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Appetibility and effect of neem (*Azadirachta indica*) leaf foods on weight performance and viability of pre-weaning rabbits (*Oryctolagus cuniculus*).

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The aim of this study was to evaluate the possibility of using neem (*Azadirachta indica*) leaves in the feeding of lactating rabbits. For 35 days, food consumption, weight performance and mortality were recorded in 96 mother cages of four batches of lactating rabbits subjected to four diets, including a control diet without neem leaves (lot 0) and three diets (lot 5: 5% leaves; lot 10: 10% leaves, and lot 15: 15% leaves) containing dried leaves of neem at different concentrations. The mean dietary intake of the animals of lot 15 (167.20 g/day/cage) was significantly lower than that of lot 0 (206.29 g/day/cage). Ingestions recorded in C3 litter class (7 to 9 rabbits) were higher (P<0.05) than those in C1 (1 to 3 rabbits) and C2 (4 to 6 rabbits). The initial mean weights of the young rabbits from lot 15 were significantly higher (P<0.05) than those of lot 5. No difference was observed between the birth-weaning of the four lots. The growth rate of young rabbits from females belonging to the C1 litter class (17.30 g/day) was higher (P<0.01) than that of young rabbits whose litters were higher than 7 rabbits (8.82 g/day). The birth-weaning mortality rates of lot 0 (12.50%) and 5 (18.30%) were similar (P>0.05). It was the same (P>0.05) for batches 10 (37.60%) and 15 (34.30%). The incorporation of the neem leaves can be considered to increase the cost-efficacy during breeding rabbits.

Key words: *Oryctolagus cuniculus, Azadirachta indica*, ingestion, growth rate, mortality.

INTRODUCTION

Domestic rabbits (*Oryctolagus cuniculus*) are found in virtually every country in the world, providing protein, fiber,

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research models, and companionship. Rabbits can utilize low-grain and high-roughage diets because they are able to utilize this type of diet, breed year-round, and have a "quick" generation interval. They are also uniquely poised to provide animal protein for developing countries, such as Benin.

Despite the nutritional benefits offered by rabbit meat and easy climate adaptation of species, rabbit breeding is less developed in Benin. To promote this activity, reducing the cost of feeding could be a key point of increasing the production. Indeed, farmers must be able to control and reduce their cost of production without adversely affecting the profitability of farms. Among the factors likely to affect both the production performance of rabbits and the profitability of farms, food plays an important role. The leaves of selected plants have been used in the tropics as a cheap protein sources in animal feeds (Ekenyem and Madubuike, 2006). Among those plants, neem can be mentioned, an omnipotent tree and a sacred gift of nature mainly cultivated in the Benin.

Neem is a member of the mahogany family, Meliaceae. Today it is known by the botanical name *Azadirachta indica* A. Juss. Neem has been used extensively by humankind to treat various ailments before the availability of written records which recorded the beginning of history. This plant has been suggested to be useful for the feeding of rabbit. There is less information on the benefic effect on subsequent body composition and feed intake in rabbits of the addition of dry leaves in Benin. The aims of this study were to evaluate the feasibility and effect of neem leaf foods on the performance of lactating rabbit production and the viability of young rabbits.

MATERIALS AND METHODS

Study area

The study was carried out on the experimental farm of the Technical Center for Poultry and Small Animal Breeding. This farm is located at Tori-Bossito (6°25'and 6°37' N latitude and 2°1 ' and 2°17' E longitude). Like all the southern communes of the country, this municipality enjoys a subequatorial climate characterized by two rainy seasons (April to July and September to November) and two dry seasons (July to September and November to March). The mean rainfall is 1200 mm per year. Average monthly temperatures range from 27 to 31°C.

Animals and experimental procedure

The experiment was performed with 96 sucking rabbits and their litters housed in galvanized wire cages (0.43 m^2) disposed in flat-desk. The mother cages were randomly divided into 4 lots (Lot 0: 23, Lot 5: 25, Lot 10: 24, and Lot 15: 24) feed with different proportion of neem leaves. These females represent all the rabbits that led their gestation to term over an initial strength of 120 raised rabbits. Each batch was composed of the same amount of nulliparous and multiparous females. Thus, the number of nulliparous females in the four batches was as follows: Lot 0 (13), Lot 5 (14), Lot 10 (12), and Lot 15 (13). The mean number of rabbits maintained at the beginning of the study by the rabbits of the four lots was: 4.48 (Lot 0), 7.00 (Lot 5), 5.51 (Lot 10), and 4.07 (Lot 15). Inspired by previous works (Kpodekon et al., 2006; Drogul et al., 2009), the tested foods (Table 1) differed by the incorporation rates of neem leaves (NL) in their formula, namely: Food 0: 0% NL, Food 5: 5% NL, Food 10: 15% NL, and Food 15: 15% NL.

Data collection

The amount of feed served and the number of alive rabbits per cage was daily recorded by cage-mother (Gidenne and Lebas, 2005; Vidjannagni et al., 2017). The weights of alive young rabbits per cage were taken each 7 days. In addition, in case of mortality of young rabbits, the (poor) maternal behavior was taken in consideration. Apart of those, the other studied parameters were: dietary intake, weight of young rabbits, weight gain (WG), growth rate of young rabbits (GRyR), mortality rate of rabbits (MRR), average mortality rate of rabbits per rabbit (AMR), and the mortality rate of young rabbits (MRyR).

Three effects were considered: feeding effect (N0, N5, N10 and N15), parity effect (nulliparous and multiparous) and range class effect (C1, C2, and C3). The rabbits were grouped into three classes of litters as follows: rabbits suckling from 1 to 3 rabbits (C1), rabbits suckling from 4 to 6 rabbits (C2) and rabbits suckling a number of rabbits superior or equal to 7 rabbits (C3).

Feed intake: Feed intake was determined weekly until 5 weeks of age according to kind of food, parity, and range class. The feeder was weighed at the beginning and the end of each period and all feed given was weighed and recorded. If feed wastage was observed, the entrance of the feeder was modified with wire to prevent animals from standing in front of the feeder while still allowing them enough access to eat. If wastage occurred, period and cage were recorded, and the feed intake for this period was scored as a missing value.

Body weight: Rabbits were weighed individually on day 0, 7, 14, 21, 28, and 35.

Statistical analysis

The statistical analyzes were carried out with the SPSS (1.6) software. A multivariate analysis of variance was performed using the Generalized Linear Models (Proc GLM) procedure. The least squares means were estimated and compared by the Duncan test at the 5% probability threshold. Frequency comparisons were made using the χ^2 test.

RESULTS

Food consumption

Table 2 shows that except the first week during which the ingestions of the animals of the four batches were similar (P>0.05), the feeding effect was observed over all the other periods. The litter class effect was not observed during the first and third week of young rabbit's life.

During all periods when differences in feed consumption between the four batches were observed, the ingestion levels obtained in lot 0 were always higher than those of animals in lot 15 (P<0.05). The first and third week were the only moments of the trial during

Table 1. Centesimal compositions and theoretical food values tested.

Parameter	Lot 0	Lot 5	Lot 10	Lot 15
Centesimal compositions (%)				
Neem leaves	00.00	05.00	10.00	15.00
Corn	09.00	06.25	02.00	0.00
Corn bran	24.00	23.00	20.00	19.50
Rice bran	24.00	22.00	20.00	18.00
Palm cake	24.00	23.00	24.50	21.00
Cottonseed cake	03.00	05.00	09.50	11.00
Soybean cake	08.00	07.00	03.50	04.50
Fishmeal	03.00	03.00	04.00	04.00
Shell	02.00	02.00	02.00	02.00
Oil	02.50	03.25	04.00	04.50
Salt	00.20	00.2	00.20	00.20
Premix	00.30	00.3	00.30	00.30
Total	100	100	100	100
Food values				
Dry matter	89.376	89.70	90.22	90.42
Organic materials (%DM)	91.07	91.01	90.83	90.746
Total nitrogen content (%DM)	17.18	17.72	18.72	19.73
Total Fat (%DM)	6.97	7.67	8.57	08.88
Celluloses crude from weende (%DM)	10.79	11.34	12.33	12.55
Gross energy (Kcal/kg DM)	4100.91	4147.41	4217.31	4241.01
Digestible proteins (%DM)	12.25	12.32	12.70	13.235
Digestible energy (Kcal/kg DM)	2627.35	2624.98	2621.30	2620.45

which no differences were noted between food consumption recorded in lots 5, 10 and 15 (P>0.05). However, the quantities of feed consumed by rabbits and rabbits in batches 5 and 10 were always similar to those recorded in lot N0 (P>0.05). Mean consumptions throughout the nursing period (Ing1-35) in batch 15 were significantly lower (P<0.001) than those of the other batches.

The average daily dietary intake during the entire lactation period (Ing1-35) in the class C3 (206.50 ± 6.45 g/cage/day) was higher (P<0.001) than that of rabbits of class C1 (174.33 ± 7.15 g/cage/day). However, no difference (P>0.05) was observed between intake levels of class C2 (202.48 ± 4.77 g/cage/day) and C3 class rabbits. Food consumption recorded in the cages of nulliparous and multiparous rabbits was always similar (P>0.05) and ranged between 190.60 ± 4.94 and 193.20 ± 4.68 g/c/d for the period ranging from birth to fattening.

Weight performance of rabbits

The range effect was perceived on the overall results of the young rabbits average weights (P<0.01). The feeding effect was observed (P<0.05) on 50% of the mean weight results (days 7, 14 and 21). Concerning the parity effect, it was only observed on the weaning weight of the young rabbits (Table 3). The feeding effect was observed (P<0.05) on weight gains (WG) and growth rates of young rabbits (GRyR) calculated between the birth and the 21st day of age of the young (WG1-21 and GRyR 1-21). In addition, the parity effect was observed on the WG and the GRyR obtained for the periods: 21st to 35th day of age and birth-serf (P<0.01). The effect class range influenced the WP and GRyR of the periods 1st to 21st day and birth-weaning (P<0.01).

In all batches, the growth rates recorded during the first 21 days of the young rabbits life were lower than those obtained between the 21st and 35th day of age (P<0.001). At birth, the average individual weights of the young rabbits of the four lots were similar and these weights increased during the 35 days of lactation. The growth rates recorded during this period did not differ from a lot to another. However, it was noted that during the first 21 days of life, the average growth rate of the young rabbits of lot 15 was better than those of the other lots (P<0.5). The periods, during which differences were observed, the weights of the rabbits of lot 15 were always higher than those of the young rabbits of lot 5. However, there was no differences between the lots 0, 10 and those of the other lots.

With the exception of the mean weights recorded on the

Table 2. Average daily food intake per cage of non-pregnant and pregnant rabbits (g/c/d).

Parameter	Feed					Parity			Litter class			
	Lot 0	Lot 5	Lot 10	Lot 15	P	Nul	Mult	P	C1	C2	C3	P
Ing_{1-7}	156.81^{a}±7.59	144.75^{a}±9.67	149.22^{a}±8.94	156.81^{a}±8.52	ns	145.00±5.85	154.30±6.76	ns	141.61^{a}±8.94	154.87^{a}±5.88	148.20^{a}±8.05	ns
Ing_{7-14}	207.31^{a}±7.82	210.38^{a}±9.97	205.44^{a}±9.21	176.33^{b}±8.78	*	200.50±6.02	184.70±6.36	ns	183.89^{b}±9.21	208.87^{a}±8.30	197.70^{ab}±6.06	*
Ing_{14-21}	208.69^{a}±9.63	206.00^{ab}±2.05	202.00^{ab}±11.34	178.00^{b}±1.58	**	200.60±7.42	190.50^{a}±7.84	ns	193.44^{a}±11.34	202.09^{a}±6.06	201.21^{a}±7.46	ns
Ing_{21-28}	211.81^{a}±10.21	205.25^{a}±13.02	203.78^{a}±12.02	166.44^{b}±11.46	**	193.40±7.97	196.40±7.84	ns	169.00^{b}±12.03	204,30^{a}±7.91	214.30^{a}±10.83	**
Ing_{28-35}	231.31^{a}±15.86	248.38^{a}±18.67	246.39^{a}±20.21	178.89^{b}±17.80	*	219.00±12.22	218.40±12.91	ns	178.56^{b}±18.67	232.65^{a}±12.28	256.20^{a}±16.82	**
Ing_{1-35}	206.44^{a}±6.07	205.00^{a}±7.75	203.11^{a}±7.15	168.89^{b}±6.82	***	193.20±4.68	190.6±4.94	ns	174.33^{b}±7.15	202.48^{a}±4.71	206.50^{a}±6.45	***

ing_{i-j}: food intake in gram /cage/day (g/C/d) over period i to j, Nul : nulliparous, Mult: multiparous, C1: litter between 1 and 3, C2: litter between 4 and 6, C3: litter greater than 7, a, b: the averages with different letters are different at the 5% threshold, ns : P>0.05, * : P<0.05, **: P<0.01, ***: P<0.001.

Table 3. Weight performance (g/cage/day) of the rabbits feed with neem leaves incorporation.

Parameter		Food					Parity			Litter class			
		Lot 0	Lot 5	Lot 10	Lot 15	P	Nul	Mult	P	C1	C2	C3	P
Weight (g)	Day_{1}	57.25±11.44	51.58±8.43	45.60±9.13	62.57±16.20	ns	52.00±1.78	66.42±2.06	ns	70.30^{a}±16.23	54.89^{b}±8.68	44.46^{c}±4.45	***
	Day_{7}	118.06^{ab}±29.77	105.25^{b}±30.33	108.40^{b}±25.86	140.67^{a}±38.31	*	112.90±5.19	124.00±6.04	ns	159.00^{a}±26.74	114.54^{b}±21.69	84.91^{b}±11.42	***
	Day_{14}	213.38^{ab}±58.99	190.08^{b}±47.00	202.40^{b}±49.38	263.89^{a}±73.25	*	213.20±7.83	227.30±9.09	ns	297.00^{a}±54.23	212.58^{b}±31.20	153.91^{b}±17.04	***
	Day_{21}	315.56^{ab}±75.23	275.58^{b}±64.98	316.40^{ab}±97.73	374.56^{a}±125.97	*	308.10±13.21	328.90±15.34	ns	441.50^{a}±83.07	311.39^{b}±48.08	216.37^{c}±27.59	***
	Day_{28}	423.56±100.18	377.08±75.52	396.50±115.08	481.33±171.58	ns	407.90±18.28	410.90±21.23	ns	566.70^{a}±122.51	411.39^{b}±56.85	294.18^{b}±47.47	***
	Day_{35}	532.06±130.28	478.75±94.73	476.70±136.11	588.56±220.40	ns	508.00±24.66	492.00±28.64	*	692.50^{a}±172.39	511.73^{b}±72.30	372.00^{c}±74.75	**
WG (g)	WG_{I}	170.50^{ab}±66.24	137.92^{b}±42.36	149.50^{b}±36.43	201.00^{a}±68.45	*	173.71±59.61	152.96±57.10	ns	240.50^{a}±68.82	157.12^{b}±28.43	108.82b±14.74	***
	WG_{II}	216.31±71.37	202.83±59.70	160.10±60.08	213.56±105.81	ns	179.04±51.45	220.83±88.67	*	250.80±115.45	200.08±46.82	155.28±60.85	ns
	WG_{III}	474.06^{ab}±122.55	426.33^{b}±91.72	423.90^{b}±127.84	525.67^{a}±212.87	*	501.63±165.73	418.78±94.72	*	621.60^{a}±174.03	456.12^{b}±70.87	326.91^{b}±74.35	**
GRyR (g/j)	$GRyR_{I}$	7.50^{b}±3.18	6.17^{b}±2.04	6.70^{b}±1.77	9.11^{a}±3.26	*	7.75±2.86	6.83±2.71	ns	10.90^{a}±3.35	7.00^{b}±1.41	4.73^{b}±0.65	***
	$GRyR_{II}$	14.94±6.05	14.08±4.12	10.90±4.36	14.67±7.45	ns	15.29±6.25	12.26±3.68	*	17.30±8.13	13.81±3.37	10.64±4.39	ns
	$GRyR_{III}$	13.13±3.56	11.83±2.59	11.50±3.56	14.44±6.31	ns	11.48±2.66	13.88±4.78	*	17.30^{a}±4.97	12.58^{ab}±2.06	8.82^{b}±2.09	**

Day_{i}: Weight recorded on day i, Nul: Nulliparous, Mult: multiparous, GRyR: growth rate of young rabbits, WG: weight gain, C1: litter size between 1 and 3, C2: litter size between 4 and 6, C3: litter size higher than 7, a,b: the averages with different letters are different at the 5%, ns: P>0.05, *: P<0.05, **: P<0.01, ***: P<0.001.

35th day of age of young rabbits (W35), there was no difference between the mean weights of rabbits from nulliparous and multiparous rabbits (P>0.05) (Table 3).

The lowest litter sizes rabbits were heavier than those from the rabbits with the largest litter size. The mean weaning weights for young rabbits were in decreasing order (P<0.01) as follows: class C1>class C2>class C3.

Table 4. Mortality rate among rabbits feed with difference amount of neem leaves.

Effects		Food					Parity			Litter class			
Lots		Lot 0	Lot 5	Lot 10	Lot 15	P	Nul	Mult	P	C1	C2	C3	P
Mortality rate by age (MRR)	MRR_0	0.00	0.90	2.20	3.57	ns	1.43	1.43	ns	4.35	2.17	0.00	ns
	MRR_1	5.20^b	10.60^b	31.70^a	31.30^a	***	13.01	26.12	***	8.70	18.5	18.2	ns
	MRR_2	2.20	1.10	4.30	0.00	ns	1.60	2.6	ns	0.00	4.00	0.00	ns
	MRR_3	1.10	2.20	1.50	4.30	ns	4.00	0.7	ns	0.0	3.5	0.9	ns
	MRR_4	0.00	0.00	0.00	0.00	ns	0.00	0.00	ns	0.00	0.00	0.00	ns
	MRR_5	4.50	6.70	3.10	0.00	ns	5.8	3.30	ns	14.3^a	2.2^b	5.5^b	*
	MRR_I	8.30^a	13.50^a	35.6^b	34.30^b	***	14.30	28.10	**	8.70	23.90	23.2	ns
	MRR_{II}	4.5	6.70	3.10	0.00	ns	5.70	5.20	ns	14.30^a	2.10^c	7.8^b	*
	MRR_{III}	12.50^b	18.30^b	37.60^a	34.30^a	***	19.30	31.00	**	21.70	26.10	27.3	ns
Mortality rate related to poor maternal behavior		0.00^c	1.9^c	10.50^b	30.40^a	***	1.40	12.7	***	0.00^b	5.40^a	14.0^a	**
Mortality rates excluding maternal malnutrition mortality		3.5^b	8.8^b	23.4^a	10.30^{ab}	*	8.00	14.8	ns	8.70	13.8	9.8	ns

Nul: Nulliparous, Mult: multiparous, C1: litter size between 1 and 3, C2: litter size between 4 and 6, C3: litter size higher than 7, a, b: the averages with different letters are different at the 5%, ns: $P>0.05$, *: $P<0.05$, **: $P<0.01$, ***: $P<0.001$.

The growth rates of the young rabbits from the three litter classes, for periods 1 to 21 days and 1 to 35 days, also follow the same trend. The growth rate measured between birth and weaning in the group of young rabbits from C1 females was higher than that of C2-born young rabbits. Similarly, that of class C2 was higher than that of class C3 (Table 3).

Mortality

During the first week of the young rabbits' life, the mortality rates significantly varied ($P<0.05$) from a lot to another (Table 4). In the first week, the mortality rates of rabbits recorded in lots 10 and 15 were similar but higher than those of lots 0 and 5. In all lots, juvenile mortality rates recorded in the first three weeks were higher than those of the last two weeks ($P<0.001$). Significant differences between batches were observed for mortality rates between birth and 21st day of age and throughout breastfeeding. For this purpose, it was noted that during these two periods the rabbits mortality rates of lots 10 and 15 were similar but higher than those of lots 0 and 5 ($P<0.001$). The mortality of rabbits associated with poor maternal behavior (denial of breastfeeding, contamination of urine nest boxes, crushing of young rabbits, etc.) was highest in lot 15. The mortality rates obtained after removal of the female from the list of females subjected to experimentation made it possible to classify the lots in decreasing order of mortality rates as follows: lot 0 < lot 5 < lot 10.

Like the feeding effect, the parity effect influenced the mortality rates. During all these periods, the mortality rates recorded in the multiparous rabbits were higher than the mortality rates of nulliparous females. The litter class affected the mortality recorded during the fifth week and the period from the 21st to the 35th day. During these periods, the highest mortality rates were in the C1 class group ($P<0.05$). The weaning death rates recorded in the three classes were similar and ranged between 21.70 and 27.30%.

DISCUSSION

During the first 20 days when milk is almost the only food of the young rabbits, the mother rabbits increase their food consumption in order to satisfy the young rabbits, who have to multiply their weight by six (Drogul et al., 2009). The downward trend in the level of intake observed between the 14th day and the 28th day in the lots of animals fed on food containing neem leaves shows that at the beginning of the consumption of solid foods the leaves of neem had a repellent effect in rabbits.

This behavior of rejection of the feed by the young rabbits could be attributed to the bitter taste of the leaves. This observation leads us to conclude that, during the first days of food consumption, young rabbits have aversion for the bitter taste. The food constituents that are likely to affect food consumption (energy and protein) being equal in all four foods, the differences noted between food ingestions of the four batches cannot be explained by the value-related chemostatic regulation (Gidenne and Lebas, 2005) or by the satietogenic effect of proteins (Marmonnier et al., 2002).

The intake results recorded in the four lots show that neem leaves do not have a depressive effect on food consumption when used up to 10% in the ration of rabbits. The decrease in palatability observed in the animals of lot 15 suggests, in contrast to foods lots 5 and 10, that the bitterness of this food exceeded the threshold (3 mg/g of feed) admitted by rabbit (Gidenne and Lebas, 2005). The best intake of lots 0 and 5 compare to lot 15 could also have been favored by the low fiber content of these foods. Such observation was made by Kouakou et al. (2016) who mentioned that the rabbit takes better advantage of the less fibrous foods that it consumes more. Considering the fiber concentration in lots 10 and 15 foods, the difference between food intakes of the animals would be much higher due to the bitterness of the lot 15 food.

Although the foods tested were in the form of flour and had a higher energy value than the granulated feed tested by Kouakou et al. (2016) some of the food administrated (lots 0, 5 and 10) were nevertheless better ingested. The average quantity of food consumed in all lots is higher than the level of ingestion with lactating females that were subjected to a farinaceous feed (Dahouda et al., 2013; Toleba et al., 2017). The differences between the results of this study and the mentioned authors may be due to the fact that these foods contain red oil. Thus, the addition of oil to the food would have contributed to the reduction of dust emissions by the foods tested, thus inducing better ingestion of the foodstuffs, because of the reduction of the annoyance that the animals would have felt when grasping the food.

Differences for feed consumed by animals in the three litter classes indicate that the nutritional needs of suckling rabbits increase with litter size. This confirm the linear relationship reported between food consumption and the number of rabbits (litter size) maintained by the rabbit (Lebas, 1987).

Weight performance of rabbits

In general, the growth of the animals was not influenced by the composition of the foods composition. These results suggest that neem leaves have a real nutritional value for lactating rabbits and their young rabbits. However, the significant differences noted during the first 21 days of breastfeeding between the animals in lot 15 and the other lots show that during this period the lot 15 feed was better valued than the other three foods. However, the best weight performance obtained in lot 15 could be related to the fact that this food concentrates the largest number of females belonging to class C1. The study revealed that the rabbits belonging to the C1 litter class were heavier and had the highest growths, so it can be deduced that the best weight performances recorded in lot 15 are the consequence of the fact that this lot was more equipped with rabbits of class C1. The study revealed that litter size negatively affects the performance of the maternal rabbits. This observation was also made by several authors (Cifre et al., 1998; Bignon et al., 2013). This can be due to the fact that the weight performances of rabbits aged less than 21 days reflect the amount of milk they consumed. Indeed, before the 21st day, when the feeding of the young rabbits is essentially milky, the weight performances of the young rabbits depend closely on the quantity of milk they consume. As the increase in litter size is accompanied by a decrease in the quantity of milk available for each rabbit (Zerrouki et al., 2012; Yuan et al., 2015), it is easy to understand that during this period, weight performance decrease with increasing range sizes. The absence of a significant difference between the weights performances recorded during the second measurement period makes it possible to say that the four foods tested have the same food value. Moreover, this result also shows that during this period the young rabbits belonging to class C3 were able to compensate for their growth retardation by the phenomenon of compensatory growth as evoked (Prud'hon and Bel, 1968; de Oliveira et al., 2012). This weight compensation of growth could justify the weight performance results recorded during the second measurement period. Indeed, given the predominance of young rabbits from classes C2 and C3 in lots 0, 5 and 10, the reduction of the differences between the weight performances could have been favored by compensating the growth retardation of young rabbits from the litter classes C1 and C2 by increased food consumption. The results recorded during the study do not allow to interpret the differences noted between the weight performances of the young rabbits from the nulliparous and multiparous females. However, some of the weighting results reported during the study are not the same as those reported by Bignon et al. (2013). Indeed, these authors have shown that rabbits from nulliparous females have weaker performance by weight than those of uniparous and multiparous females.

Moreover, the growth rates of young rabbits (GRyR) (birth-weaning) obtained with the different foods are superior to the one recorded by Dahouda et al. (2013) with diets associating a farinaceous feed and fodder. The differences noted between the cited and the present study, suggest that the foods tested in this study have a better feeding value for lactating rabbits.

Mortality

The life of the mother rabbits is marked by two critical moments: the first week and the fifth week of life. However, the high values of mortality rates recorded during the first week corroborate the report of several authors concluding that the first week of life is the most critical period in the life of the pre-weaning rabbits (Perrier et al., 2003; Kpodekon et al., 2006).

Moreover, the role of litter size on mortalities cannot be offended either. Indeed, the trend of increased mortality as a result of the increase in litter sizes noted during the study in the first week is consistent with the observations previously made (Perrier et al., 2003; Kpodekon et al., 2006). Also, Kpodekon et al. (2006) attribute the large mortalities recorded in large litters to the inability of mother rabbits to satisfy the quantitative milk requirements of all their young. To this end, Combes et al. (2013, 2016) report that in large litters, the fight for access to teats is lost by the lightest rabbits of litter. As a result, these rabbits fail to consume the colostrum that is essential to the establishment of the immune system. Moreover, in the litters of high sizes the lightest rabbits are disadvantaged during the struggle for space. Indeed it is the biggest young rabbits who appropriate the central position in the nest box. This gives them better thermal comfort and thus allows them to better control the cold compared to the rabbits at the ends (Smith et al., 1998; De la Fuente et al., 2007; Romanovsky, 2014).

If litter size were to be considered as the only factor responsible for mortality during this period, no difference should be observed between the mortality rates of the lots 0 and 15 mother-rabbits. The mean litter size of live rabbits present in these two batches during the first week was similar. This was not the case; as the mortality rate of the sub-mother babies in lot 0 ranks first among the best mortality rates recorded in the study. Moreover, the mortality rates obtained in lots 5 and 10 also do not allow the mortality cases recorded in these two batches to be attributed to the litter size. Indeed, based on the principle of increasing the mortality rate according to litter size (kpodekon et al., 2006), the mortality rate of lot 5 had to be higher than that of lot 10. The non-alignment of the mortality results recorded in the four batches with the results of Kpodekon et al. (2006) suggests that above 5% feeding rate, dried neem leaves can cause a significant increase in killer mortality rates during the first week of life.

The resumption of mortalities during the fifth week can be attributed to the inadequacy of the chemical composition of the tested foods to the feeding needs of the young rabbits. Given the antagonism between the feeding needs of the young rabbits and their mothers (Fortun-Lamothe and Gidenne, 2003), it was virtually impossible to compose these foods in order to satisfy the nutritional requirements of young rabbits (fiber and energies) of their mother (energy). Indeed, the young rabbits mortality risk during the period of perishage (25th - 42nd day of age) are lower when they are subjected to foods with a high rate of fiber (13 to 14% of Crude/kg of food) and a low energy value (<2350 kcal/kg feed). On the other hand, in the same period, an energy-poor diet (less than 2500 kcal/kg of food) and rich in fiber (>11 to 12% of raw cellulose) increases the risk of mortality of mother (Haigler et al., 2012; Szendrő et al., 2012; Li et al., 2014). Considering the chemical composition values of the tested foods, it would be difficult not to associate the mortalities recorded in the pre-seed period to the inadequacy of the bromatological values of the tested foods with the needs of the young rabbits.

The mortality rates recorded between births and weaning in batches 0 and 5 are in the majority margins recorded (5.89 to 26.72%) in 12 Beninese farms (Kpodekon et al., 2006). On the other hand, the mortality rates recorded in lots 10 and 15 are higher than all the mortality rates mentioned by these authors. The mortality rates recorded in these two lots are better than the lowest mortality rate recorded in Benin.

Conclusion

The feeding results at the end of the study indicate that suckling rabbits and their rabbits can support up to 10% of neem leaf incorporation rate in their diets. Weight performance is no less impacted by the presence of neem leaves. They are mainly influenced by the number of young rabbits maintained by the mother rabbit. The calculated mortality rates, between birth and weaning, showed that above 5% incorporation rate, neem leaves can significantly increase the mortality of submerged rabbits. In sum, in view of the overall lessons learned from the study, it should be said that the limited incorporation of dehydrated neem leaves in the feeding of rabbits to mothers should be 5%.

CONFLICTS OF INTERESTS

The authors have not declared any conflict of interests.

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