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Research article

Effect of Fertilization Level on Chemical Composition, intake and Digestibility *in vivo* of *Moringa oleifera* Cutting at 6 Months in Guinea Pig

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Abstract

In order to contribute to a better use of *Moringa oleifera* in guinea pigs diet, tests were conducted at the LAPRONAN of FASA of the University of Dschang between May 2017 and April 2018. The study focused on the chemical composition and *in vivo* digestibility of *Moringa oleifera* in guinea pig (*Caviaporcellus*) fertilized at different levels with chicken droppings. *Moringa oleifera* used for this trial was fertilized at doses of 0, 50, 100, 150, 200 and 250 kg N/ha and harvested when the plants were 6 months old on the experimental path. The harvested *M. oleifera* was dried and then crushed with a hand grater. Fertilization levels significantly influenced the chemical composition of *Moringa oleifera*. Protein content increased with fertilization level at 6 months (16.67, 21.63, 25.40, 29.11, 32.99 and 32.69% DM respectively at doses of 0, 50, 100, 150, 200 and 250 kg N/ha). Similarly, 60 adult guinea pigs of English breed, including 30 males and 30 females, were purchased from stock farmers in the town of Dschang and the surrounding area. These animals were 5 months old and had an average weight of 450 ± 50 g. After 2 weeks of acclimatization in the farm rearing lodges and 10 days of adaptation in the individual digestibility cages, the animals were randomly divided into 2 groups of 6 batches having 5 animals in each batch. Each group was subjected to 6 rations of *Moringa oleifera* fertilized at different doses with chicken manure (0, 50, 100, 150, 200 and 250 kg N/ha) and 200g Trypsacumlaxum as staple food. During the digestibility test which lasted 7 days, each ration was repeated on 10 guinea pigs; 5 males and 5 females. The main results showed that Crude protein increase with fertilization levels while MD, OM, Nitrogen Free Extract (NFE) and sugar decreased with fertilization levels.Ingestion of *M. oleifera* and nutrients in animals was not significantly different (P>0.05) with fertilization levels. Regardless of fertilization level, digestibility of all nutrients was not significantly different. This study showed that female has resulted in the highest fiber digestibility of *Moringa oleifera* at 6 months.

Key words: Caecal flora; Chemical composition, Guinea pigs, in vivo digestibility; *Moringa oleifera*.

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Introduction

Food is the main factor limiting the expression of production potential tropical animals [1,2]. According to animals ingest food to meet their energy and nutrients [3]. Thus, the more food is able to release its nutrients, the better it allows achieving good animal performance at a lower cost as a result of the reduction in consumption. In addition, according to food consumption entirely of plant origin by herbivores slows digestion, and consequently allows a good absorption of food and a more favorable balance of nutrients by calories due to good cell growth management [4]. Thus, improving the productivity of monogastric herbivores like the guinea pig can be between others, by improving their diet and, above all, by making available to them fodder rich in protein. Among the alternative sources of high-protein forage in Cameroon, they are the plant of *Moringa oleifera* which, in addition to minerals contains vitamins in quantity important. The leaves of *Moringa oleifera* are an excellent source of protein whose grades range from 19-35% DM [5]. The amino acid content of the *M. ofeifera* leaf meal is not significantly different to that of soybean meal with a digestibility of 79.2% [6-8]. Its energy content metabolizable range from 2273-2978 kcal/Kg DM [7]. The leaves of *M. oleifera* contain a very high concentration of vitamins, A (6.8 mg), B (423 mg) and C (220 mg); in minerals (Iron, Calcium, Zinc, Selenium) and are rich in B-Carotene [9,10]. Despite this good protein content, the use of this plant in animal feed is not very popular. In addition, its chemical composition and digestibility vary according to geographical areas, fertilizer type, fertilization levels and age of mowing. The work of showed that *Moringa oleifera* fertilized at different doses urea (0, 30, 60, 90 and 120 kg/ha) affected their chemical composition [11]. Likewise, apparent digestive utilization coefficient of nutrients from *M. ofeifera* fertilized to poultry manure and cutting at 90 days was not significantly different in rabbits. These coefficients of use apparent digestive increased with the inclusion level of *M. ofeifera* (5 to 20%) [12]. On the other hand, the work of in Guatemala on degradation rumen of the dry matter and fibers of *Cynodondactylon* fertilized with different levels of nitrogen and harvested at two different dates, have shown that nitrogen fertilization improved the effective degradation of the dry matter and NDF for every 100 kg N/ha [13]. If the work was done in Cameroon on the fertilization of *Moringa oleifera*, none have yet been realized on the effect of different levels of fertilization and age of cutting on *Moringa oleifera* digestibility [14]. It is therefore to overcome this gap that the present work was initiated with the aim of evaluating the effect of fertilization level on the chemical composition, ingestion and digestibility of *Moringa oleifera* cutting at 6month in the guinea pig.

Material and Methods

Experimental site

Our study was conducted at the Animal Production and Nutrition Research Unit from the University of Dschang. Dschang is located at the 15th degree of the eastern meridian, at latitude 5° 26 27 "North and longitude 10° 26 29" East. The climate of the region is Equatorial type of Cameroon modified by altitude. Outside of commercial activities, the area is strongly agro-pastoral. The rainfall varies between 1500 and 2000 mm per year. The average annual temperature is around 20° C, the annual total insolation at 1800 hours and, average relative humidity ranging between 40 and 97%. The rainy season corresponds to the cultivation period from mid-March to mid-November. February is generally the hottest, and the coldest months of July and August. Soil, ferralitic type, is well drained and slightly acidic (with a pH of about 4.8). The lands, brown and derived from basaltic rocks have a very heavy (clay) texture and a quite a marked deficiency in potash. Natural vegetation carries species whose presence testifies to it's formerly forest nature [14].

Precipitations

During the trial period (May 2017 to February 2018), rainfall data were collected daily at 8:00 am in the experimental site. The highest (431.6 mm) precipitation was obtained in August. It is also the month who it rains most in the West Cameroon.

Soil analysis

An analysis of the chemical and textural composition of the soil was made before the preparation of the soil. The sample was taken from the site in the horizon 0 to 20cm deep. The chemical analysis of the soil (Table 1) was carried out at the Laboratory of Soil Analysis and Environmental Chemistry (LABSAEC) of the University of Dschang following the method described by Pauwel and et al. (1992).

Description, origin and chemical composition of the fertilizer source

Poultry manure used as a source of nitrogen was obtained from a laying hen in the Menoua division (Dschang). It was analyzed (Table 2) before it's spreading on plots.

Animal material

To carry out this test, 60 guinea pigs of English race (30 males and 30 females) aged approximately 5 months and average weight 450 ± 50 g were used for the evaluation of the intake and the digestibility of *Moringa oleifera*. These animals were placed in cages 0.105 m^3 screens (0.76 m x 0.46 m x 0.3 m), each equipped with a 100g plastic feeder and 100 ml plastic waterer. The complete cleaning of the building followed by the disinfection of the cages was carried out with the water of bleach at a dose of 125 ml per 15 liters of water before the animals are introduced. The anti-stress (Amine Total) was given in the drinking water and given to the animals as soon as they arrived in the livestock building. To avoid a possible vitamin C deficiency, one tablet 240 mg of vitamin C was diluted in 1.5l of drinking water and animals for the duration of the test.

Parameters	Values
Depth	0-20 cm
Texture (%)	
Sand	62
Total silt	10
Clay	28
Textural Class	L
Ground reaction	
Water-pH	4.8
KCL-pH	4
Organic matter	
CO (%)	6.6
MO (%)	11.35
Total N (g/kg)	2.7
C/N	22
Exchangeable cations (meq/100g)	
Calcium	11
Magnésium	3
Potassium	0.7
Sodium	0.08
Sum of Bases (SB)	14.78
Cation exchange capacity	
CEC at pH7	46
Saturation in bases (%)	32
Assimilated phosphorus	
Phosphorus Bray II	21

Table 1: Physico-chemical characteristics of the soil.

Parameters	Values
Carbon (%)	31
Organicmatter (%)	53.1
Potassium (ppm)	3382
Sodium (ppm)	617
Phosphorus (ppm)	911
Nitrogen (g/kg)	24

Table 2: Chemical composition of poultry (laying hens) manure.

Plant material

The plant material consisted of *Moringa oleifera* leaves fertilized to different doses (0, 50, 100, 150, 200, 250 kg N / ha). Theses 6 levels of nitrogen were applied one month after sowing. The leaves of *Moringa oleifera* were harvested at 6 months of age after fertilization. The harvested leaves preserved in plastic were dried in the shadeat room temperature, crushed and stored for manufacture of granules.

For the staple food, 200g of Trypsacumlaxum was served every day per animal. This grass has been harvested every day on the farm and pre-faded before being served to animals the next day.

Manufacture of *Moringa oleifera*

The harvested and dried leaves were crushed using a grainy manual and served to animals in granular form (Photo 1). Animals were distributed in a completely randomized device. The daily ration served to each animal has been constituted as follows:

(A) (B)

Photo 1: (A) Dried *Moringa* leaves; (B) Granulated *Moringa* leaves.

R0=200g fresh *T.laxum* + 3.46g dry *M. oleifera* leaves produced with 0kg.N/ha/animal/day;

R50=200g fresh *T.laxum* + 3.46g dry *M. oleifera* leaves produced at 50kg.N/ha/animal/day;

R100=200g fresh *T. laxum* + 3.46g dry *M. oleifera* leaves produced at 100 kg.N/ha/Animal/day;

R150=200g fresh *T. laxum* + 3.46g dry *M. oleifera* leaves produced at 150 kg.N/ha/Animal/day;

R200=200g fresh *T. laxum* + 3.46g dry *M. oleifera* leaves produced at 200 kg.N/ha/Animal/day;

R250=200g fresh T. laxum + 3.46g dry M. oleifera leaves produced at 250 kg.N/ha/Animal/day;

Evaluation of the chemical composition of *Moringa oleifera*

A 100 g sample of each treatment fertilized at different doses (0, 50, 100, 150, 200, 250 kg N/ha) was removed, oven-dried to constant weight, crushed and preserved in plastic bags for the evaluation of their chemical composition. The Dry Matter Content (DM), Organic Matter (OM), ash, Crude Protein (CP), fat and Crude Fiber (CF) were determined according to the methods described by [15]. The Nitrogen Free Extract (NFE) and sugar were determined by the following equation 1 and equation 2 according to AOAC (2000):

- **Equation 1:**NFE = DM-(CP+CF+Ash+Fat)
- **Equation 2:**Sugar = OM-(Fat+CP)

Evaluation of ingestion of *Moringa oleifera*

For each treatment, 5 guinea pigs were randomly individual cages, and the food was served only once each day between 8 and 9 am. For the evaluation of the intake, the quantities of food served were noted and the refusals were collected daily and weighed before any new distribution.

Evaluation of the digestibility of *Moringa oleifera*

The digestibility test was preceded by a period of adaptation of the animals to the cage of digestibility and granular *Moringa*, which lasted 10 days. During the digestibility period proper that lasted 7 days, each morning before the distribution of the food, the feces were collected, weighed and a representative sample of approximately 100g was then taken and dried at 60° C to constant weight in the laboratory in a ventilated oven. Subsequently, dried feces were milled using a homemade tri-hammer mill, and kept in plastic bags for evaluation of their dry Matter Content (DM), Organic Matter (OM), Crude Protein (CP) and Crude Fiber (CF) according to method described by [15]. The digestibility of the Dry Matter, Organic Matter, Crude Protein and crude fiber were determined according to the formula of Roberge G et al Toutain B (1999).

Statistical analyzes

Chemical composition of *Moringa oleifera* were subjected to one wayanalysis of variance following General Linear Models (the doses of chicken droppings used to fertilize the *M. oleifera*). Food intake and nutrient digestibility were subjected to a two-way analysis of variance (doses of chicken droppings used to fertilize *M. oleifera* and sex) according to the Model Linear General (MLG) with the statistical software SPSS 20.0. When the differences significant existed between the treatments, the separation of the averages was done by the test from Dunkan at 5% significance level [16].

Results and Discussion

Effect of fertilization level on the chemical composition of *Moringa oleifera* cutting at 6 months

The levels of DM and OM of *Moringa oleifera* collected from unfertilized plots and fertilized at 50, 100, 150, and 200 kg N/ha were not significantly different ($p > 0.05$) and significantly ($p < 0.05$) higher than those of the plots fertilized at the rate of 250 kg.N/ha (Table 1). These results are consistent with those of [17-19]. According to, nitrogen fertilization decreases the dry matter content and soluble carbohydrate contents, the total nitrogen content, especially nitric increases, which has the effect of not changing the nutritional value of the feed [18,19]. The results obtained differ from those obtained by who found that the use of increasing amounts of mineral nitrogen on pure grass prairies generally causes a decrease in the dry matter content of plants [20,21]. This difference could be explained by the forage species and/or soil type.

The CP content had significantly ($p < 0.05$) increased with fertilization up to 200 kg N/ha. These results are superior to those obtained by when he fertilized *M. oleifera* on cow bursaries and similar to those obtained by when they applied the increasing doses of urea and chicken droppings on the chemical composition of *M. oleifera* respectively [11,19,22,23]. Increasing the crude protein content of *M. oleifera* under the effect of nitrogen fertilization is accompanied by a decrease in protein nitrogen in favor of non-protein nitrogen. In fact, the entry of nitrogen into the plant, which takes place essentially in the form of nitrate, increases rapidly with fertilization, which leads in a first step to the accumulation of no-protein nitrogen, followed by nitrate for high fertilization levels [2,19,24].

The CP content of plots fertilized at 200 and 250 kg N/ha, however, remained not significantly different. The ash and fat contents of *Moringa oleifera* have varied with fertilization levels. The highest values for ash (8.33% DM) and fat (5.01% DM) were obtained with plants fertilized at 250 kg N/ha and unfertilized plants respectively. NFE and sugar of *Moringa oleifera* decreased with fertilization levels. Indeed, the results presented show significant variations whose nitrogen intensification is not the least cause. A decrease of 10 to 20% in the non-nitrogenous extract content of the forage is recorded as soon as one goes from a fertilization of 30 units to 90-120 units of nitrogen. It thus appears that the fodder obtained under these intensification conditions are less rich in non-nitrogen extractives, which does not imply that they are less energetic, because at the same time they are richer in nitrogenous matter. Likewise, the increase in nitrogen content following nitrogen fertilization is often associated with a decrease in the level of soluble carbohydrates (sugars), which are sometimes halved. This significant decrease results from the fact that the development of soluble carbohydrates, limited by leaf area and photosynthesis, is not increased by nitrogen fertilization, contrary to their use.Fertilization had no significant effect ($p > 0.05$) on the CF content of *Moringa oleifera* [25].

Effect of fertilization level on ingestion of *Moringa oleifera* cutting at 6 months in guinea pigs

The total daily intake of M. *oleifera* and *T. laxum* did not significantly vary with fertilization. It was the same for the ingestion of dry matter, organic matter and crude protein. However, the highest values of these ingestions were obtained with *M. oleifera* fertilized at 200 kg N/ha. These results could be explained by the fact that *M. oleifera* fertilized at 200 kg N/ha would therefore have provided good quality proteins which favored the ingestion of nutrients. Similarly, the highest gross cellulose intake was obtained with R200 diets. *M. oleifera* contained in this ration is the one with the highest protein content (32.99% DM). Indeed, according to many authors, protein supplements promote a sufficient proliferation of intestinal microorganisms involved in digestion in guinea pigs [19,26-28,]. This would promote the increase of food fermentation and transit with consequent increase in food intake (Table 3).

Comparative effect of fertilization levels on ingested *Moringa oleifera* at 6 months between male and female

Food intake was not significantly different ($P > 0.05$) in animals of both sexes for R0, R200 and R250 diets (Figure 1). In contrast, males significantly ($P < 0.05$) better ingested DM, OM, CP and CF for R50, R100 and R150 diets. This could be explained among other things by the fact that, in general, in adulthood, males have a high weight compared to that of females and are therefore more vigorous. They may therefore be able to eat better because the food intake is very often correlated with the weight of the animal. According to many authors, males ingest better than females in guinea pigs [19,26,27]. The best DM intake recorded in males in this study (30.93g.DM/animal/d) is greater than the 21.32g.DM/animal/d observed by in guinea pigs males supplemented with cotton cake but lower than the values (58.12 g.DM/animal/d) obtained by supplementing with *Tithoniadiversifolia* in guinea pigs of the same sex fed *P. purpureum*. These differences would be related to the composition of the experimental foods used [26,29].

Effect of fertilization level on digestibility of Moringa oleifera nutrients cutting at 6 months in guinea pigs

The fertilization of Moringa oleifera with chicken droppings had no effect ($p > 0.05$) on the digestibility of dry matter, organic matter, crude protein and crude fiber both at males, females than for all sexes combined regardless of ration (Table 4 and Table 5).

Ingestions (g DM/Day/animal)		**Traitments**						**SEM**	**P**
		R0	R50	R100	R150	R200	R250		
Experimental diet									
***M. oleifera* (DM)**	♂(5)	22.13^a	22.53^a	30.93^a	29.73^a	21.93^a	24.53^a	1.43	0.25
	♀(5)	21.73^b	12.60^a	13.26^a	19.46a^b	22.40^b	23.06^b	1.34	0.03
	♂♀(10)	21.93^a	17.56^a	22.09^a	24.59^a	22.16^a	23.79^a	1.38	0.14
***T. laxum* (DM)**	♂(5)	140.00^a	134.73^a	143.00^a	144.26^a	148.60^a	140.26^a	3.27	0.92
	♀(5)	137.93^a	138.80^a	119.06^a	128.46^a	133.40^a	127.26^a	3.96	0.77
	♂♀(10)	138.96^a	136.76^a	131.03^a	136.36^a	141.00^a	133.76^a	3.62	0.84
Total Nutrients									
Dry Matter	♂(5)	148.67^a	144.27^a	159.13^a	159.38^a	156.45^a	149.99^a	3.62	0.83
	♀(5)	146.41^a	139.29^a	121.58^a	135.76^a	142.82^a	136.76^a	3.84	0.58
	♂♀(10)	147.54^a	141.78^a	140.35^a	147.57^a	149.63^a	143.37^a	3.73	0.71
Organic Matter	♂(5)	128.31^a	124.44^a	136.68^a	137.17^a	134.92^a	127.99^a	3.1	0.83
	♀(5)	126.36^a	120.71^a	105.13^a	117.21^a	123.00^a	116.62^a	3.33	0.6
	♂♀(10)	127.33^a	122.57^a	120.90^a	127.19^a	128.96^a	122.30^a	3.21	0.71
Crude Protein	♂(5)	21.19^a	19.97^a	24.27^a	23.63^a	21.88^a	21.12^a	0.61	0.34
	♀(5)	20.87^a	18.70^a	17.26^a	19.51^a	20.17^a	19.31^a	0.52	0.5
	♂♀(10)	21.03^a	19.33^a	20.76^a	21.57^a	21.02^a	20.21^a	0.57	0.42
Crude Fiber	♂(5)	58.27^a	57.37^a	61.28^a	62.41^a	62.12^a	59.38^a	1.38	0.9
	♀(5)	57.39^a	56.20^a	48.23^a	53.79^a	56.46^a	54.08^a	0.55	0.64
	♂♀(10)	57.83^a	56.78^a	54.75^a	58.10^a	59.29^a	56.73^a	0.96	0.77

Table 3: Ingestion of Moringa oleifera fertilized at different levels of chicken droppings and mowed at 6 months.

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: significance level; ( ) : effective; ♂: male; ♀: female; ♂♀: male and female combined.

Fertilization Level (kg N/ha)	Chemical Composition (%DM)							
	DM	OM	Ash	CP	CF	Fat	NFE	Sugar
0	87.44^{b}	70.11^{b}	6.36^{a}	16.67^{a}	26.08^{a}	5.01^{c}	33.29^{d}	28.33^{c}
50	87.97^{b}	70.52^{b}	6.87^{bc}	21.63^{b}	31.00^{a}	2.56^{b}	25.89^{c}	27.72^{c}
100	87.43^{b}	69.40^{b}	7.05^{bc}	25.40^{c}	25.57^{a}	1.09^{a}	28.30^{c}	26.83^{c}
150	87.85^{b}	70.45^{b}	6.74^{ab}	29.11^{d}	28.94^{a}	2.39^{b}	20.66^{b}	24.92^{b}
200	87.51^{b}	69.30^{b}	7.29^{c}	32.99^{e}	29.30^{a}	1.11^{a}	16.75^{b}	22.56^{a}
250	83.28^{a}	61.31^{a}	8.33^{d}	32.69^{e}	29.65^{a}	1.77^{ab}	10.83^{a}	20.95^{a}
SEM	0.404	0.8	0.157	1.44	0.673	0.333	1.88	0.684
p	0	0	0	0	0.106	0	0	0

Table : Effect of fertilization level on the chemical composition of the whole Moringa oleifera plant mown at 6 months.

a, b, c, d, e: Mean with the same letters on the same column are not significantly different at the 5% level; SEM: Standard Error of the Mean; P: significance level; DM: dry matter; OM: organic matter; CP: crude protein; CF: crude fiber; ENA: Extractive non-nitrogenous.

Digestibility (%)		Diets						SEM	P
		R_{0}	R_{50}	R_{100}	R_{150}	R_{200}	R_{250}		
DM	♂	90.55^{a}	87.51^{a}	83.49^{a}	82.35^{a}	84.47^{a}	88.81^{a}	0.97	0.06
	♀	88.75^{a}	90.69^{a}	91.49^{a}	91.70^{a}	86.84^{a}	92.03^{a}	0.64	0.1
	♂♀	89.65^{a}	89.10^{a}	87.49^{a}	87.02^{a}	85.65^{a}	90.42^{a}	0.8	0.08
OM	♂	90.37^{a}	87.29^{a}	84.25^{a}	83.34^{a}	86.10^{a}	90.65^{a}	0.91	0.06
	♀	88.35^{a}	90.65^{a}	91.94^{a}	92.85^{a}	88.04^{a}	93.28^{a}	0.7	0.09
	♂♀	89.36^{a}	88.97^{a}	88.09^{a}	88.09^{a}	87.07^{a}	91.96^{a}	0.8	0.08
CP	♂	93.22^{a}	91.25^{a}	88.30^{a}	86.93^{a}	87.97^{a}	92.39^{a}	0.79	0.06
	♀	91.84^{a}	94.45^{a}	94.54^{a}	92.95^{a}	90.90^{a}	94.08^{a}	0.54	0.26
	♂♀	92.53^{a}	92.85^{a}	91.42^{a}	89.94^{a}	89.43^{a}	93.23^{a}	0.66	0.16
CF	♂	91.73^{a}	88.82^{a}	86.53^{a}	86.36^{a}	89.73^{a}	91.76^{a}	0.74	0.09
	♀	97.30^{a}	98.33^{a}	97.88^{a}	97.85^{a}	96.52^{a}	97.96^{a}	0.19	0.06
	♂♀	94.51^{a}	93.57^{a}	92.20^{a}	92.10^{a}	93.12^{a}	94.86^{a}	0.46	0.07

Table 5: Digestibility of nutrients in guinea pigs fed on M. oleifera cutting at 6 months.

a, b: Averages with the same letters on the same line are not significantly different at the 5% level; SEM: Standard Error of Mean; P: significance level; R: Rations; DM: Dry matter; OM: Organic matter; CP: Crude protein; CF: Crude fiber.

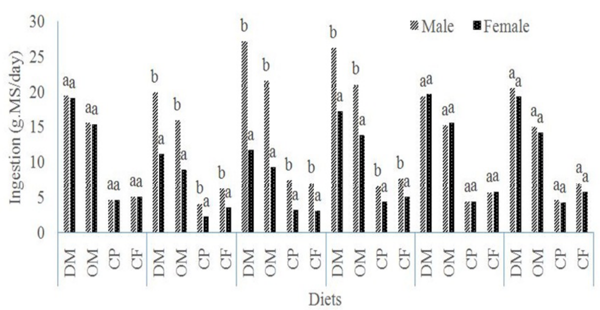

Figure 1: Comparative Effect of Fertilization Levels on Ingested *Moringa oleifera* at 6 Months between Male and Female.

a, b: Bars with the same letters for the same ration are not significantly different at the 5% level; DM: Dry matter; OM: Organic matter; CP: Crude protein; CF: Crude fiber.

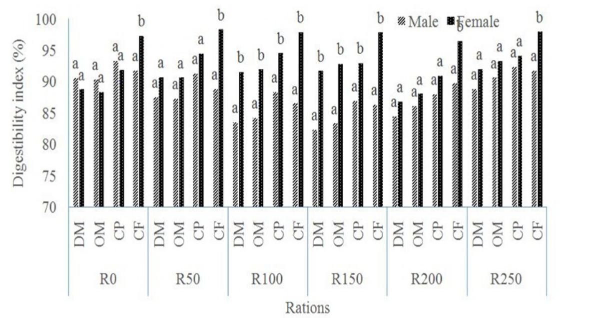

Figure 2: Comparative digestibility of DM, OM, CP, and CF between males and females fed Moringa oleifera cutting at 6 months based on dietary diets.

a, b: Bars with the same letters for the same ration are not significantly different at the 5% level; Di: Digestibility; DM: Dry matter; OM: Organic matter; CP: Crude protein; CF: Crude fiber

comparative effect of fertility levels on *Moringa Oleifera* digestibility cutting at 6 months between male and female

Females had significantly (P <0.05) better digested than males DM, OM, CP and CF with R100 and R150 diets (Figure 2). Similarly, the female digestibility of CF was significantly (P <0.05) higher than the males for the R0, R50, R200 and R250 diets. These results are contradictory to those observed by [27,28]. This can be explained by the fact that digestive use is more affected by food than by sex. In fact, according to [30], food itself is the factor that has the most net influence on digestibility. Digestibility will therefore be affected by the structure and physical state of the ration, that mean the form in which the food is presented to the animal. These factors condition the action of the microbial flora and digestive juices. The rations used in this test were in the form of granules, which favored both ingestion and digestive use.

Conclusion

At the end of this study, it appears that nitrogen fertilization influenced the chemical composition of M. oleifera. Fertilization increased with protein content, however, the dry matter, organic matter, NFE and sugar content decreased with the level of fertilization. Fertilization did not affect the intake and the digestibility index of the nutrients. The same thing was observed with the sex.

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