meat cutting parts. The shoulder part (46.78 mg / gDM: females of ML 12% diet) is the richest iron muscle and this is in agreement with observations made by Bauchart et al. [24] who noticed that on the basis of analyzes carried out on meat from French cattle breeds, the "Hample" is the richest muscle in iron (3.7 mg / gDM). The increase in iron content at shoulder's level reflects the richness of cassava leaves in iron [20]. Compared to meats of rabbit (1.4 mg / gDM) [21] and beef (2.3-3.7 mg / gDM) [24], guinea pig's meat is particularly rich in iron with an average content of 24.30 mg / gDM (1.81-46.78 mg / gDM).

Sodium is one of the ions that maintain the hydromineral balance and determine the electrochemical gradient of cell membranes. It is the most represented cation in the extracellular compartment and the lowest represented cation in the intracellular compartment. Sodium is supplied by the diet [22]. In general, the incorporation of CLM in the diet significantly reduced (P<0.05) the sodium content of the different parts studied suggesting that supplementation with CLM favors a decrease of sodium in certain tissues. The significant variations (P>0.05) of sodium contents between the two sexes were also observed by Ella Nteme et al. [14]. The sodium value 33.47 mg / gDM (18.60-48.34 mg / gDM) obtained in this study is lower than the values 49 and 70 mg / gDM reported in rabbit [21] and poultry [25] meats respectively.

In general, regardless of the diet and cutting portions of muscles, the potassium content differs significantly (P>0.05) between sexes (3.30 mg / gDM (males) and 5.12 mg / gDM (females). The same observation was made by Ella Nteme et al. [14].

Magnesium is important, like calcium, in the transmission of nerve impulses and muscle contraction. Without it, phosphorus could not be well used by the body when it is involved in reactions that produce energy, because it is an activator of many ATPases. It is also active at the cellular level and has a role to play in protein synthesis [22]. After potassium, magnesium is the predominant intracellular cation. Magnesium is needed for more than 300 biochemical reactions in the body. It helps to maintain normal muscle and nerve function, keeps heart rhythm steady, supports a healthy immune blood and regulates blood sugar levels [26]. Due to its indispensable role in metabolism, magnesium deficiencies cause serious disorders [27]. Magnesium all together with zinc and selenium prevent cardiomyopathy, muscle degeneration, growth retardation, impaired spermatogenesis, immune- logic dysfunction and bleeding disorder [28]. The overall magnesium content varies significantly (P<0.05) between and within sexes whatever the considered diets. The poverty of guinea pigs' meat in magnesium imposes the complementation in this element by other alimentary sources. Compared to rabbit meat with an average grade of 24 mg / gDM [21], guinea pigs' meat is particularly poor in magnesium with an average content of 0.52 mg / gDM (0.09-0.95 mg/100 g).

The overall zinc content of animals of the supplemented groups was significantly (P<0.05) higher to that of Control animals irrespective of sex and considered part. This means that cassava leaves increase the zinc content of feeds. Like iron, zinc of meat is better assimilated by the body than that supplied by other foods [27]. The average zinc content 18.24 mg / gDM (13.58-22.89 mg / gDM) obtained in this study is higher than that of the bib (6.8 mg / gDM) which is the most zinc-rich part of the various bovine muscles [24] as well as that reported by Combes [21] in rabbit meat (0.69 mg

CONCLUSION

CLM improved mineral contents of guinea pigs' meat up to 12% incorporation whatever the studied parts. Female guinea pigs presented higher mineral proportions than males. Compare to other slaughter meats, guinea pigs' meat presents nutritional characteristics close to those of rabbit.

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