World Rabbit Science

World Rabbit Sci. 2024, 32: 21-29
https://doi.org/10.4995/wrs.2024.19616
WRSA, UPV, 2003

GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF RABBITS FED CONCENTRATE DIETS CONTAINING GRADED LEVELS OF *BRASSICA OLERACEA* OUTER LEAVES AND *MUSA PARADISIACA* LEAVES

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Abstract: Ninety-six (96) 8-wk-old "mixed breed" of New Zealand white, California white and chinchilla rabbits were used to determine the growth performance, carcass and organ percentages of rabbits fed concentrate diets containing graded levels of *Brassica oleracea* outer leaves and *Musa paradisiaca* leaves. The rabbits were assigned to two groups of 48. Those in group 1 were allotted to four dietary treatments with concentrate diets containing 0, 10, 20 and 30% inclusion levels of *B. oleracea* outer leaves for one week and 12-wk adaptation and testing periods, respectively, for growth performance evaluation. Similar treatment and design were adopted for group 2 rabbits using graded levels of *M. paradisiaca* leaves. Six rabbits were randomly selected from each treatment group for slaughter at the end of the testing period for carcass and internal organ characteristics evaluation. There were no dietary effects on the parameters of rabbits fed graded levels of *B. oleracea* outer leaves except for *M. paradisiaca,* where the control diet had the lowest feed intake and the least (P<0.05) feed conversion ratio comparable to 30% inclusion level and final body weight, which was the highest (P<0.05) for rabbits fed diets containing 10 and 20% inclusion levels of *M. paradisiaca* leaves. The cost of feed was highest for the control diets, and reduced with increasing inclusion levels of the leaves in the diets. None of the rabbits died during the experimental period. The findings suggest that rabbits can be fed concentrate diets containing *B. oleracea* outer leaves and *M. paradisiaca* leaves up to 30% inclusion level for good growth performance and high carcass characteristics at a lower production cost than concentrate diets, while maintaining good health.

Key Words: carcass, forages, rabbits, intake, internal organs.

INTRODUCTION

Generally, forages are good sources of protein and their inclusion in rabbit diets results in reduction in feeding costs (Lebas *et al.,* 1986), with improvement in feed intake, growth performance and dressing percentage (Gayrard *et al.,* 2022, 2023). Forages in the form of crop residues are often considered as waste products and discarded. On the other hand, forages can substitute much of the grain in rabbit diets and lessen the need for concentrate when the right ratio of nutrients is present (Arijeniwa *et al.,* 2000).

Brassica oleracea, cabbage, is a vegetable in high demand in Ghana. It is produced all year round in the urban centres, with about eight different varieties grown in the country (Timbilla and Nyarko, 2004). The green cabbage usually grown in Ghana is a rich source of nutrients and contains, on a dry weight basis, 11.84% crude protein, 1.89% crude lipid, 8.1% acid detergent fibre, 23.14 natural detergent fibre, 8.75% ash and 16.58% gross energy

Correspondence: D.Y. Osei, *doysgh@yahoo.com.* Received *April 2023* - Accepted *January 2024.*
https://doi.org/10.4995/wrs.2024.19616

Cite as: Osei D.Y., Apori S.O., Hagan J.K., Amedorme D., Ayizanga R. 2024. Growth performance and carcass characteristics of rabbits fed concentrate diets containing graded levels of *Brassica oleracea* outer leaves and *Musa paradisiaca* leaves. *World Rabbit Sci., 32: 21-29. https://doi.org/10.4995/wrs.2024.19616*

(Mahgoub *et al.,* 2018). *Musa paradisiaca*, plantain or cooking banana, is one of the most important crops of the tropical plants (Okareh *et al.,* 2015), and considered as a major food item in the middle and southern parts of Ghana. A study by Okareh *et al.* (2015) showed that plantain leaves contained, on a dry weight basis, 19.4% crude protein, 1.8% crude lipid, 8.1% crude fibre, 7.2% ash and 54.6% carbohydrate. *M. paradisiaca* and *B. oleracea* were ranked among trees and forbs, respectively, providing the most available and acceptable forages for rabbits in the Coastal Savannah ecological zone of Ghana (Osei *et al.,* 2019). However, the outer leaves of *B. oleracea* and *M. paradisiaca* leaves are by-products often left in the farm as wastes after harvesting of the hard core and fruit.

Several studies have been undertaken on the use of concentrate diets containing forages or supplemented with forages for feeding rabbits in tropical Africa (Makinde *et al.,* 2015, 2016; Enyenihi *et al.,* 2019). However, there appears to be only a few studies undertaken on the use of composite diets containing crop residues for feeding rabbits in Ghana. This study was therefore carried out to determine the effect of concentrate diets containing graded levels of *B. oleracea* outer leaves and *M. paradisiaca* leaves on growth performance, carcass and internal organ characteristics of grower rabbits.

MATERIALS AND METHODS

Study location

The study was conducted at the Council for Scientific and Industrial Research-Animal Research Institute (CSIR-ARI) Accra, Ghana located in the Adentan Municipal Assembly at latitude 5' 43" north and longitude 0' 09" west. The average annual rainfall in the zone is 730 mm, with two rainy seasons. There is very little variation in temperature throughout the year, and the mean monthly temperature ranges from 24.7°C to 28.0°C with an annual average of 26.8°C (Ghana Statistical Service, 2014).

Experimental diets

B. oleracea outer leaves and *M. paradisiaca* leaves, collected from a farm near the experimental station, were cleaned of contaminants with water, cut into small pieces and spread on a washed floor under a shed to dry over a period of 14 d and milled. The milled leaves were incorporated into diets containing maize, soymeal, wheat bran, corn cob, oyster shell, salt, lysine, methionine, dicalcium phosphate and premix, at 0, 10, 20 and 30% inclusion levels (Tables 1 and 2). The ingredients in the diets were adjusted to achieve crude protein levels from 16.8 to 17.9%, nitrogen free extract (NFE) of 60.50 to 65.89% dry matter to meet the rabbits' requirements. All the diets contained premix of similar composition.

Experimental animals and housing

A total of 96 eight-weeks-old weaned "mixed breed" of New Zealand White, California and chinchilla rabbits were used in the study. Two same-sex kits were housed in a wire mesh cage with a wooden frame, measuring 40×40×50 cm (width×length×height), equipped with a plastic feeding trough and an automatic watering facility. Six hutches, with three rows of six cages each, were placed on concrete blocks 70 cm above ground level, under *Azadirachta indica* canopy in an area with natural ventilation and lighting, and identified by treatment and replicate numbers.

Experimental design and dietary treatments

The weaner kits were randomly assigned to two groups of 48 (24 males and 24 females) each. Rabbits in each group were randomly allotted to four dietary treatments of 12 kits, six of each sex. Each treatment was replicated three times with four animals, two of each sex, per replicate. In the first group, the treatments were concentrate diet without *B. oleracea* outer leaves as control, and concentrate diets containing 10, 20 and 30% inclusion levels of the leaves. Similar treatments were applied to rabbits in the second group fed with diets containing graded levels of *M. paradisiaca* leaves. The kits were adapted to the experimental diets for one week, followed by a 12-wk testing period. Based on the amount of feed consumed during the adaptation period, rabbits in each cage were initially offered 240 g (120 g per animal) of the diet per day, and increased as the feed consumption increased. The feed

Table 1: Ingredients and nutrient composition of diets containing graded levels of *Brassica oleracea* outer leaves.

	B. oleracea inclusion rate (%)			
Ingredients	0	10	20	30
Maize	52.00	47.00	47.00	45.00
Soymeal	21.00	14.00	11.00	8.00
Wheat bran	5.00	16.00	10.00	5.00
Dicalcium Phosphate	0.90	0.90	0.90	0.90
Oyster shells	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50
Lysine	0.20	0.20	0.20	0.20
Methionine	0.15	0.15	0.15	0.15
Corn cob	18.00	9.00	8.00	8.00
Premix[1]	0.25	0.25	0.25	0.25
B. oleracea outer leaves	0.00	10.00	20.00	30.00
Analysed nutrients (%)				
Dry matter	89.60	83.50	88.20	84.00
Ash	5.40	7.80	9.50	10.10
Crude protein	17.70	17.40	16.80	17.70
Ether extract	2.50	2.70	2.40	2.30
Crude fibre	8.60	9.00	9.10	9.40
Calculated nutrients				
NFE	65.80	63.10	62.20	60.50

[1]Premix composition per kg diet: Vit. A: 12 000 000 IU; Vit. E: 15 000 mg; Vit. B1: 1500 mg; Niacin: 30 000 mg; Vit. B6: 1500 mg; Vit. D3: 4 500 000 mg; Vit. K3: 3000 mg; Pantothenic acid: 12 000 mg; Vit. B12: 10 000 mg; Vit. B2: 6000 mg; Folic acid: 800 mg, Iron: 60 000 mg; Copper: 75.00 mg; Iodine: 750 mg; Manganese: 130 000 mg; Zinc: 70 000 mg; Selenium: 300 mg; Calcium: 17.50%, Lysine: 1330 mg; Methionine: 1075 mg; B-Carotenic acid: 350 mg. NFE: Nitrogen Free Extract.

provided and remaining uneaten were weighed daily before the next feeding, and the rabbits were weighed at the start and end of the feeding period. Fresh drinking water was provided *ad libitum* throughout the experimental period, and routine prophylaxis was provided to the animals prior to the adaptation period.

Dressing and internal organ evaluation

Six rabbits, comprising three of each sex, were randomly selected from each treatment group at the end of the 12-wk testing period, starved overnight to clear the guts, and the live weights taken. The rabbits were stunned mechanically, bled by severing the carotid artery and jugular vein at the level of the atlas vertebra with a sharp knife and allowed to bleed for 30 min with the head down. The head, tail, feet, pelt, gastrointestinal tract and other gut contents were removed and carcasses prepared as recommended by Blasco and Ouhayoun (1996). The internal organs, comprising heart, lungs, liver, kidneys and spleen, were separated and blotted dry of blood.

Data collection and analysis

Data collected were the rabbit initial and final body weights, feed supplied and left uneaten, live weight at slaughter, dressing and internal organs weights. Parameters calculated were total and average daily weight gains, total and average feed intakes, feed conversion ratio, cost of feed, dressing percentage and internal organs, comprising liver, heart, lungs, kidney and spleen percentage of live weight. The data generated were subjected to Analysis of Variance as outlined by the Generalized Linear Model of the GenStat Discovery Edition (VSN International, 2010) in a completely randomised design according to the model below: $Y_{ij}=\mu+T_i+E_{ij}$

Table 2: Ingredients and nutrient composition of diets containing graded levels of *Musa paradisiaca* outer leaves.

	M. paradisiaca inclusion rate (%)			
Ingredients	0	10	20	30
Maize	52.00	41.50	44.50	44.00
Soymeal	21.00	14.50	11.50	10.50
Wheat bran	5.00	20.00	15.00	6.00
Dicalcium Phosphate	0.90	0.90	0.90	0.90
Oyster shells	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50
Lysine	0.20	0.20	0.20	0.20
Methionine	0.15	0.15	0.15	0.15
Corn cob	18.00	10.00	5.00	5.50
Premix[1]	0.25	0.25	0.25	0.25
M. paradisiaca leaves	0.00	10.00	20.00	30.00
Analysed nutrients (%)				
Dry matter	89.60	90.30	90.00	89.70
Ash	6.60	8.70	8.40	8.90
Crude Protein	17.50	17.80	16.80	17.80
Ether extract	2.50	2.20	2.10	2.01
Crude fibre	8.60	9.90	9.70	9.80
Calculated nutrients				
NFE	64.80	61.40	63.00	61.49

[1]Premix composition per kg diet: Vit. A: 12000000 IU; Vit. E: 15000 mg; Vit. B1: 1500 mg; Niacin: 30000 mg; Vit. B6: 1500 mg; Vit. D3: 4 500000 mg; Vit. K3: 3000 mg; Pantothenic acid: 12000 mg; Vit. B12: 10000 mg; Vit. B2: 6000 mg; Folic acid: 800 mg, Iron: 60000 mg; Copper: 75.00 mg; Iodine: 750 mg; Manganese: 130000 mg; Zinc: 70000 mg; Selenium: 300 mg; Calcium: 17.50%, Lysine: 1330 mg; Methionine: 1075 mg; B-Carotenic acid: 350 mg. NFE: Nitrogen Free Extract.

Y_{ij} is the response variable, such as initial body weight, final body weight, total weight gain, average daily weight gain, total feed intake, average daily feed intake and feed conversion ratio. μ is the overall mean; T_i is the different inclusion levels for each individual forage and E_{ij} is the residual error. Least Significant Difference (LSD) Test was used to separate means at (P<0.05) level of significance and the results were expressed as means±standard error of means.

RESULTS

Growth performance, feed conversion ratio and cost of concentrate diets containing graded levels of Brassica oleracea *outer leaves*

Initial and final body weights, total and average daily feed intakes, total and average daily weight gains, and feed conversion ratio of rabbits fed concentrate diets containing graded levels of *B. oleracea* outer leaves were not significantly different (P>0.05) among the treatment groups (Table 3). However, rabbits fed concentrate diet containing 20% inclusion level of *B. oleracea* leaves tended to have higher initial and final body weights, final and daily weight gains, and total and daily feed intakes, and the feed conversion ratio tended to be higher for rabbits fed the control diet and lower for rabbits fed the concentrate diet containing 30% inclusion level of the leaves. The cost of feed was highest for the control diet, and reduced with increasing forage inclusion levels in the diets. The rabbits were healthy throughout the experimental period.

Table 3: Growth performance of rabbits fed diets containing graded levels of *Brassica oleracea* outer leaves, feed conversion ratio and cost of feeding.

	B. oleracea outer leaves inclusion levels (%)						
Parameter	0	10	20	30	No.	SEM	*P-value*
Initial body weight (g)	823.3	841.1	854.5	820.7	48	16.0	0.405
Final body weight (g)	2246	2233	2338	2251	48	30.9	0.080
Average daily weight gain (g)	16.9	16.6	17.7	17.0	48	0.4	0.325
Average daily feed intake (g)	84.1	81.3	84.8	78.3	48	2.8	0.354
Feed conversion ratio	5.0	4.9	4.8	4.6	48	0.2	0.475
Cost of feed (Gh¢/kg)	1.59	1.4	1.31	1.2	48		

SEM: standard error of means. No.: number of rabbits used. Gh¢/kg: Ghanaian Cedis Currency per kilogram. Least square means. Effect of diet analysed.

Growth performance, feed conversion ratio and cost of concentrate diets containing graded levels of Musa paradisiaca *leaves*

Growth performance of rabbits, feed intake and conversion ratio, and cost of concentrate diets containing graded levels of *M. paradisiaca* leaves are presented in Table 4. Rabbits fed the control diet and diets containing 10 and 20% inclusion levels of *M. paradisiaca* leaves had higher ($P<0.05$) final body weights compared to that of rabbits fed the diet containing 30% inclusion level of the leaves. However, rabbits fed the control diet and 30% inclusion level of the *M. paradisiaca* leaves had no significantly different ($P>0.05$) final weight gain. The total and average daily feed intake was higher ($P<0.05$) for rabbits fed 10, 20 and 30% inclusion levels of the *M. paradisiaca* as compared to rabbits fed the control diet. The feed conversion ratio was higher ($P<0.05$) for rabbits fed 30% inclusion levels as compared to rabbits fed the control diet. However, there was similarity between rabbits fed the control diet and diets containing 10 and 20% inclusion levels of the leaves. The feed cost was highest for the control diet, and reduced with increasing forage inclusion levels in the diets. The rabbits were healthy and no mortalities occurred during the experimental period.

Live weight at slaughter, dressing and internal organs percentage of rabbits fed graded levels of Brassica oleracea *outer leaves*

The live weight at slaughter, dressing and internal organs percentage of live weight of rabbits fed the concentrate diets containing graded levels of *B. oleracea* outer leaves are shown in Table 5. There were no dietary effects ($P>0.05$) in the parameters measured. However, the rabbits fed diet containing 10% inclusion level of the *B. oleracea* outer leaves tended to have higher slaughter weight, while rabbits fed control diet tended to have higher dressing, lung

Table 4: Growth performance of rabbits fed diets containing graded levels of *Musa paradisiaca* leaves, feed conversion ratio and cost of feeding.

	M. paradisiaca inclusion levels (%)						
Parameter	0	10	20	30	No.	SEM	*P-value*
Initial body weight (g)	823.3	878	870	895	48	57.8	0.839
Final body weight (g)	2246^{ab}	2346^{b}	2357^{b}	2072^{a}	48	75.6	0.039
Average daily weight gain (g)	16.9	17.5	17.7	15.4	48	0.7	0.114
Average daily feed intake (g)	84.1^{b}	99.2^{a}	98.3^{a}	95.3^{a}	48	3.3	0.009
Feed conversion ratio	5.0^{a}	5.8^{ab}	5.7^{ab}	6.5^{b}	48	0.3	0.030
Cost of feed (Gh¢/kg)	1.59	1.36	1.29	1.23	48		

SEM: standard error of mean. No.: number of rabbits used. ^{ab}Means in a row with different superscripts are different ($P<0.05$). Gh¢/kg: Ghanaian Cedis Currency per kilogram. Least square means. Effect of diet analysed.

Table 5: Slaughter weight, dressing percentages and internal organ weight percentages of rabbits fed diets containing graded levels of *Brassica oleracea* outer leaves.

	B. oleracea inclusion levels (%)						
Parameter	0	10	20	30	No.	SEM	*P-value*
Slaughter weight (g)	2131	2314	2165	2112	16	99.3	0.493
Dressing percentage (%)	70.2	69.2	64.7	67.3	16	2.1	0.330
Internal organ weights (% of live weight)							
Liver	2.19	2.18	2.48	2.17	16	0.1	0.255
Lung	0.76	0.43	0.53	0.46	16	0.1	0.177
Kidney	0.52	0.47	0.47	0.49	16	0.06	0.959
Heart	0.22	0.24	0.25	0.29	16	0.02	0.160
Spleen	0.06	0.05	0.06	0.05	16	0.01	0.968

SEM: standard error of mean. No.: number of rabbits used. Least square means. Effect of diet analysed.

and kidney percentages among the treatment groups. The rabbits fed the concentrate diet containing 20% inclusion level of the leaves tended to have higher liver percentage among the treatment groups. The spleen percentage was not significantly different ($P>0.05$) among the rabbits fed concentrate diets containing graded levels of the leaves.

Slaughter weight, dressing percentages and internal organ weight percentages of rabbits fed concentrate diets containing graded levels of Musa paradisiaca *leaves*

Table 6 presents the mean live weight at slaughter, dressing percentage and internal organs weight percentage of rabbits fed the graded levels of *M. paradisiaca* leaves based diets. The dietary effects on slaughter weight and internal organ percentages of live weight in the rabbits fed graded levels of *M. paradisiaca* based diets were not significantly different ($P>0.05$), with the exception of the dressing percentage of live weight. The rabbits fed the control diet and concentrate diets containing 10% inclusion levels of the leaves had higher ($P<0.05$) dressing percentage compared to rabbits fed 30% inclusion level of the leaves. However, rabbits fed the 20 and 30% inclusion levels tended to have similar dressing percentages.

DISCUSSION

Growth performance, feed conversion ratio and cost of feeding

The final body weights of the rabbits recorded in the present study were higher than the values of 1391 to 1445 g obtained for 16-wk-old rabbits fed concentrate diets supplemented with *Leucaena leucocephala* and *Macroptilium atropurpureum* (Makinde, 2016), and 14- to 18-wk-old mixed breed rabbits fed graded levels of *M. paradisiaca* leaves (Enyenihi *et al.,* 2019). However, the body weights fell within the range of 1400 to 3550 g for 20-wk-old

Table 6: Live weight, dressing percentages and internal organ weight percentages of rabbits fed diets containing graded levels of *Musa paradisiaca* leaves.

	M. paradisiaca inclusion levels (%)						
Parameter	0	10	20	30	No.	SEM	*P-value*
Slaughter weight (g)	2131	2181	2358	2105	16	67.7	0.083
Dressing percentage (%)	70.2^{a}	71.2^{a}	67.4^{ab}	64.0^{b}	16	1.6	0.033
Internal organ weights (% of live weight)							
Liver	2.19	2.15	2.49	2.45	16	0.12	0.145
Lung	0.76	0.53	0.53	0.54	16	0.1	0.379
Kidney	0.52	0.47	0.54	0.49	16	0.06	0.853
Heart	0.22	0.24	0.30	0.24	16	0.02	0.173
Spleen	0.06	0.05	0.06	0.06	16	0.01	0.701

SEM: standard error of mean. No.: number of rabbits used. ^{ab}Means in a row with different superscripts are different ($P<0.05$). Least square means. Effect of diet analysed.

normal male rabbits (Brown *et al.,* 1925). The average daily weight gain of the rabbits obtained in this study were higher than the 7.81 to 13.38 g recorded for growing hybrid rabbit by Makinde *et al.* (2015). The range of daily weight gains in this study were also higher than the 4.11 to 12.14 g obtained for rabbits fed *M. paradisiaca* leaves in the study by Enyenihi *et al.* (2019). The differences in the values of the body weights and body weight gains resulted mainly from the variation in the initial body weights of the rabbits and the duration of the feeding periods. The nutritive quality of the diets could also have influenced the values obtained.

The total and average daily feed intakes recorded for the rabbits in the present study were higher than the values of 2664.46 to 3185.51 g and 47.58 to 56.88 g reported for hybrid (New Zealand White×Chinchilla) rabbits fed concentrate diets supplemented with *Leucaena leucocephala* and *Macroptilium atropurpureum* respectively (Makinde *et al*., 2015). The differences in the daily feed intake and weight gain in this and the other studies cited might be due to the differences in breed and age of the rabbits at the outset and duration of the feeding trials, as well as nutritive quality and acceptability of the diets. However, the similarity in the feed intakes of the diets containing graded levels of *B. oleracea* and *M. paradisiaca* by the rabbits observed in the present study suggests that the inclusion levels of the forages in the concentrate generally did not affect the acceptability of the diets by the rabbits. Furthermore, the high intake of the diets and survivability of all the rabbits during the experimental period suggest that the diets were of good nutritive quality.

Feed conversion ratio is the most extensively used parameter to express the efficiency of converting feed to live weight gain (Gidenne and Maertens, 2016). The feed conversion ratio values were similar ($P>0.05$) across diets containing graded levels of *B. oleracea* outer leaves, while there were differences ($P<0.05$) in the ratio among diets containing *M. paradisiaca* as compared to the control diet. The feed conversion ratios observed in this study were higher than the values of 3.56 to 4.21 recorded for cross breed rabbits fed graded levels of Mucuna seed beans (Ani and Ugwuowo, 2011). However, the values were comparable with the values, ranging from 4.0 to 6.3, obtained for growing rabbits fed diets supplemented with *Leucaena leucocephala* and *Macroptilium atropurpurem* leaves (Makinde *et al.,* 2015). They were also comparable with the values; 3.12 to 5.56 for cross breed rabbits fed graded levels of *Lufta cylindrica* seed meal (Dairo, 2008) and 3.51 to 5.57 recorded for New Zealand White rabbits fed sweet potato (*Ipomoea batatas*) vines supplemented with paddy rice and Guinea grass supplemented with concentrate (Luyen and Preston, 2012). This implies that the diets used in this study were well utilised by the rabbits.

Feed accounts for the largest part of the cost of rabbit production (Ogunsipe *et al.,* 2011). The unit cost of concentrate diets containing graded levels of *B. oleracea* outer leaves and *M. paradisiaca* leaves in this study decreased gradually as the inclusion levels of the leaves in the diets increased. This was consistent with the findings by Luyen and Preston (2012), in which the cost of feed containing Guinea grass declined as the concentrate level in the feed decreased, indicating an advantage of incorporating forage of good nutritive quality in diets at appropriate levels for the production of rabbit feed at lower cost.

Live weight, dressing and internal organ weight percentages

The dressing percentages of the rabbits obtained in this study were higher than the values of 54.50 to 55.77% recorded for grower rabbits fed concentrate plus *Tridax procumbensa* ad libitum (Adeyemi and Akanji, 2012) and encompass the values of 60.8 to 62.9% obtained for weaner rabbits fed graded levels of Ackee leaf meal (Osman *et al.,* 2020). The values were, however, lower than the minimum value of the range of 74.06 to 83.33% recorded for growing rabbits fed diets containing varying levels of fermented *Albizia lebbeck* seed meal (Tsado *et al.,* 2018). The differences in the dressing percentages observed in this and the other studies might be due to a variety of factors such as the differences in the live weight, breeds, age, carcass fatness and gender muscularity of the rabbits (Eikelenboom *et al.,* 2004), as well as pre-slaughter fasting period.

It is a common practice in feeding trials to use weights of some internal organs, such as liver or kidneys, as indicators of possible toxicity, because they should differ significantly if there were any serious effect of anti-nutritional factors on the major detoxification organs (Sese and Berepubo, 1996). The highest liver weight percentage of rabbits in the present study was lower than the upper limits of 3.33% and 4.64% recorded for rabbits in the studies by Tsado *et al.* (2018) and Makinde *et al.* (2015), respectively, and the lung percentages were higher than the values of 0.23% to 0.25% obtained for growing rabbits (Ojebiyi *et al.,* 2013). However, most of the lung values fell below the minimum

value of 0.58% for rabbits fed concentrate diets supplemented with *Leucaena leucocephala* (Makinde *et al.,* 2015). Most of the kidney percentages fell below the lower limit of 0.60% obtained for rabbits fed *Leucaena leucocephala* or *Macroptilium atropurpureum* leaves (Makinde, 2016). The heart weight percentages observed in this study were below the minimum value of 0.32% recorded for rabbits fed concentrate diets supplemented with forages (Makinde *et al.,* 2015), while the spleen percentage values were below the values of 0.21% to 0.24% recorded for grower rabbits fed forages as sole diet (Ojebiyi *et al.,* 2013).

The differences in the organ percentages of the body weights in this and the other cited studies might be due to the non-proliferation of nephrons of the organ (Lim *et al.,* 1996). However, the similarity in the organ percentages of rabbits fed the diets containing the graded levels of *B. oleracea* outer leaves, as well as the diets containing graded levels of *M. paradisiaca* leaves, suggests that the physiological and anatomical functions of the organs were not affected by the diets (Oloruntola *et al.,* 2015).

CONCLUSION

The results of the present study showed that growing rabbits fed diets containing 0, 10, 20 and 30% inclusion levels of *B. oleracea* outer leaves and *M. paradisiaca* leaves exhibited good growth performance, feed conversion ratio, high dressing and internal organ characteristics and good health. Furthermore, the cost of the diets reduced with increasing forage inclusion level of leaves. The findings suggest that rabbits can be fed concentrate diets containing 10 to 30% inclusion levels of *B. oleracea* outer leaves and *M. paradisiaca* leaves for good growth performance and high meat yield at a lower production cost than concentrate diets, while maintaining good health of the animals.

Acknowledgement: The authors are grateful to Ms. Edna Ann Quarshie and Mr. Ebenezer Mensah, National Service Personnel at CSIR- Animal Research Institute, for taking care of the experimental animals and assisting in the data collection.

Authors contribution: Osei D.Y.: conceptualization, methodology, data curation and writing – original draft. Apori S.O.: conceptualization and methodology. Hagan J.K.: conceptualization and methodology. Amedorme D.: data curation and writing – review & editing. Ayizanga R.: data curation and writing – review & editing.

Conflict of interest: Authors declare no conflict of interest.

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