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Digestibility of *Moringa Oleifera* Lam. Leaves Meal Based Diet by *Oryctolagus Cuniculus*

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Abstract

The use of local feed resources in animal diet can contribute to improve the sustainability of rabbit production. The aim of this work was to evaluate the digestibility of the *Moringa oleifera* (Lam) leaf meal based diet in rabbits. In this study seven groups of 9 rabbits, aged 40 to 45 days, were fed with 7 different feeds: two commercial feed (ProvA and ProvB), four dried *M. oleifera* leaf (ML) based diet (Mor10: 10% ML, Mor20: 20% FL, Mor30: 30% FL, and Mor40: 40% ML) and a control diet (CTL). Organic matter digestibility of commercial feed was similar to that of the control feed (P>0.05). The dietary digestibility coefficients Mor10 (62.92%), Mor20 (61.62%) and Mor40 (62.75%) were similar (P>0.05) and lower (P<0.05) than that of Mor30 (69.12%). The highest protein digestibility coefficients were obtained with CTL feed (73.33%), followed by Mor40 (69.83%), Mor10 (69.12%) and Mor30 (68.91%). No difference was observed between the digestive energy utilization coefficients of the feed tested (P>0.05). Weight gains, energy and protein efficiency ratios of feed were similar (P>0.05). The good protein digestibility recorded with the *M. oleifera* (Lam) leaf feed show that these leaves can be used up to 40% in rabbit feed.

Keywords *Moringa oleifera*; Digestibility; Organic matter; Feed efficiency; *Oryctolagus cuniculis*

Introduction

Like other animal species, the profitability of rabbit production is highly dependent on the quality and cost of feed. In fact, feed cost represent more than 70% of the animal production [1]. In Benin, this situation is emphasized by the fluctuating and high costs of imported feed such as wheat bran and fishmeal. Moreover, the low diversity of feedstuffs and feed competition between humans and animals and between animal species of livestock for certain feed ingredients (corn, corn bran and wheat, palm kernel cake, etc.) also are a problem for the profitability of the rabbit production [2]. Alternative feed resources to conventional and locally available feeds are identified [3-5]. Rabbit is able to digest and process forages into meat [6]. As a result, the use of dehydrated leaves as feedstuffs for the production of whole feed could help reduce feed production costs. Among leaves available in Benin, *M. oleifera* leaves can be used in the rabbit diet.

M. oleifera is an Asian originates plant witch cultivation and uses are promoted worldwide because of its high nutritional and pharmaceutical potential [7,8]. All parts of this plant (root, bark, flowers, fruits, and leaves) can be used for both human and animal wellbeing. The use of moringa leaves in animal feed is now encouraged because of their high protein, vitamins and minerals contents [9,10]. Thus, the use of moringa leaves in the rabbit's diet could help to increase the profitability of rabbit production and reduce the dependence of rabbit production on expensive conventional feedstuffs. However, the inclusion of these leaves in rabbit feed and as ingredient in the production of rabbit diet supplement can be good a good path to be investigated. The aim of this work was to evaluate the acceptability and digestibility of the *M. oleifera* (Lam) leaf meal based diet in rabbits.

Material and Methods

Experimental design

The study was conducted at the Experimental Farm of the Technical Center for Poultry and Livestock Production of Small Animals located at Abomey-Calavi (Southern Benin) with sub-equatorial climate. The trial involved 63 young rabbits of both sexes aged between 40 and 45 days at the onset of the experiment. The animals were grouped into seven lots of nine animals (771 ± 1 g). A digestibility trap was used to collect the droppings under each cage **(Figure 1)**. The data collection phase (7 days) was preceded by an adaptation phase (4 days) and a feed transition phase (10 days).

Figure 1: Cage and digestibility tray.

Figure 2: Tested feed after granulation.

Two groups of animals were fed with two commercial feeds (ProvA and ProvB), four groups were fed on diet containing moringa leaves incorporated at 10% (Mor10), 20% (Mor20), 30% (Mor30) and 40% (Mor40). Animals in the control group consumed the leaf-free control diet (CTL: 0% moringa leaves).

The diet formula for moringa feed and the control feed were derived from the recommendations of [11,12]. The chemical composition of the feed ingredients and the moringa leaves was calculated according to the previous study [13,14]. The formulated feed was produced as granules **(Figure 2)**.

Therapeutic care

The test animals were dewormed with Alfamizol® (Levamisol, 1 g/1.5 L per day) and Anticox® (Sulfamidine, 4 g/20 L per day for 3 days) to reduce the effect of potential pathogens. In addition, a vitamin treatment (5 g/20 L per day for 3 days) based on AMIN'TOTAL® was administered as anti-stress during the adaptation phase.

Data collection and chemical analysis

At the beginning of each phase (accommodation, feed transition, and data collection), the animals were weighed after a 24 hour of food fasting. The quantities of distributed feed, feed residue and the excrement per cage were collected daily between 7-8 am. The collected samples were then dehydrated in a ventilated oven at 60°C for 48 hours before being ground and vacuum packed in plastic packaging.

The chemical analyzes of the moringa leaves **(Table 1)**, the feed tested **(Table 2 and 3)** and the droppings were carried out by the laboratory.

Table 1: Chemical composition of moringa leaves.

DM	Ash	OM	Nitrogenous	Fat	NDF	ADF
92.00%	8.20%	91.84%	36.20%	5.58%	17.28%	13.20%
DM: Dry matter, OM: Organic matter, NDF: Neutral detergent fiber, ADF: Acid detergent fiber						

Table 2: Centesimal compositions (g) of experimented feed for 100 g of food.

	CTL	ProvA	ProvB	Mor10	Mor20	Mor30	Mor40
Cassava	0	-	-	3	3	3	3
Corn	4	-	-	10	14.5	10	10
Cotton cake	9	-	-	10	9	10	8
Palm kernel cake	20	-	-	20	20	23	13

Soybean meal	2	-	-	0	0	0	0
Bran	11	-	-	0	0	0	0
Corn bran	25.5	-	-	25	20	21.5	23.5
Rice bran	5	-	-	5.5	0	0	0
Malt	21	-	-	14	11	0	0
Oyster shell	1	-	-	1	1	1	1
Moringa leaves	0	-	-	10	20	30	40
Lysine	0.5	-	-	0.5	0.5	0.5	0.5
Premix	0.5	-	-	0.5	0.5	0.5	0.5
Salt	0.5	-	-	0.5	0.5	0.5	0.5

ProvA and ProvB: commercial feeds, Mor20: 20% of moringa leaves, Mor30: 30 % of moringa leaves and Mor40: 40 % of moringa leaves, CTL: control food.

Table 3: Chemical compositions of experimented feed.

	CTL	ProvA	ProvB	Mor10	Mor20	Mor30	Mor40
DM (% DM)	90.9	91.5	91.2	90.5	91.3	91.4	85.4
OM	93	90	88.9	90.5	92.6	91.7	92.5
Nitrogen	22.7	17.3	20.9	21.1	20.9	22.5	25.9
NDF	42.6	40.5	41.9	36.3	34.5	34.2	37.8
ADF	18	20.5	25	15.5	13.9	14.1	12.1
Hcl	24.6	20	16.9	20.8	20.6	20.1	25.7
Fat	8.2	7.4	4.9	10.3	10.1	9.1	12.9
Ash	7	10	11.1	9.5	7.4	8.3	7.5
Starch*	16.31	-	-	19.2	18.55	14.85	13.44
GE (kcal/kgMS)	5066.3	4958.9	4877	5176	5150.9	5127.2	5392.1

%MF: %Dry matter, DM: Dry matter, OM: Organic matter, NDF: Neutral detergent fiber, ADF: Acid detergent fiber, Hcl: Hemicellulose, GE: Gross energy, Starch*: The starch content was calculated, ProvA and ProvB: Commercial feeds, Mor20: 20% of moringa leaves, Mor30: 30 % of moringa leaves and Mor40: 40 % of moringa leaves, CTL: Control food.

Dry matter (DM), organic matter (OM), total ash, crude protein and fat were determined according to AOAC (1990) procedures. The concentrations *acid detergent fiber* (ADF) and *neutral detergent fiber* (NDF) were evaluated according to the sequential method [15]. The energy values were estimated from the equation: EB=5.7 P+9.57 F+4.24 (OM-P-F) [16].

The digestibility coefficients of feed constituents and energy (dx) were calculated according to the formula: $dx\ (\%) = \frac{Ix - Fx}{Ix}*100$, With x: Energy or feed constituents (DM, OM, P, F, ...), dx: apparent digestive utilization coefficient of x, lx: total ingested x during the test, Fx: total quantity of x rejected in the feces.

Data analysis

Statistical analyzes were performed with SPSS software. Two levels of analysis were considered: food effect or treatment and food category effect. In the first case, the variances of recorded parameters were analyzed followed by the Student-Newman and Keul test. So it was used to comparative effect of the two feed groups (feed without moringa leaves: Mor^- and feed with moringa leaves: Mor^+).

Results

Ingestion of experimental foods

Globally, the average feed consumption (72.54 g/day) of moringa leaves base diet was lower (P<0.01) than the moringa leaves free diet (82.56 g/day) **(Table 3)**. The dietary intakes of animals from CTL groups (73.1 g/day), Mor10 (68.91 g /day), Mor20 (70.91 g/ day) and Mor30 (71.16 g/day) were similar (P>0.05) but significantly lower (P<0.05) than those of ProvA (88.39 g/ day), ProvB (89.21 g/day) and Mor40 (79.18 g/day) groups which were equivalent (P>0.05).

Apparent digestibility of tested feed

The comparison of the digestibility coefficients of moringa-based feed with those of other feed is presented in **Table 3**. The digestibility coefficients of organic matter (63.44% *vs* 53.24%), acid detergent fiber (64.10% *vs* 55.88%) , hemicelluloses (46.20% *vs* 30.02%) and minerals (52.54% *vs* 16.89%) of leaf-based diet were higher than (P<0.001) those of leaf-free diet. The acid detergent fiber digestibility of moringa feed (28.36%) was also better (P<0.05) than that of other feed (20.87%). No significant difference was noted between the digestibility of energy and proteins of the two feed categories (P>0.05).

Except energy, coefficients high digestibility (P<0.001) were recorded in group for all feed constituents. In general, the highest digestibility coefficients were obtained in Mor30 **(Table 4)**. No difference was observed between the digestibility coefficients of the various feed constituents of the ProvA, ProvB and CTL feed (P>0.05).

Table 4: Feed ingestions (g) and digestibility coefficients (%) recorded with the experimental groups.

	Ingestion	dMS	dMO	dNitrogen	dADF	dNDF	dHcl	dFat	dAsh	dGE
Mor10	68.91^{d}	62.35^{b}	62.92^{b}	69.72^{ab}	25.32^{b}	32.38^{dc}	37.65^{b}	89.53^{ab}	54.40^{b}	57.52^{a}
	-4.5	-1.35	-1.2	-1.18	-2.62	-2.7	-3.31	-1.55	-1.77	-1.55
Mor20	70.91^{cd}	61.36^{b}	61.62^{b}	64.97b^{c}	22.66^{b}	33.28^{c}	40.45^{b}	85.30^{bc}	48.55^{bc}	57.12^{a}
	-2.84	-0.88	-1.17	-0.82	-2.16	-1.74	-1.76	-2.1	-1.35	-1.2
Mor30	72.61^{cd}	68.56^{a}	69.12^{a}	68.91^{ba}	42.03^{a}	50.20^{a}	55.93^{a}	82.12^{c}	61.79^{a}	57.59^{a}
	-2.98	-1.77	-1.71	-1.9	-3.6	-3.22	-3.5	-1.67	-2.44	-1.57
Mor40	79.18^{bcd}	61.48^{b}	62.75^{b}	69.83^{ba}	23.44^{b}	42.03^{b}	50.79^{a}	86.51^{bc}	45.42^{c}	56.76^{a}
	-1.62	-1.05	-1.03	-1.71	-2.3	-2.43	-3.78	-2.08	-2.46	-1.4
ProvA	88.39^{ab}	52.31^{c}	55.28^{c}	67.46^{b}	19.19^{b}	22.37^{d}	25.62^{b}	93.08^{a}	16.78^{de}	56.89^{a}
	-1.2	-0.8	-0.66	-0.75	-1.44	(2.27	-4.03	-0.4	-2.02	-0.51
ProvB	90.91^{a}	51.28^{c}	54.15^{c}	62.94^{c}	18.86^{b}	23.22^{dc}	29.67^{b}	89.44^{ab}	11.58^{e}	54.91^{a}
	-1.25	-0.99	-0.89	-1.21	-1.95	-1.83	-4.89	-1.15	-1.03	-0.61
CTL	80.11^{bc}	56.51^{c}	58.19^{bc}	72.91^{a}	24.91^{b}	30.94^{dc}	35,35^{b}	88.06^{ab}	23.28^{d}	57.83^{a}
	-2.83	-2.56	-2.59	-1.52	-5.2	-4.82	4.58)	-1.71	-4.73	-1.2
Significances	***	***	***	***	***	***	***	***	***	ns
Mor^{+}	72.90^{b}	63.44^{b}	64.10^{a}	68.36^{a}	28.36^{a}	39.47^{a}	46.20^{b}	85.87^{a}	52.54^{a}	57.25^{a}
	-1.64	-0.78	-0.8	-0.78	-1.81	-1.74	-1.98	-1	-1.44	-0.5
Mor^{-}	86.72^{a}	53.24^{a}	55.88^{b}	67.58^{a}	20.87^{b}	25.30^{b}	30.02^{a}	90.28^{b}	16.98^{b}	56.49^{a}
	-1.36	-0.97	-0.92	-1.04	-1.87	-1.87	-2.62	-0.77	-1.84	-0.69
Significances	***	***	***	ns	***	***	***	**	***	ns

dDM: Dry matter digestibility, dOM: Organic matter digestibility, dNitrogen: Total nitrogen digestibility, dNDF: Neutral detergent fiber digestibility, dADF: Acid detergent fiber digestibility, dHcl: Hemicellulose digestibility, dFat: Fat digestibility, dAsh: Ash digestibility, dEB: Gross energy digestibility, ProvA and ProvB: Commercial feeds, Mor20: 20% of moringa leaves, Mor30: 30 % of moringa leaves and Mor40: 40 % of moringa leaves, CTL: control food, NS: Not significant (P>0.05), **: Very significant (P<0.01), ***: Highly significant (p<0.001). a,b,c,d,e : values of the same columns assigned with the same letter are statistically different 5%, Numbers in the parenthesis are SD.

Energy and protein values of feed

The weight gains recorded in all experimental diets were similar (P>0.05) and ranged from 133.50 g to 176.21 g **(Table 5)**. Digestible protein ranged from 135.78 to 180.87 g/kg of DM for moringa leaf diets. Digestible protein in ProvA and ProvB were 116.71 and 131.55 g/kg DM, respectively. The highest protein value was obtained in Mor40 feed (P<0.001). The Digestible protein composition in ProvA was lower than that of the other diet (P<0.05). No difference was observed between the Digestible protein values in Mor10, Mor20 and Mor30 feed. The digestible energy of feeds ranged from 2624.8 kcal/kg DM to 3463.8 kcal/kg DM. The digestible energy concentration in Mor10 feed was higher than that of other feeds (P<0.001). The lowest dE value was obtained with the ProvB feed. The energy differences between Mor10 and the other lots are as follows:

+159.1, +158.6, +39.6, +622.7, +839 and +294.9 kcal/kg MS respectively for Mor20, Mor30, Mor40, ProvA, ProvB and CTL.

Table 5: Weight gain, energy and protein values.

	WG (g)	DP (g/kgDM)	DE (kcal/kgDM)	DP/DE (g/1000kcal)	PE (g DP/g WG)	EE (Kcal ED/g GP)
Mor10	133.50a	148.82c	3437.39a	43.42d	0.51a	12.69a
	-8.73	-3.85	-107.52	-0.9	-0.05	-1.05
Mor20	123.36a	135.78d	3297.90a	41.31d	0.56a	13.67a
	-6.56	-1.71	-78.6	-0.85	-0.04	-0.94
Mor30	148.40a	155.04c	3271.40a	47.51c	0.55a	11.67a
	-8.51	-4.27	-113.71	-0.75	-0.04	-0.8
Mor40	153.42a	180.87a	3407.80a	53.09b	0.76a	14.34a
	-18.16	-4.44	-81.76	-0.47	-0.14	-2.79
ProvA	146.6a	116.71e	2834.06c	41.20d	0.49a	11.99a
	-12.82	-1.29	-32.11	-0.38	-0.06	-1.45
ProvB	176.21a	131.55d	2607.75d	50.52b	0.60a	11.99a
	-16.38	-2.57	-36.08	-1.22	-0.06	-1.11
CTL	144.06a	167.20b	3168.87bc	52.99b	0.79a	15.01a
	-20.39	-3.26	-90.97	-0.83	-0.02	-2.97
Significances	ns	***	***	***	ns	ns
Mor+	142.20a	155.13a	3353.62a	46.33b	0.59	13.09
	-5.83	-3.3	-47.71	-0.83	-0.04	-0.79
Mor-	156.07a	137.38b	2858.74b	48.02a	0.2	12.9
	-9.61	-4.38	(55.09	-1.12	-0.06	-1.1
Significances	ns	**	***	ns	ns	ns

ProvA and ProvB: Commercial feeds, Mor20: 20% of moringa leaves, Mor30: 30 % of moringa leaves and Mor40: 40 % of moringa leaves, CTL: Control food, WG: Weight gain, DP: Digestible proteins, DE: Digestible Energy, EE: Energetic efficiency, PE: Proteins efficacy, ns : Not significant (P> 0.05), ** : Very significant (P <0.01), *** : Highly significant (p <0.001), a, b, c, d, e : values of the same columns assigned with the same letter are statistically different 5% Numbers in the parenthesis are SD

A highly difference between the dP/dE ratio of the different experimental groups (P<0.01) was noted. The highest dP/dE ratio was recorded in CTL (56.20g dP/1000 kcal dE). The values of this ratio were similar for ProvA, Mor20 and Mor10 feed but lower than those of the other groups (P>0.05).

The average energy efficiency coefficient of moringa feeds (12.68 kcal dE/g gain) was similar to other foods at 12.54 kcal/g gain. On the other hand, the values of the protein efficiency ratio ranged from 0.49 g dP/g gain to 0.79 g dP/g gain. Mean protein efficiency for moringa feeds (0.59 g dP/g gain) was similar (P>0.05) to other feed (0.63 g dP/g gain). Like the feed categories, the energy efficiency and protein efficiency of all feeds were similar (P>0.05).

Discussion

Feed Intake

The dietary intakes of moringa leaf-meal diets are quite interesting since they did not reveal a depressive effect of moringa leaves on rabbits' feed consumption. These results indicate that rabbits can tolerate up to 40% incorporation of moringa leaves into their diet and are in the same level as previously [17,18]. The differences noted between dietary intakes recorded in the different groups can be explained by the chemical composition of the tested feeds. The feed consumption of rabbits is reported to be affected by the feed's energy concentration because there is a need to keep constant the body temperature [19]. The low ingestions recorded in batches of animals fed with moringa leaves-base feed may be partly attributed to the high energetic value of such diets. In addition to energy, the feed consumption recorded in the groups may have been influenced by other feed constituents. In fact, the comparison of feed consumption **(Table 4)** with the chemical compositions of feeds **(Table 3)** shows that the least ingested feeds are those which were least concentrated in organic matter, in fat and protein. The implication of fat on feed consumption is related to its nature of energy feed. In fact, the excess fat found in moringa leaf feeds, favoring an increase in the energy density of these feeds, has led to a decrease in the amount of feed consumed by animals that have been subjected to these feeds.

The higher satietogenic effect of proteins relative to other macronutrients may also have contributed to the lower levels of feed intake observed in groups fed with moringa leaf [20-24]. Tomé [25] points out that dietary intake of the domestic rabbit can be affected by proteins and their balance in essential amino acids such as methionine [26,27]. Indeed, moringa leaf foods, more concentrated in protein, were less ingested than leafless foods. However, the higher satietogenic effect of the proteins was not systematically observed at all the groups. In fact, if the protein value of the feed should be taken into account only, the quantities of feed ingested should make it possible to classify the group in ascending order of the feed quantities consumed as follows: Mor40<CTL<Mor30<Mor10<Mor20<ProvB<ProvA. But thought the Mor40 food was more protein-rich than the Mor30 and Mor20 feeds, it was better ingested. The non-recognition of the depressive effect of proteins and/or energy on feed intake in certain groups could be attributed to the fiber concentration of foods because it was reported that feed intake, in the growing rabbit, is positively correlated with fiber concentration [17]. Therefore, in rabbits, feed consumption increases with the increase in fiber concentration content of feeds.

The comparison of ingestion results with those of Ewuola et al. [28] and [18] reveals that the feeds tested in this study were less ingested than those tested by these authors were. For example, the daily consumption of the feed containing 10% of moringa leaves, tested by these authors was 100.03 g/day against 68.91% during the study. The feed intakes recorded by [16] with feed containing 30% to 40% leaf were respectively 97.48 g/day and 109.41 g/day for these two incorporation rates respectively, compared to 72.61 g/day and 109.41 g/day for the study. These differences noted between the dietary intakes recorded during the study and those of these authors can be attributed to the fact that the feeds tested are more energy and protein than the feeds tested by these authors.

Digestibility of food constituents of experimental rations

The differences noted between the digestibility coefficients could thus be favored by other chemical constituents of the feeds and their interaction. It is also possible that the nature and quantity of the feedstuffs that were used for the composition of the feed could alter the digestibility of the feed [29]. The low digestibility of fibrous can be explain by the fact that fibers are able to reduce the length of feed stay in the digestive tract; inducing a lower efficiency of the digestive phenomena. Other parietal constituents may also explain the differences noted between the coefficients of feed's digestibility. In the same way, it was report that pectic substances are better digested than other dietary fibers [30]. The best digestibility values obtained in batches of animals fed on foods containing moringa leaves, suggest that these feeds were more concentrated in pectic substances than foods formulated from conventional feedstuffs.

Concentrations of starch may also explain the differences noted between the digestibility coefficients of organic matter and nitrogen content obtained during the study. With a longer residence time in the digestive tract, starch induces a better digestibility of feed. Therefore, the digestibility results recorded during the study could be associated with the starch doses contained in each feed. The comparison of dry and organic matter digestibility coefficients of Mor10, Mor20 and CTL feeds confirms the beneficial effect of starch on the recovery of feed in rabbits. The best digestibility coefficients were recorded with Mor10 and Mor20 feeds at which the highest starch levels were calculated. However, the best digestibility values recorded in Mor30 and Mor40 suggest that the use of moringa leaves in the rabbit diet has a beneficial effect on feed digestibility. It was also mentioned that moringa leaves could help to improve rabbits feed digestibility [13,28,31]. Moreover, the best digestibility of dry and organic matters, in comparison to commercial feed; reveal a high the nutritional and economic interest of moringa leaves in rabbit diet. In fact, these results show that the quantity of feed lost in the form of feces is higher with feeds lacking moringa leaves.

The higher values of fiber digestibility found in animals fed on leaf-based diets and the trend towards increased fiber digestibility increased with leaf moringa incorporation rates. In our study, the digestibility coefficients of dry and organic matters recorded, with feeds containing moringa leaves, are better than those reported previously [32]. The data recorded by these authors conform to those obtained during the study with standard foods (without leaves). The digestibility coefficients of dry matter and organic matter recorded with the Mor30 feed were higher than those obtained by [16] with a feed that also concentrated 30% moringa leaves (64.93% for dDM and 66.36% for dOM). However, at equal incorporation rates of moringa leaves, the digestibility coefficients of the tested feeds nutrients were lower than those observed by other authors [33,17]. The differences noted between our results and those of the above mentioned authors could be attributed to the origin of dietary intakes and to their proportion in the feeds tested. For this purpose, some authors have observed that the digestibility of feed in rabbits is affected by the origin of dietary intakes [30,34-36].

Energy and protein efficiency

They represent a criterion for evaluating feed quality. Also, for each of the coefficients, the best feed is the one with the lowest values. In the present study, no statistical difference was observed between the coefficients of effectiveness of different feeds, it could be established that the feed values of these feeds are equivalent. Regardless of the feed, the energy and protein efficiency coefficients are higher than those reported [37]. Indeed, in a trial aiming at valorizing clover seed in feed incorporating 35% of alfalfa leaf, these authors obtained values for energy efficiency values between 8.9 and 9.3 kcal of ED/g of weight gain. As for the energy efficiency coefficients obtained they ranged between 0.39 and 0.42 g PD/g of weight gain. The differences observed between the experimental data and those of the authors cited above indicate that the feeds used in the study are less effective. This could be justified by the nature of the feed ingredients used in each of the studies.

Conclusion

This study shows that foods without leaves of *M. oleifera* have generally been better ingested than foods containing these leaves. However, *M. oleifera* leaf feeds have been better digested than foods formulated exclusively from conventional resources. The digestibility coefficients of dry and organic matter, acid detergent fiber and hemicelluloses of moringa leaf-based diet were higher than those of moringa leaf-free diet. The study also found that *M. oleifera* leaves could safely be incorporated up to 40% into the rabbit diet.

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