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INFLUENCE OF CASSAVA LEAF (MANIHOTESCULENTA CRANTZ) MEAL SUPPLEMENTATION ON THE NUTRITIVE VALUE OF CAVY (CAVIA PORCELLUS) MEAT

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The study investigates the use of Cassava Leaf Meal (CLM) as a cheaper alternative protein source to replace soybean cake in the diet of cavies. The effect of this replacement on the chemical composition of cavy meat was evaluated.Forty-eight guinea pigs (24 females and 24 males) were distributed in a completely randomized experimental design. The animals were divided into 4 groups and given Pennisetumpurpureumad libitumsupplemented with one of the experimental diets: RC0, RC8, RC10 and RC12 containing respectively 0, 8, 10 and 12 % of CLM. After 22 weeks, meat from the breast, thigh and shoulder, were analyzed. Results revealed that, water and ash contentsin all the meat types were similar (P>0.05) irrespective of sex and diet. Incorporating 8% and 12% CLM led to a significant increase (P<0.05) in protein levels in the breast (22.89%) and shoulder (22.43%) of females and in the thigh (21.68%) and shoulder (21.09%) of males. The lipid contents of female thighs (10.52%) and shoulders (15.95%) from diet RC12 were greater than for males (5.26 and 8.82%) given the same diet. CLM can satisfactorily replace soybeancake for growing cavies as a non-conventional source of highly nutritive animal protein.

Keywords: *Pennisetumpurpureum*, Soybean cake, Cassava leaf meal, Chemical composition, Cavy meat

INTRODUCTION

The rearing of non-conventional animal species is considered as the fastest and most effective strategy for reducing the deficit of animal proteins in the diets of people in developing countries (Defang *et al*., 2014; and Kenfack *et al*., 2015). The major role played by these species in income generation, food supply and financial security for rural populations has been demonstrated (Ngou Ngoupayou *et al*., 1995; and Niba *et al*., 2012). In this light, cavy husbandry seems an ideal option towards reducing animal protein deficiency in poor Cameroonian households (Ngou Ngoupayou *et al*., 1995).

Cavy (*Caviaporcellus*, Linnaeus, 1758) is a domestic rodent which is very prolific, rustic and with a high productivity rate (kg of meat produced per female per year) of 64.9% compared to 35% rate for sheep (Combes, 2004). In developing countries, they feed mainly on locally available forage and kitchen residues (Niba *et al*., 2012). Previous research work has shown that supplementing the diet with concentrates (soybean and cotton seed cakes, etc.) significantly improves the production performance of cavy (Fotso *et al*., 1995; and Ngou Ngoupayou *et al*., 1995). However, soybean cake is expensive forpoor households (Niba *et al*., 2012). Therefore alternative cheaper protein sources need to be identified for incorporation in cavy diets. Cassava leaf seems promising because it is relatively high in protein, cheap and easily available (Dada and Oworu, 2010).

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Irrespective of the animal species, certain factors influence the nutritive properties of the meat including the sex and feeding regime (Combes, 2004). The nutritive quality of cavy meat as influenced by these factors has not yet been evaluated in Cameroon, as is the case with other types of meat. This study therefore seeks to evaluate the effect of replacing soybean cake incavy diet with cassava leaf meal on the nutritive value of cavy meat.

MATERIALS AND METHODS

Experimental Site

The study was carried out at the Research farm, the Food science/nutrition and the Soil science laboratories of the University of Dschang. Dschang is found in the Western region of Cameroon (Central Africa) and located at longitude 10°26' East and latitude 5°26' north of the Equator.

Animals and Housing

Forty eight adult guinea pigs (cavies) comprising 24 males and 24 females were used for the study. All were 22 weeks old with an average weight of 522.21±28.88 g (for the females) and 566.75±43.13 g (for the males). The animals were raised in pens at the research farm. The floor of the pens was covered with saw dust which was replaced every two days. Throughout the study period, each pen was heated by an electric bulb.

Feeding Rations and Experimental Design

Four rations: RC0, RC8, RC10 and RC12 (Table 1) were formulated by gradually increasing the proportion of cassava leaf meal (CLM) (0, 8, 10 and 12%) in replacement of soybean cake in the control ration. The feeding rations were established based on cavy's nutrient requirements as recommended by Numbelaand Valencia (2003). CLM was obtained by harvesting leaves from cassava plants growing at the Dschang University farm. The leaves were sun dried, ground and stored in plastic bags until used.Each of the 4 rations was assigned randomly to 4 groups of animals. The animals were distributed in a completely randomized block design with 12 replicates per ration, six of which were per sex and per group. The weight of the corresponding experimental ration provided to each group was recorded, water and *Pennisetumpurpureum* were served *ad libitum*. Feed was administered once daily (between 6 and 8 am). The water provided contained vitamin C and was replaced every morning.

Data Collection

Preparation of the Meat Samples

After 22 weeks of feeding, 12 animals (6 males and 6 females) per ration were deprived of feed for 12 hours. They were killed by puncturing of the jugular vein. After bleeding was complete, the carcasses were eviscerated and dressed. Meat (150 g) was collected from the thighs, breasts and shoulders respectively and used for chemical analysis.

Chemicalanalysis

Dry Matter (DM), crude ash, crude fat (lipid) and crude protein contents were obtained as described (AOAC, 1990). Moisture content was obtained using the formula: % Moisture = 100-DM.

Statistical Analysis

Analysis of variance (ANOVA) was done using the General Linear Model approach (SPSS version 19.0). Means were separated for significant differences ($p<0.05$) using Duncan's multiple range test (Steel and Torrie, 1980).

RESULTS

Moisture Content

The moisture contents of the different cavy meat types in relation to sex and feeding ration are presented in Table 2. Irrespective of the feeding ration and meat type, the moisture content varied from 60.38 to 75.39%. With respect to sex, the moisture content in female breast given ration RC12 (65.56%) was significantlylower ($P<0.05$) than for males given the same ration (71.97%). Still for the breast, the moisture content was statistically similar ($P>0.05$) in all the other rations compared to that in the control, irrespective of sex.Irrespective of feeding ration or sex, the moisture content in the thigh did not vary significantly ($P>0.05$). However, the moisture contents of the shoulder meat from rations RC0, RC8 and RC12 were significantly higher ($P<0.05$) in males than in females.

Protein Content

The protein content in the different meat types varied from 13.64 to 21.68% in male carcasses and from 13.58 to 22.89% in females (Table 3). The protein contents in the breast of males in the supplemented rations were respectively similar ($P>0.05$)to that in the control ration.However, the protein content in the breast of females was significantly higher ($P<0.05$)in ration RC8 (22.89%) than in the other rations. The protein content in male thigh was significantly higher

Table 1: Composition of Experimental Rations and of *P. purpureum*

Ingredients	Rations				
	RC0	RC8	RC10	RC12	*P. purpureum*
Maize	31	44	45	45	
Wheat bran	48	31	30	28	
Soyabean cake	6	4	2	0	
Cottonseed cake	2	1	1	2	
Palm kernel cake	4	1	1	1	
Fish flour	5	7	7	8	
Bone flour	2	2	2	2	
Iodised salt	1	1	1	1	
Premix* 0.5%	1	1	1	1	
CLM	0	8	10	12	
Total	100	100	100	100	
Chemical Composition					
Dry matter (%)	90.85	90.38	91.5	90.61	90.3
Organique matter (% DM)	89.52	86.95	87.69	86.46	86.32
Crude proteines (% DM)	19	18.75	18.81	17.18	7.89
Crude fat (% DM)	4.66	4.27	6.19	6.13	2.2
Crude fiber (% DM)	7.74	8.51	9.71	10.69	33.46
Ash (% DM)	10.48	13.05	12.31	13.54	9.68
ME (Kcal/KgDM)	2915.65	2896	2837.29	3045.51	407.18

Note: * Premix 0.5% flesh: Vit. A = 3000000 UI/kg, Vit. D3 = 600000 UI/kg, Vit. E = 4000 mg/kg, Vit. K3 = 500 mg/kg, Vit. B1 = 200 mg/kg, Vit. B2 = 1000 mg/kg, Vit. B3 = 2400 mg/kg, Biotin = 10 mg/kg, Vit. PP = 7000 mg/kg, Folic acid = 200 mg/kg, Choline chloride=10000mg/kg, Iron sulfate = 8000 mg/kg, Copper (II) sulfate = 2000 mg/kg, manganese oxide = 1400 mg/kg, Calcium iodate = 200 mg/kg, Cobalt carbonate = 200 mg/kg, Sodium selenite = 20 mg/kg, Methionine = 20000 mg/kg, Lysine = 78000 mg/kg, ME: Metabolizable energy; CLM: Cassava Leaf meal.

(P<0.05)in ration RC12 (21.68%) compared to the other rations; but no significant differences between rations were observed in female thighs (P>0.05). For the male shoulder, the protein content in ration RC12 (21.09%) was significantly higher (P<0.05) than in the other rations. Furthermore, proteinwas significantly lower (P>0.05) in rations RC8 (13.91%) and RC10 (13.64%) compared to the control ration(18.60%). The protein in female shoulder from rations RC10 (16.55%) and RC12 (13.58%) were similar (P>0.05) to that of the control ration RC0 (15.29%), while that of ration RC8 (22.43%) was significantly (P<0.05) higher in comparison to the other rations. With respect to sex, the protein contents in RC8 and RC10 was higher in females than males, irrespective of the meat type.

Lipid Content

The lipid contents from different meat types varied between 5.26 and 12.73% in males and between 6.24 and 15.95% in females (Table 4).The lipid content in the breast showed no significant difference (P>0.05)between males and females irrespective of the ration given. No significant differences were observed in female thigh and shoulder irrespective of the ration given. However, the lipid contents in male thigh

Table 2: Moisture Content (%) of Various Cavy Meat Types with Respect to Inclusion Level of Cassava Leaf Meal

			Rations			
	Meat Type		RC0	RC8	RC10	RC12
Moisture Content (%)	Breast	♂	$73.2 \pm 0.72^{a}_{A}$	$73.62 \pm 1.09^{a}_{A}$	$73.54 \pm 1.75^{a}_{A}$	$71.97 \pm 1.09^{a}_{A}$
		♀	$68.65 \pm 1.87^{a}_{A}$	$70.37 \pm 0.80^{a}_{A}$	$71.64 \pm 2.07^{a}_{A}$	$65.56 \pm 2.66^{a}_{B}$
	Thigh	♂	$73.56 \pm 0.95^{a}_{A}$	$75.39 \pm 1.65^{a}_{A}$	$74.56 \pm 0.23^{a}_{A}$	$73.16 \pm 1.39^{a}_{A}$
		♀	$71.05 \pm 1.55^{a}_{A}$	$73.23 \pm 0.48^{a}_{A}$	$69.01 \pm 2.19^{a}_{A}$	$69.19 \pm 2.09^{a}_{A}$
	Shoulder	♂	$72.95 \pm 0.03^{a}_{A}$	$74.86 \pm 1.36^{a}_{A}$	$70.45 \pm 0.24^{a}_{A}$	$70.54 \pm 0.53^{a}_{A}$
		♀	$66.58 \pm 1.05^{a}_{B}$	$70.99 \pm 1.26^{a}_{B}$	$70.40 \pm 1.29^{a}_{A}$	$60.38 \pm 2.29^{a}_{B}$

Note: $^{a, b}$ Means in the same row with a common letter are not significantly different (P>0.05). $_{A, B}$: Means in the same column with a common letter are not significantly different (P>0.05).

Table 3:Protein Content (% Fresh Matter) of Various Cavy Meat Types with Respect to Inclusion Level of Cassava Leaf Meal

			Rations			
	Meat Type		RC0	RC8	RC10	RC12
Protein Content (%)	Breast	♂	$20.28 \pm 0.72^{a}_{A}$	$19.44 \pm 0.55^{a}_{A}$	$20.23 \pm 1.01^{a}_{A}$	$20.51 \pm 1.50^{a}_{A}$
		♀	$17.20 \pm 0.99^{a}_{A}$	$22.89 \pm 0.67^{b}_{A}$	$22.74 \pm 0.37^{c}_{A}$	$16.19 \pm 1.35^{a}_{B}$
	Thigh	♂	$18.74 \pm 0.89^{a}_{A}$	$17.68 \pm 0.93^{a}_{A}$	$15.34 \pm 0.09^{b}_{A}$	$21.68 \pm 1.10^{c}_{A}$
		♀	$18.04 \pm 1.43^{a}_{A}$	$20.09 \pm 0.14^{a}_{B}$	$18.11 \pm 0.51^{a}_{B}$	$17.17 \pm 0.66^{a}_{B}$
	Shoulder	♂	$18.60 \pm 0.41^{a}_{A}$	$13.91 \pm 0.93^{b}_{A}$	$13.64 \pm 0.23^{c}_{A}$	$21.09 \pm 0.60^{d}_{A}$
		♀	$15.29 \pm 0.71^{a}_{B}$	$22.43 \pm 1.31^{b}_{B}$	$16.55 \pm 0.48^{a}_{B}$	$13.58 \pm 0.79^{a}_{B}$

Note: $^{a, b}$ Means in the same row with a common letter are not significantly different (P>0.05). $_{A, B}$: Means in the same column with a common letter are not significantly different (P>0.05).

Table 4: Lipid Content (% Fresh Matter) of Various Cavy Meat Types with Respect to Inclusion Level of Cassava Leaf Meal

			Rations			
	Meat Type		RC0	RC8	RC10	RC12
Lipid Content (%)	Breast	♂	$6.83 \pm 0.10^{a}_{A}$	$7.78 \pm 1.28^{a}_{A}$	$7.25 \pm 0.39^{a}_{A}$	$6.13 \pm 0.04^{a}_{A}$
		♀	$7.70 \pm 1.13^{a}_{A}$	$6.45 \pm 2.24^{a}_{A}$	$6.46 \pm 1.67^{a}_{A}$	$8.90 \pm 0.04^{a}_{A}$
	Thigh	♂	$7.30 \pm 0.33^{a}_{A}$	$8.94 \pm 0.24^{b}_{A}$	$8.45 \pm 0.67^{a}_{A}$	$5.26 \pm 0.28^{c}_{A}$
		♀	$9.04 \pm 1.00^{a}_{A}$	$6.24 \pm 0.05^{a}_{A}$	$7.85 \pm 1.86^{a}_{A}$	$10.52 \pm 0.61^{a}_{B}$
	Shoulder	♂	$10.15 \pm 0.45^{a}_{A}$	$12.73 \pm 0.31^{b}_{A}$	$12.30 \pm 0.50^{c}_{A}$	$8.82 \pm 0.30^{d}_{A}$
		♀	$13.77 \pm 0.55^{a}_{B}$	$10.47 \pm 0.77^{a}_{A}$	$13.50 \pm 1.92^{a}_{A}$	$15.95 \pm 0.99^{a}_{B}$

Note: $^{a, b}$ Means in the same row with a common letter are not significantly different (P>0.05). $_{A, B}$: Means in the same column with a common letter are not significantly different (P>0.05).

Table 5: Ash Content (% DM) of Various Cavy Meat Types with Respect to Inclusion Level of Cassava Leaf Meal

			Rations			
	Meat Type		RC0	RC8	RC10	RC12
Ash Content (%)	Breast	♂	$5.17 \pm 0.94^{a}_{A}$	$4.11 \pm 0.93^{a}_{A}$	$5.43 \pm 0.74^{a}_{A}$	$4.63 \pm 0.38^{a}_{A}$
		♀	$5.00 \pm 0.42^{a}_{A}$	$3.90 \pm 1.27^{a}_{A}$	$5.03 \pm 0.25^{a}_{A}$	$4.93 \pm 0.26^{a}_{A}$
	Thigh	♂	$5.64 \pm 0.69^{a}_{A}$	$4.27 \pm 0.03^{a}_{A}$	$5.33 \pm 0.49^{a}_{A}$	$4.34 \pm 0.62^{a}_{A}$
		♀	$5.79 \pm 0.30^{a}_{A}$	$5.77 \pm 0.19^{a}_{A}$	$5.50 \pm 0.71^{a}_{A}$	$5.30 \pm 0.42^{a}_{A}$
	Shoulder	♂	$5.50 \pm 1.34^{a}_{A}$	$4.56 \pm 1.49^{a}_{A}$	$5.43 \pm 0.68^{a}_{A}$	$5.70 \pm 0.63^{a}_{A}$
		♀	$5.11 \pm 0.28^{a}_{A}$	$4.85 \pm 0.35^{a}_{A}$	$4.99 \pm 0.01^{a}_{A}$	$4.32 \pm 1.87^{a}_{A}$

Note: $^{a, b}$ Means in the same row with a common letter are not significantly different (P>0.05). $_{A, B}$: Means in the same column with a common letter are not significantly different (P>0.05).

from rations RC8 (8.94%) and RC12 (5.26%) were significantlydifferent(P<0.05) from those of RC0 (7.30%) and RC10 (8.45%). For male shoulder, the lipid content was significantly higher (P<0.05) in ration RC8 (12.73%) and RC10 (12.30%) than in the other two rations. With respect to sex, the lipid contents of female shoulder from rations RC12, RC0 and female thigh from ration RC12 were significantly higher (P<0.05) than for males.

Ash Content

Irrespective of the ration given, sex and meat type analyzed, the ash contents of the animals in the rations receiving cassava leaf meal were not significantly different (P>0.05)from those given the control ration RC0 (Table 5). Nevertheless, the ash content was highest in the thigh of females receiving the control ration RC0 (5.79%) and lowest in breast of females receiving ration RC8 (3.90%).

DISCUSSION

Irrespective of meat type or sex, the incorporation of CLM did not seem to significantly affect the moisture content (P>0.05). These results are similar to that reported by Horcada *et al*. (1998) who reported no sex influence on the moisture content of meat from the *Longissimusdorsi* of Spanish lambs. The high moisture content in cavy meat recorded in this study varied between 60 and 75%, whichis similar to that of rabbit (66%) and that of chicken (75%) as reported by Nout *et al*. (2003) andCombes (2004). It was also similar to that of beef (72-75%) as reported by Fonteh *et al.* (2015) and that of pork (55-75%) as reported by Cheftel *et al.* (1985). However, cavy meat is lower in moisture content than meat from wild cane rat (77.35%) (Nteme Ella *et al*., 2014).

The incorporation of 12% cassava leaf meal (RC12) in cavy diet seemed to have improved protein content of meat from male cavies especially at the thigh and shoulder regions. Thesemeat types showed sex differences in protein content. These results are contrary to those of Pugliese *et al.* (2004) and Nteme Ella *et al*. (2014) who reported that sex did not influence the protein content ofpork of cane rats respectively. Compared to meat from other animal species, the average protein content of cavy meat (18.24%) is similar to that of pork (18.2%) as reported by Rinaldo and Mourot (2002) and that of rabbit (19.5-22.5%) as reported by Combes (2004). However, cavy meat is lower in protein content in comparison to chicken which varies between 20 and 20.5% (Nout *etal*. 2003) and beef which varies between 22 and 25% (Fonteh *et al.*, 2015).

Overall, the lipid content was higher in all meat types from females given rations RC0 and RC12 compared to males given the same ration. Sex influence observed in this study agrees with the results of Horcada *et al.* (1998) who, using the *Longissimusdorsi* muscle of lambs reported that the fat content was higher in females (2.74-3.54%) than in males (1.87-3.15%) but is contrary to Nteme Ella *et al*. (2014) who reported no such influence. Our results also corroborate those of Combes (2004) who reported that lipid content varies with the anatomical part of the animal. Our results show that cavy meat has an average lipid content of 10.61% which is higher than reported for veal (1-7%), chicken (0.9 to 12%), bullock (3 to 14%) as reported by Dalle (2004) as

well as that of cane rat (1.4-1.47%) as reported by Nteme Ella *et al*. (2014). It is however lower than that of pork (3 to 22%) as reported by Dalle (2004). Cavy meat is considered as to be fatty because its lipid content is greater than 6% (Mirand and Remond, 2008).

Irrespective of feeding regime or sex, the ash content in the different meat types were similar ($p<0.05$), implying that the introduction of cassava leaf meal did not influence ash content. The values obtained in our study varied between 3.90 and 5.79%, indicating that cavy muscle is a good source of minerals. The values obtained are similar to that reported by Olusola *et al*. (2012) for beef (4.42%) but higher than that of cane rat (1.2%) as reported by Nteme Ella *et al*. (2014).

CONCLUSION

The resultsof thisstudy have shownthat the incorporation of cassavaleafmealin cavydietled to the production good qualitycavymeatwhoseprotein content issimilar to that of rabbit andpork.Furthermore, chemicalanalysisrevealedthat the nutrient content varies with the part of the animal as well as withthe sex of the animal. The meat parts studied (breast, thigh, shoulder) wererich in protein, moisture and ash contents. Proteinwashighest in the breast (22.89%) of femalesreceiving ration RC8, lipidwashighest in the shoulder (15.95%) of femalesreceiving ration RC12 and ash washig hest in the thigh (5.79%) offemalesreceiving the control diet RC0. Therefore cassava leaf meal can satisfactoritly repalce soyabean meal in growing cavies as a non-conventional source of animal protein.

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