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Influence of the Inclusion of Graded Levels of Cassava Leaf Meal in the Diet on Post Partum Weight and Pre-Weaning Growth of Guinea Pigs (*Cavia Porcellus L.*)

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Abstract **- A study on the effect of the inclusion of graded levels of cassava leaf meal in the diet on post partum weight and pre-weaning growth of guinea pig was carried out from September 2012 to December 2012 at the teaching and research farm of the University of Dschang in West-Cameroon. 72 guinea pigs (60 females and 12 males) weighing averagely 555,00±58,25g were divided following a completely randomized design into 4 groups of 15 females and 3 males each and put on breeding for a period of 31 days and then the males were removed. Each group received *Pennisetumpurpureum ad libitum* supplemented to four diets with graded levels of cassava leaf meal named ration R0, ration R1, ration R2 and ration R3 respectively for group 1, 2, 3 and 4. Samples of experimental diets were collected and taken to the laboratory of nutrition and feeding for analysis of their nutritive value. From birth to weaning, females and their kids were weighed every 7 days. This study revealed that, cassava leaves contained 26.29% of crude protein therefore indicating their potential to be used as protein source. The difference in the chemical composition of the experimental diets reflected the protein source. Thus, R3 diet containing 100% of CLM, obtained a lower crude protein (17.18% DM) and higher crude fiber (13.54% DM) with exactly the opposite trend for R0 diet containing 100% of soybean meal. No significant difference (P>0.05) has been observed between post partum weights of females in all the groups. At birth, mean weights of newborns were 94.00±9.78g; 98.64±13.20g; 98.75±8.70g and 94.00±9.88g respectively for diets R0, R1, R2 and R3 and all statistically comparable (P>0.05). Mean weights of kids at weaning for the diets R0, R1, R2 and R3 were 182.03±16.92g; 190.42±15.57g; 205.83±19.87g and 197.50±17.17 giving a daily weight gain of 4.19±0.60g; 4.37±0.57g; 5.10±0.79g and 4.93±0.60g respectively. At weaning, kids submitted to R2 diet (205.83±19.87) registered a mean weight significantly higher (P<0.05) to that of kids of R0 diet (182.03±16.92). Besides, mean weights of kids of R2 and R3 (197.50±17.17) diets, R0 and R1 (190.42±15.57) on the one hand, R1 and R3 on the other hand were statistically comparable (P>0.05). We can conclude that dried cassava leaves can substitute soybean meal and improve growth performances of guinea pigs at very low cost in rural area.**

Keywords **- *Caviaporcellus*, Dschang*manihotesculenta*, *Pennisetumpurpureum*, Soybean Meal.**

I. Introduction

The challenge for research and development of cavy production in Cameroon requires knowledge on adequate feeding according to the nutritional requirements of the animals [27]. In this country, cavies are hitherto reared mainly by traditional system where these animals scavenge on the floor for their daily needs [27]; most food is provided from kitchen wastes and farm residues and sometimes supplemented with vegetables and forages [23] such as*Panicum maximum*, *Trypsacumlaxum*, *Pennisetumpupureum.* The protein content of these feeds is low and quite high levels of protein supplements are needed to satisfy nutrients requirements. However, conventional sources of protein meals (fish meal, groundnut cake, soya bean meal) are expensive and scare [10]. It is therefore important to identify local sources of protein especially those that can be produced on small farm such as cassava leaves.

Cassava (*ManihotesculentaCrantz*) ranks first in front of banana plantain, coco and maize [13] in Cameroon. It is a widely grown crop in all the five agro ecological zones in this country. Cassava is extremely reliable to grow especially on slopping rain fed soils of low fertility, survives drought periods and grows well with limited supplies of water [6]. In addition, it is tolerant of acids soils and yields well on marginal soils without excessive use of costly inputs [6]. These qualities have endeared cassava to resource poor farmers [6]. Cassava is traditionally grown for the production of roots. At roots harvesting, an average yield of the order of 2-8 tones of DM /ha/year of cassava leaves has been reported [17] which unfortunately are unexploited because they remain on the farm. These leaves have become increasingly important as a source of protein for monogastric and ruminant animals [32] with a protein content of 14-40 % DM [4; 9]. The main limiting factor to the use of cassava leaves as animal feed is the presence of cyanogenicglucosides, which give rise to hydrocyanic acid (HCN) when the plant tissue is broken down by processing or during ingestion by animals [11]. The cyanide levels in leaves are influenced by genetic, physiological, edaphic and climatic differences with the stage of maturity being perhaps the major source of variation [11]. Many researchers have demonstrated that the HCN content in leaves can be reduced by sun drying [7] and by ensiling [19]. Positive effect of processing cassava leaves could definitely ameliorate its nutritive value and their safe utilization as animal feed.

There is abundant literature on cassava leaves as a protein source in diets for pig [16; 38; 39], for broiler chicken [13], for ruminant [22; 35; 40; 15; 33; 21; 41] productions. But little or no information exist in the use of cassava leaf meal in diets for guinea pigs. The objective of the present study was to elucidate the potential of cassava leaves as dietary source of protein in order to encourage their inclusion in diets for cavy's livestock production.

II. Materials and Methods

Study site

The study was conducted at the teaching and research farm of the University of Dschang. Dschang is situated in the Western Highland of Cameroon which is in the sudano-guinean zone (latitude 5-70 N, longitude 8-120 E). The mean annual temperature and relative humidity are 16-17°C and 49-97% respectively. The mean annual rainfall is about 2000 mm, the wet season ranges from March to November and the dry season from late November to March.

Animal and housing

Seventy two (72) adult local breeds guinea pig including sixty (60) females and 12 mature breeding males with mean body weight of 519.50 ± 10.76 g and 578.67 ± 66.00g respectively were used in this trial. The females were divided into 4 groups of 15 animals each and housed in 4 identical pens surrounded by plywoods and measuring 1.5m in length, 0.8m in breadth and 0.6m in height. Each floor pen was recovered with a litter material made up of non treated shaving woods of 5 cm of thickness and renewed every 4 days to avoid accumulation of feces and urine.

Trial management

The females were placed in a complete randomized design with 15 replications per treatment or per group. The 4 groups corresponded to the 4 levels of cassava leaf meal inclusion in the diet. At the beginning of the trial, males were allowed to mate naturally with females (4 males for 15 females) during 31 days, after which they were isolated. Females and their kids were identified using ear rings bearing numbers. Animals in all the groups received daily *P. purpureumad libitum* and as supplement 20g of one of the four rations with graded levels of cassava leaf meal / animal. *P. purpureum* was collected every day in the neighborhoods of the town and left to dry about 2 hours before given to animals. Branches of cassava leaves were taken from plants of cassava in the farms. Their leaves were cut off from branches and dried. After drying, they were crushed before their inclusion in the diets. The formulation of different rations was preceded by analysis of crude protein content of cassava leaf meal (CLM) and soybean meal. Supplements used in this study was made up of four rations with graded levels of cassava leaf meal (0, 8, 10 and 12%) named R0, R1, R2 and R3 respectively for group 1, 2, 3 and 4. The percentage composition of the feed components per rations used in the experiment is presented in table 1.

Experimental diets were given one time in the morning as follows:

- T0: *P. purpureumadlibitm*+ 20g of R0
- T1: *P. purpureumadlibitm*+ 20g of R1
- T2: *P. purpureumadlibitm*+ 20g of R2
- T3: *P. purpureumadlibitm*+ 20g of R3

Drinking water containing vitamin C was served to animals every day.

Data on post-partum weekly weights of dams and on birth weights, weaning weights, and weekly weights were recorded for the growth performance of the kids using an electronic scale of 3 kg with a precision of 1g.

Chemical analysis

Samplesof *P. purpureum,* cassava leaf meal, soybean meal and of those of the experimental diets were collected and dried at 60°C. The dried samples were milled through a 1mm screen prior to chemical analysis. The chemical composition was determined according to the methods of AOAC [3].

Data collection and statistical analysis

Data collected on the dams and on kids were subjected to analysis of variance following the general linear model (GLM) procedure. While significant differences between means were compared by Duncan's multiple range test [36].

III. Results and Discussion

Chemical composition of experimental diets

There were major differences in the chemical composition of the protein sources (Table 2). Crude protein was highest in soybean meal with lowest value for cassava leaf meal. Crude fiber was highest in cassava leaf meal and lowest in soybean meal.

The composition of the test diets (Table 3) reflected the differences in the composition of the protein sources, with lowest levels of crude protein for R3 diet, with exactly the opposite trend for the R0 diet. *P. purpureum* had the lowest protein level but encountered the highest crude fiber.

Growth weight

Post-partum weight of dams

The evolution of postpartum weights as reflected by the inclusion of graded levels of CLM (figure 1) in diets, showed decrease in weights of all dams from childbirth to weaning in all the groups. Weights of the dams of control group who does not receive cassava leaf meal in their diet (R0) decreased from 638 to 567 g and those of the 3 other groups receiving cassava leaf meal in their diets from 652 to 560g; 648 to 585g; 651 to 593g which gave a total decrease of 11.13; 14.11; 9.72 and 8.91% respectively in weights of dams receiving R0, R1, R2 and R3 treatments. There was no significant difference (P>0.05) between weights of the dams submitted to the 4 treatments.

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Table 1: Percentage composition of the feed components (ingredients) per rations

Ingredients	R0	R1	R2	R3
Corn	31	44	45	45
Wheat bran	48	31	30	28
Soybean cake	6	4	2	0
Cottonseed cake	2	1	1	2
Palm kernel cake	4	1	1	1
Fish meal	5	7	7	8
Bonemeal	2,5	2,5	2,5	2,5
Salt	1	1	1	1
BroilerPremix*	0,5	0,5	0,5	0,5
Cassavaleafmeal	0	8	10	12
Total	100	100	100	100

**Composition of BroilerPremix 0.5%: Vit. A=3000000 UI/kg, Vit. D3=600000 UI/kg, Vit. E=4000mg/kg, Vit. K3=500mg/kg, Vit. B1=200mg/kg, Vit. B2=1000mg/kg, Vit. B3=2400mg/kg, Biotine=10mg/kg, Vit. PP=7000mg/kg, Acide folique=200mg/kg, Choline chloride=10000mg/kg, Sulfate ferreux=8000mg/kg, Sulfate (II) cuivrique= 2000mg/kg, Oxyde manganeux=1400mg/kg, Iodate de calcium=200mg/kg, Carbonate basique de cobalt=200mg/kg, Sélénite de sodium=20mg/kg, Méthionine=20000mg/kg, Lysine=78000mg/kg*

Table 2: Chemical composition of cassava leaf (*Manihotesculenta*) and soybean meal

Experimentalfeeds	Chemical composition						
	Dry matter (%)	**Organicmatter (%DM)**	**Crudeprotein (%DM)**	**Crude fat (%DM)**	**Crudefiber (%DM)**	**Ash (%MS)**	**ME (Kcal/kg DM)**
Cassavaleafmeal	91.81	92.57	26.29	4.94	18.44	7.43	2280.97
Soybeanmeal	87.76	92.11	46.38	5.10	8.2	7.89	3179.19

Table 3: Chemical composition of the supplemented diets and of *P. purpureum* (% dry matter basis)

Composition	Treatments (Diets)				
	R0	**R1**	**R2**	**R3**	***P. purpureum***
Dry matter (%)	90.85	90.38	91.50	90.61	90.30
Organicmatter(% DM)	89.52	86.95	87.69	86.46	86.32
Crudeprotein (% DM)	19.00	18.75	18.81	17.18	7.89
Crude fat (% DM)	4.66	4.27	6.19	6.13	2.20
Crudefiber (% DM)	7.74	8.51	9.71	10.69	33.46
Ash (% DM)	10.48	13.05	12.31	13.54	9.68

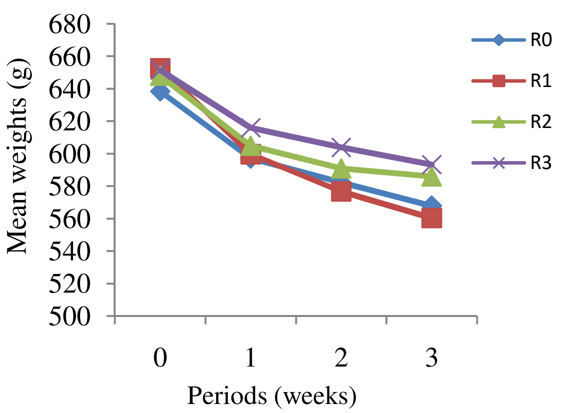

Fig.1. Evolution of postpartum weights as reflected by graded levels of CLM in the diets

Growth weight of young guinea pigs from birth to weaning

At birth, male weights were lowest in R3 treatment (94.62 ±9.88 g) and highest in R2 (102.07 ±8.99 g) with intermediate values for R1 (100.56±10.57g) and R0 (95.94±8.76 g) (figure 2). Nevertheless, no significant difference (P>0.05) was observed between these values according to treatment. There were major differences in weight at weaning in respect of the different treatment. Male weights of R2 were statistically (P<0.05) higher (213.21±20.93) than male weights of R0 (185.06±16.40), R1 (194.50±11.10) and R3 (196.77±14.96) which values were statistically (P>0.05) similar. Higher weights at birth were recorded by females of R1 (96.60±15.66) and lower weights by females of R0 (91.42±10.82). However, weights of females according to treatment did not differ significantly (P>0.05) at birth. But at weaning, females of R1, R2 and R3 have comparable (P>0.05) weight values respectively 186.07±18.67; 195.50±13.15 and 198.36± 20.20 and statistically higher (P<0.05) to weight value of females of R0 (178.00±17.46).

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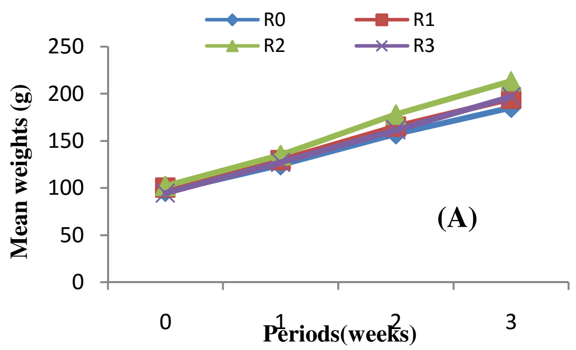
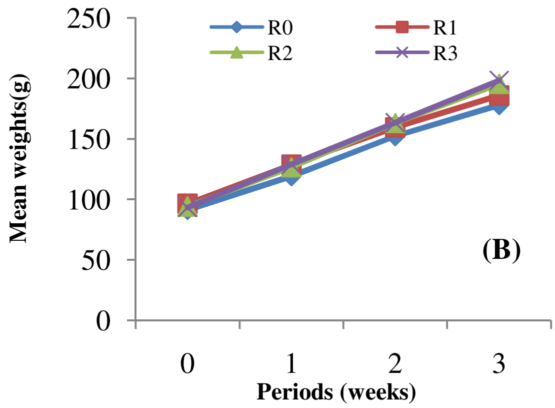
Independently of sexes, no significant difference (P>0.05) appeared between weight of young guinea pigs at birth. At weaning, major differences occurred with youngs of R2 having weight values statistically higher (P<0.05) than the youngs of R0 whose values were comparable (P>0.05) to R1 values. Besides, R2 and R3 on the one hand, R3 and R1 on the other hand presented similar values (P>0.05).

Weight gains of young guinea pigs from birth to weaning

Males receiving R2 diet obtained highest (P<0.05) total gains and DWG, followed by males of R3 diet and lastly by males of R0 and R1 diets which obtained comparables (P>0.05) but lowest values of these parameters (Table 4). Females receiving R2 and R3 diets on the one hand, R0 and R1 on the other hand obtained comparable (P>0.05) total gains and DMW values but the values of the former diets were statistically higher (P<0.05) to the values of the latter diets of the same parameters. Independently of sexes, animals of R2 and R3 diets compared to animalsof R0 and R1 diets obtained the same tendency observed on females.





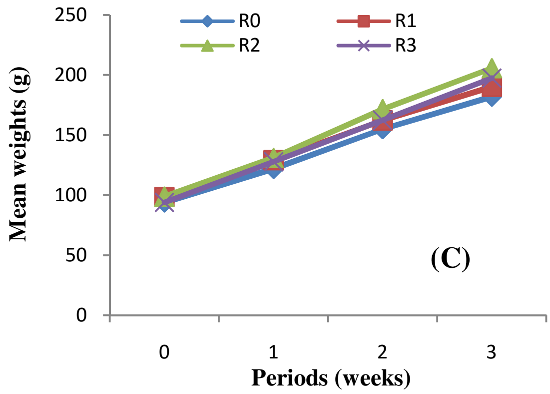


Fig.2. Cumulative curves of mean weights of young males (A), females (B) and independently of sexes (C) of guinea pigs from birth to weaning according to treatments

Table 4: Total gains and daily mean weights (DWG) of guinea pigs at birth and at weaning according to treatments

Paramètres		Treatments				SEM	P
		R0	R1	R2	R3		
Birthweight (g)	♂	95.94^{a}	100.56^{a}	102.07^{a}	94.62^{a}	1.28	0.127
	♀	91.42^{a}	96.60^{a}	94.10^{a}	93.27^{a}	1.67	0.718
	♂+♀	94.00^{a}	98.65^{a}	98.75^{a}	94.00^{a}	1.05	0.170
Weaning weight	♂	185.06^{b}	194.50^{b}	216.79^{a}	196.77^{b}	2.75	0.000
(g)	♀	178.00^{c}	186.07^{ab}	195.50^{a}	198.36^{a}	2.73	0.035
	♂+♀	182.04^{c}	190.42^{bc}	205.83^{a}	197.50^{ab}	1.85	0.000
Total gain (g)	♂	89.13^{b}	93.94^{b}	111.14^{a}	105.00^{a}	2.08	0.000
	♀	86.29^{c}	89.47^{bc}	100.44^{b}	102.23^{a}	2.09	0.003
	♂+♀	87.80^{b}	91.77^{b}	106.96^{a}	103.50^{a}	1.49	0.000
DWG	♂	4.24^{b}	4.47^{b}	5.29^{a}	5.00^{a}	0.10	0.000
(g)	♀	4.11^{c}	4.26^{bc}	4.78^{b}	4.87^{a}	0.10	0.010
	♂+♀	4.18^{b}	4.37^{b}	5.10^{a}	4.93^{a}	0.15	0.000

a, b, c : means without common superscript are different at P<0.05. DMW: daily weight gain; SEM: Standard error of means; P: probability.

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Discussion

The crude protein content of cassava leaves used as substitute to soybean meal in this study was 26.29% and similar to those reported in other studies [1; 40; 41; 16; 5; 39]. The relatively high crude protein content of these leaves confirmed earlier reports of many researchers[41, 21], that cassava leaves can be a dietary protein source in order to encourage the inclusion of the leaves in diets for animal livestock production. This value falls within a wide range of 14-40% [4, 41, 31, 9]. The protein content of soybean meal (46.38%) obtained in this study was higher than the one (41.8%) obtained by Hoang NghiaDuyet*et al.* [16]. This value proves the legitimate high protein content recognized to this feed used as conventional protein source hardly replaceable in animal diet formulations. Proximate protein contents of formulated diets were 19.00%, 18.75%, 18.81% and 17.18% on DM basis respectively for R0, R1, R2 and R3 diets. The R0 (control diet) diet which was the diet with 100% soybean inclusion as the main protein source had the highest protein content and the R3 diet with 100% cassava leaf meal inclusion as main protein source registered the lowest value. This is undoubtedly due to the fact that soybean is richer in protein than cassava leaves.

From birth to weaning, all nursing females have lost in weight in all groups. These results are similar to those of Pamo*et al.* [30]. Indeed, during lactation period, nursing females spend too much energy for milk production [20]. Requirements during lactation period are very difficult to cover, and the nursing female should make more effort to cover offsprings demands [18]. She should therefore, to ensure lactation period, call up her body reserves, this should have been an explanation to the loss of weight observed. Nevertheless, the higher weight loss has been observed in nursing females of R3 diet where there was 100% cassava leaves inclusion. This is perhaps due to the fact that cassava leaves have been proved to increase milk production [22] and so offsprings of this group suckled a lot and would have cost the higher loss in weights of their mothers.

At birth, males were heavier than females. This is in line with findings of several authors [37; 24; 25; 28]. Independently of sex and in all the groups, there were no significant difference (P>0.05) in mean weight values. In this study, newborns of R2 diet had the best weight at birth (98.75 g). This weight was higher than reported by Pamo*et al.* [30] (94g), by Niba*et al.* [25] (83.3g) when they were supplementing guinea pigs with *Moringaoleifera* and with *Desmodiumintortum* respectively. One can attribute this result to the well formulated balanced diets, their richness in protein given to their mothers during the gestation period. Indeed, proteins contribute to the increase in the number and the length of cells, hereby acting for muscle, hair and organs construction [29; 12]. It also confirms the importance of cassava leaves as good source of protein compared to soybean meal [34]. On the other hand, this weight was comparable to the observations of Tchoumboué*et al.* [37] when they were supplementing these animals with *Arachisglabrata* (98.9 g) and with *Desmodiumintortum* (100 g), of Noumbissi*et al.* [28] when they supplemented animals with *Tithonia diversifolia* (99.3 g) and inferior to weight obtained by Pamo*et al.* [30] (125g) when the animals were supplemented with multinutrient blocks. From the time of birth to the weaning period in all the groups, weight performances of kids were in agreement with reports of Cicogna [8] according which weight at weaning is commonly the double of the one at birth. This also express proper amounts of healthy food [29] and well digestible given to these animals. Between the groups, kids of R2 diet registered the highest (P<0.05) (205.83 g) value. This value was lower than that obtained by Pamo*et al.* [30] (263 g) when supplementing with multinutrient blocks. This weight was higher than the value obtained by Noumbissi*et al.* [28] (175.0 g), Tchoumboué*et al.* [37] (195 g) with supplementation with *Desmodiumintortum*, Fonteh*et al.* [14] (106-188g), Niba*et al.* [25] (188g), Niba*et al.* [24] (138g).

Kids of R2 diet had the highest (P<0.05) DMW (5.29 g/day) but comparable (P>0.05) with kids of R3 diet. This DMW value was comparable with observations of Pamo*et al.* [30] and Tchoumboué*et al.* [37] who obtained 5 and 4.5 g/day when supplementing with *Moringaoleifera* and *Arachisglabrata* respectively, but inferior to reports of Pamo*et al.* [30] who obtained 7 g/day when supplementing with multinutrient blocks. On the other hand, our DMW value was superior to that obtained by Noumbissi*et al.* [28] (3.73g/day), Fonteh*et al.* [14] (2.17 g/day). The difference in growth performances observed between animals of R2 diet and animals of the other groups can be explained by the “complementary principle” of the two sources of protein [2]. Indeed, if one associate one protein poor in a particular aminoacid, to a protein rich in that aminoacid, the overall value is improved. Even though cassava leaves and soybean meal are poorer in methionin [4], the content of other amino acids is more higher in cassava leaves [6]. The positive effect of the association of cassava leaf and soybean meal could have explained this difference. Thus R2 diet appears to be the best of all these 4 formulated diets. On the other hand, animals receiving R1 diet could have performed as animals receiving R2 diet. But they did not probably due to the poor inclusion of cassava leaf meal (8% of cassava leaf meal Vs 4% of soybean meal) in the diet compared to R2 diet (10% of cassava leaf meal Vs 2% soybean meal). Animal performances of R3 diet match animal performances of R0 diet. A result which implies that guinea pigs can be fed either on soybean meal or on cassava leaf meal with both the two protein sources exhibiting same performances.

IV. Conclusion

The present study has demonstrated that from birth to weaning, all nursing females have lost in weight in all groups. Nevertheless, the higher weight loss has been observed in nursing females of R3 diet where there was 100% cassava leaf meal inclusion. At birth independently of sexes and rations, no significant difference (P>0.05) appeared between weight of young guinea pigs. At weaning, youngs of R2 diet encountered the highest weight value (P<0.05). Animals receiving R2 and R3 diets had the highest (P<0.05) but comparables values on total gains and DWG. From an economical point of view, cassava leaf meal appears to be a protein supplement of choice for the improvement of growth performances of guinea pigs.

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