JWPR
Journal of World's Poultry Research

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J. World Poult. Res. 6(2): 92-98, June 25, 2016
Research Paper, PII: S2322455X1600013-6

Growth Performance and Gastrointestinal Tract Morphometry in Growing Japanese Quails Fed with *Moringa oleifera* Leaf Meal as Partial Replacement of Dietary Soya Beans Meal

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Received: 02 Apr, 2016
Accepted: 02 May, 2016

ABSTRACT

One hundred and twenty (120) day old Japanese quails were bought and allocated to four dietary treatments of thirty (30) birds per treatment with the aim of studying the growth performance and gastrointestinal tract morphometry of growing Japanese quails fed with graded levels of *Moringa oleifera* meal as partial replacement of dietary soybean meal. Each treatment had three replicates of 10 birds each in a completely randomized design. The experiment lasted for six weeks. Four diets containing 24% crude protein for the growing phase (0-6 weeks) were formulated in which *Moringa oleifera* leaf meal replaced soya bean meal at 0, 5, 10 and 15% as T_0, T_1, T_2, T_3 respectively. The mean initial body weights, the mean final body weight and the mean total weight gains of the four treatments were significantly different from one another. However, feed conversion ratio, protein efficiency, performance efficiency factor and production number significantly varied across the four treatments; with T_1 having the best result than the others. The mean spleen weights, mean breast weights, mean thigh weights, mean drumstick weights, mean wing weights and mean liver weights of the growing Japanese quails in the four treatments were not significantly different from one another except the heart weight of T_1. The mean weights, lengths, width and thickness of proventriculus, ventriculus, duodenum, jejunoileum, caeca and colon of the growing Japanese quails in the four treatments were not significantly different from one another, except the lengths of jejunoileum. It is therefore concluded that in growing Japanese quails, *Moringa oleifera* leaf meal may replace dietary soya beans meal up to 15%, with optimum level of 5% and no apparent adverse effects on gastrointestinal tract morphometry.

Key words: Growth performance, Gastrointestinal tract, Soya beans, *Moringa oleifera*, Japanese quail

INTRODUCTION

The prices of soya bean and fish meals which are widely and successfully used as conventional protein sources for livestock have been escalating continuously in recent times, whilst their availability is often erratic. The problem has been worsened due to the increasing competition between humans and livestock for these protein ingredients as food. According to Odunsi (2003), the rapid growth of human and livestock population, which is creating increased needs for food and feed in the less developed countries, demands that alternative feed resources must be identified and evaluated. One possible source of cheap protein is the leaf meals of some tropical legume browse plants. Leaf meals do not only provide protein source but also some essential vitamins such as vitamins A and C, minerals and oxycarotenoids (Egwui et al., 2013). The constraints to enhanced utilization of leaf meals reside chiefly on factors such as fibre content, the presence of anti-nutritive compounds and deficiencies of certain amino acids (Olvera – Castillo et al., 2011). Several treatment such as soaking, fermenting, sun drying, auto claving, boiling and toasting have been investigated to reduce or remove the anti-nutritional factors (Adegoke et al., 2010).

Recently, there has been interest in the utilization of *Moringa oleifera* commonly called horseradish tree or drumstick tree, as a protein source for livestock (Makker and Becker, 1997 and Sarwatt et al., 2002). Moringa leaf has quality attributes which make it a potential replacement for soybean meal or fish meal in non-ruminant diets. Moringa can easily be established in the field, has good coppicing ability, as well as good potential for forage production. Furthermore, there is the possibility of obtaining large amounts of high quality forage from moringa without expensive inputs due to favorable soil and climatic conditions for its growth (Makker and Becker, 1997). Sarwattet al. (2004) reported that moringa foliages are a potential inexpensive protein source for livestock feeding. The advantages of using moringa for a protein resource are numerous, and include the fact that it is a perennial plant that can be harvested several times in one growing season and also has the potential to reduce feed cost.

To cite this paper: Mahmud Muhammd A, Peter S, James G, Ruth N, Wosilat A, Musa M and Alhaji Abubakar M. 2016. Growth Performance and Gastrointestinal Tract Morphometry in Growing Japanese Quails Fed with *Moringa oleifera* Leaf Meal as Partial Replacement of Dietary Soya Beans Meal. *J. World Poult. Res.* 6(2): 92-98.
Journal homepage: www.jwpr.science-line.com

Moringa oleifera is in the group of high-yielding nutritious browse plants with every part having food value (Duke, 1998). Despite the high Crude Protein (CP) content of 25-27% in moringa leaf meal, and being extensively exploited in both broiler and layer chickens diets, there is little information available on the use of this unconventional feed resource, especially as an alternative protein source in growing Japanese quails. Therefore, this work highlights the growth performance and gastrointestinal tract morphometry as influenced by partial replacement of dietary Soya beans meal with *Moringa oleifera* leaf meal in growing Japanese quails.

MATERIALS AND METHODS

The study was carried out at the poultry unit of the Niger state College of Agriculture, College Livestock Farm, Mokwa, Nigeria. Mokwa is located at latitude 9°17'38" North and longitude 5°3'16 East (Google maps, 2015). 120 day-old Japanese quails were bought and allocated to four dietary treatments of 30 birds per treatment. Each treatment had three replicates of 10 birds per replicate in a completely randomized design. The experiment lasted for six weeks. Four diets containing 24% CP for the growing phase (0-6 weeks) were formulated in which *Moringa oleifera* leaf meal replaced Soya beans meal at 0, 5, 10 and 15% as T_0, T_1, T_2, T_3 respectively. The moringa leaves were air dried in shade until they were crispy to touch, while retaining their greenish coloration. The leaves were then milled using a hammer mill of sieve size 3 mm, to obtain a product herein referred to as moringa leaf meal (MOLM) which was stored in sacs until needed. Diet 1, which was designated as T_0 served as the control diet and contained soybean meal as the main protein source with no moringa leaf meal. Diet 2 designated as T_1, diet 3 as T_2 and diet 4 as T_3. All diets met the nutrient requirements of Japanese quail as set out by National Research Council (NRC) (1994). Table 1 represents the ingredients composition of the experimental diets.

Performance characteristics monitored included initial body weight, final body weight, final body weight gain, total feed intake, Feed Conversion Ratio (FCR), Protein Efficiency (PE), Performance Efficiency Factor (PEF) and Production Number (PN). The carcass parts weight analysis was done by weighing each of the parts using digital weighting scale with sensitivity of 0.01 gram. The gross morphometry of the Gastrointestinal Tract (GIT) was done by measuring weight (gram), length (cm), width (cm) and thickness (mm) of its segments in each treatment using digital weighting balance with sensitivity of 0.01 gram, thread stretched on a meter rule and digital Vernier caliper.

PE was calculated as the ratio of body weight gain to the crude protein fed as described by Sidduraju and Becker (2003). The PEF was calculated by dividing the live body weight of the flock by FCR and number of chicks purchased, multiplied by 100 as described by Ghosh and Samanta (2008).

The PN was calculated as described by Ghosh and Samanta (2008) using the following formular:

$$\text{PN}=\frac{\text{Daily growth x Survivability (\%)}}{\text{FCR X 10}}$$

$$\text{Daily growth}=\frac{\text{Average Final Weight/bird}}{\text{Average Fattening Period}}$$

Survivability = 100 - % mortality

One-Way Analysis of Variance (ANOVA) according to Steel and Torrie (1980) using Statistical Package for Social Sciences (SPSS) 17 at 95% confidence interval (CI) was used to determine level of significant difference in mean values of the data. Values of ($P \leq 0.05$) were considered significant. Where there were differences in means, Duncan's Multiple Range Test (DMRT) was used to separate the means (Duncan, 1955).

Table 1. Ingredient inclusion (%) of grower ration fed to Japanese quails

Ingredients (%)	**Experimental diets**			
	$\mathbf{T_{0(0\%)}}$	$\mathbf{T_{1(5\%)}}$	$\mathbf{T_{2(10\%)}}$	$\mathbf{T_{3(15\%)}}$
Maize	38.22	38.22	38.22	38.22
Soybean (Full Fat)	36.02	34.22	32.42	30.62
Maize offal	9.55	9.55	9.55	9.55
Fish meal	12.01	12.01	12.01	12.01
MOLM	0.00	1.80	3.60	5.40
Limestone	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10
Total	100	100	100	100
Chemical analysis (%)				
Crude Protein	25.64	25.28	24.92	24.56
Crude Fibre	3.47	3.53	3.59	3.63
ME (Kcal/Kg)	3083	3049	3016	2983

T_0 = Control, T_1 = Treatment 1, T_2 = Treatment 2, T_3 = Treatment 3. MOLM=*Moringa oleifera* Leaf Meal

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RESULTS

Growth performance

The results for growth performance of growing Japanese quails fed graded levels of *Moringa oleifera* leaf meal as partial replacements for Soybean meal are shown in table 2.

Mean initial body weight

The mean initial body weights of growing Japanese quails in T_0, T_1, T_2 and T_3 were 15.33 ± 0.88 gram, 16.00 ± 0.57 gram, 18.00 ± 0.57 gram and 18.00 ± 0.57 gram respectively. There was no statistical significant (P>0.05) difference in the mean initial body weights of the four treatments.

Mean final body weight

The mean final body weights of growing Japanese quails in T_0, T_1, T_2 and T_3 were 160.87 ± 1.01 gram, 170.08 ± 4.49 gram, 157.78 ± 11.84 gram and 150.78 ± 2.30 gram respectively. There was no statistical significant (P>0.05) difference in the mean final body weights of the four treatments.

Mean final body weight gain

The mean final body weight gains of growing Japanese quails in T_0, T_1, T_2 and T_3 were 145.54 ± 0.71 gram, 154.08 ± 4.69 gram, 139.26 ± 12.17 gram and 132.78 ± 2.63 gram respectively. There was no statistical significant (P>0.05) difference in the mean final body weight gain of the four treatments.

Total feed intake

The mean total feed intake of growing Japanese quails in T_0, T_1, T_2 and T_3 were 462.17 ± 0.65 gram, 500.55 ± 0.63 gram, 452.48 ± 0.79 gram and 462.16 ± 0.64 gram respectively. There was no statistical significant (P>0.05) difference in the mean total feed intake of the four treatments.

Feed conversion ratio

The mean FCRs of growing Japanese quails in T_0, T_1, T_2 and T_3 were 3.18 ± 0.04, 3.25 ± 0.01, 3.25 ± 0.01 and 3.48 ± 0.01 respectively. There was statistically significant (P≤0.05) difference in the mean FCRs of the four treatments. Though the FCR of T_0 was numerically lower, it was not significantly (P>0.05) different from those of T_1 and T_2. The FCRs of T_0, T_1 and T_3 however, differed significantly (P≤0.05) from the FCR of T_3.

Protein efficiency

The mean PEs of growing Japanese quails in T_0, T_1, T_2 and T_3 were 5.68 ± 0.01, 6.09 ± 0.01, 5.59 ± 0.01 and 5.41 ± 0.01 respectively. There was statistically significant (P≤0.05) difference in the mean PEs of the four treatments. The PE of T_1 was significantly (P≤0.05), the highest of the four treatments, while that of T_3 was significantly (P≤0.05) the lowest of the four treatments.

Performance efficiency factor

The mean PEFs of growing Japanese quails in T_0, T_1, T_2 and T_3 were 4290.05 ± 0.01 (%), 5233.23 ± 0.01 (%), 4094.34 ± 0.01 (%) and 3069.00 ± 0.58 (%) respectively. There was statistically significant (P≤0.05) difference in the mean PEFs of the four treatments. The PEF of T_1 was significantly (P≤0.05), the highest of the four treatments, while that of T_3 was significantly (P≤0.05) the least of the four treatments.

Production number

The mean PNs of growing Japanese quails in T_0, T_1, T_2 and T_3 were 9.75±0.01, 11.80±0.01, 9.30± 0.01 and 6.98±0.01 respectively. There was statistically significant (P≤0.05) difference in the mean PNs of the four treatments. The PN of T_1 was significantly (P≤0.05), the highest of the four treatments, while that of T_3 was significantly (P≤0.05) the least of the four treatments.

Carcass parts weight analysis

The results for carcass parts weight analyses of the growing Japanese quails fed graded levels of *Moringa oleifera* leaf meal as partial replacements for soya beans meal are shown in table 3.

The mean spleen weights, mean breast weights, mean thigh weights, mean drumstick weights, mean wing weights and mean liver weights of the growing Japanese quails in the four treatments were not significantly (P>0.05) different from one another. Whereas the weight of the heart in T_0 (1.33 ± 0.07 gram), T_2 (1.32 ± 0.05 gram) and T_3 (1.33 ± 0.95 gram) were significantly (P≤0.05) lower than the value of 1.58 ± 0.06 gram obtained in T_2.

Table 2. Performance of growing Japanese quails fed graded levels of *Moringa oleifera* for six weeks as partial replacement for soybean meal

Parameters	Treatments			
	T_0 (0%)	**T_1 (5%)**	**T_2 (10%)**	**T_3 (15%)**
Initial body weight (gram)	15.33±0.88^a	16.00±0.57^a	18.00±0.57^a	18.00±0.57^a
Final body weight (gram)	160.87±1.01^a	170.08±4.49^a	157.78±11.84^a	150.78±2.30^a
Body weight gain (gram)	145.54±0.71^a	154.08±4.69^a	139.26±12.17^a	132.78±2.63^a
Total feed intake (gram)	462.17±0.65^a	500.55±0.63^a	452.48±0.79^a	462.16±0.64^a
FCR (g/g)	3.18±0.04^a	3.25±0.01^a	3.25±0.01^a	3.48±0.01^b
PE	5.68±0.01^c	6.09±0.01^d	5.59±0.01^b	5.41±0.01^a
PEF (%)	4290.05±0.01^c	5233.23±0.01^d	4094.34±0.01^b	3069.00±0.58^a
PN	9.75±0.01^c	11.80±0.01^d	9.30±0.01^b	6.98±0.01^a

$^{a, b, c, d}$ Means ± SEM within the same row with different superscripts are significantly different (P≤0.05) from each other; T_0 = Control, T_1 = Treatment 1, T_2 = Treatment 2, T_3 = Treatment 3; FCR= Feed Conversion Ratio, PE= Protein Efficiency, PEF= Performance Efficiency Factor, PN= Production Number.

Gastrointestinal tract gross morphometry

The results for weights and lengths of the segments of the GIT of the growing Japanese quails fed graded levels of *Moringa oleifera* leaf meal as partial replacements for soya beans meal are shown in diagrams 1 and 2 respectively, while widths and thickness of the proventriculus and ventriculus in growing Japanese quails fed with graded levels of *Moringa oleifera* for six weeks as partial replacement for soya bean meal are shown in tables 4 and 5 respectively.

The mean weights, lengths, width and thickness of proventriculus, ventriculus, duodenum, jejunoileum, caeca and colon of the growing Japanese quails in the four treatments were not significantly (P>0.05) different from one another, except the lengths of jejunoileum. The length of jejunoileum (1.80 ± 0.22 cm) of T_1 was significantly (P≤0.05) the highest of the four treatments while that of T_3 with the value of 1.00 ± 0.11 cm was significantly (P≤0.05) the least.

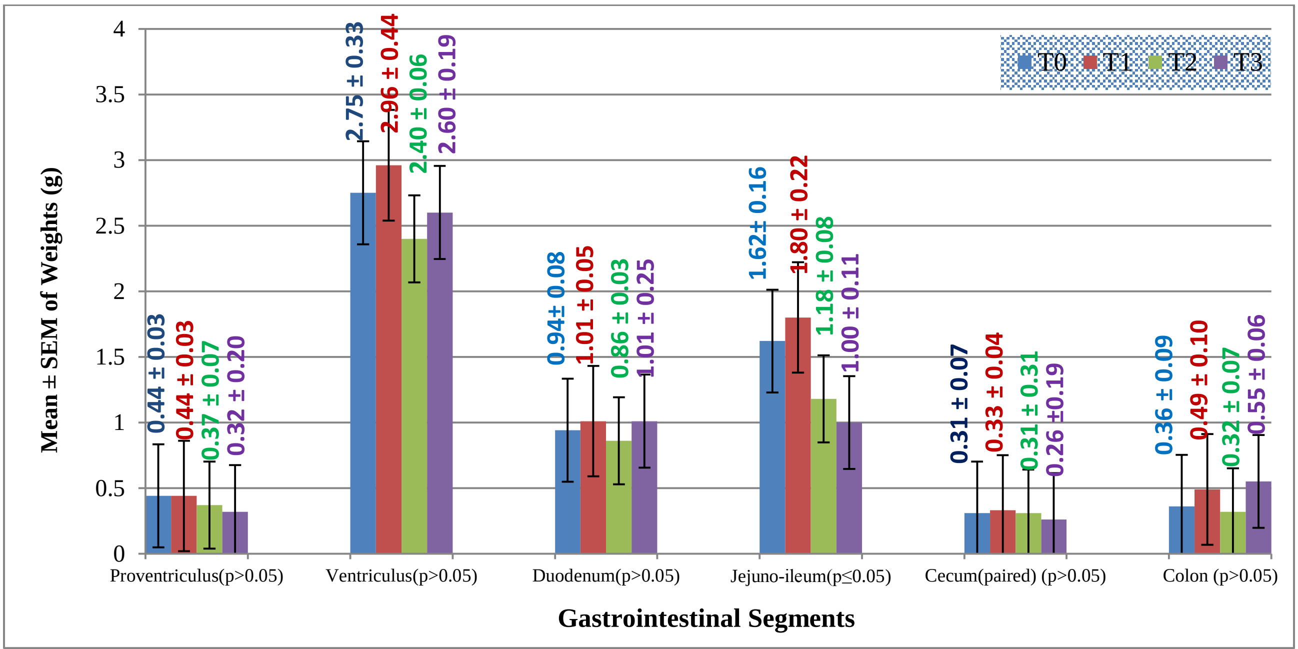

Diagram 1. Mean ± SEM weights of segments of the gastrointestinal tract in growing Japanese quails fed with graded levels of *Moringa oleifera* as partial replacement for soya bean meal. T_0 = Control, T_1 = Treatment 1, T_2 = Treatment 2, T_3 = Treatment 3.

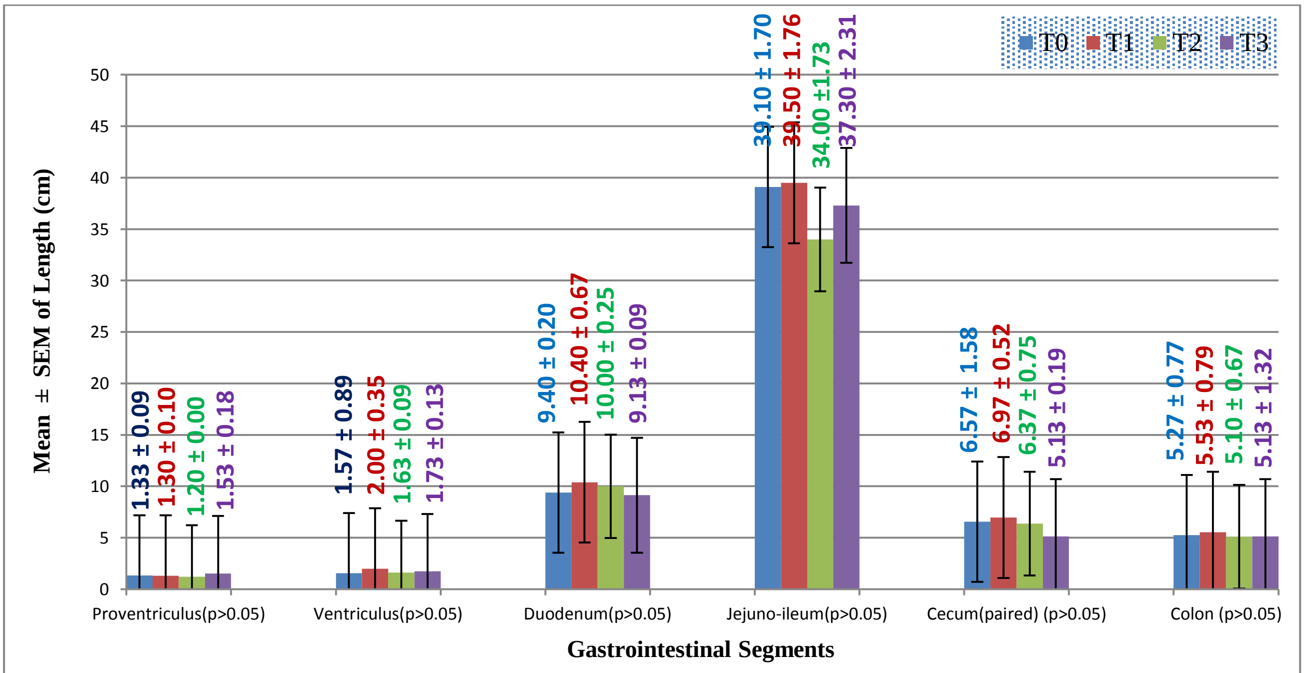

Diagram 2. Mean ± SEM length of segments of the gastrointestinal tract in growing Japanese quails fed with graded levels of *Moringa oleifera* as partial replacement for soya bean meal. T_0 = Control, T_1 = Treatment 1, T_2 = Treatment 2, T_3 = Treatment 3.

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Table 3. Mean weight of carcass organs in growing Japanese quails fed with graded levels of *Moringa oleifera* for six weeks as partial replacement for soya bean meal

Parameter	Treatments			
	T_0 (0%)	T_1 (5%)	T_2 (10%)	T_3 (15%)
Spleen (gram)	0.04 ± 0.00	0.11 ± 0.05[a]	0.06 ± 0.01	0.55 ± 0.06
Breast (gram)	30.40 ±2.93	34.77 ± 0.93[a]	30.88 ± 3.43	28.25 ± 2.06
Thigh(gram)	10.93 ± 0.06	10.43 ± 0.03[a]	10.87 ± 0.39	10.37 ± 0.19
Drumstick (gram)	1.16 ± 0.09	1.43 ± 0.02[a]	1.28 ± 0.03	1.40 ± 0.09
Wing (gram)	4.74 ± 0.28	4.91 ± 0.23[a]	4.03 ± 0.32	4.40 ± 0.01
Heart (gram)	1.33 ± 0.07	1.58 ± 0.06[b]	1.32 ± 0.05	1.33 ± 0.05
Liver (gram)	2.06 ± 0.26	2.30 ± 0.26[a]	2.45 ± 0.16	1.89 ± 0.15

[a, b] Means ± SEM within the same row with different superscripts are significantly different ($P \leq 0.05$) from each other; T_0 = Control, T_1 = Treatment 1, T_2 = Treatment 2, T_3 = Treatment 3.

Table 4. Mean ± SEM width of proventriculus and ventriculus in growing Japanese quails fed with graded levels of *Moringa oleifera* for six weeks as partial replacement for soya bean meal

Parameters	Treatments			
	T_0 (0%)	T_1 (5%)	T_2 (10%)	T_3 (15%)
Proventriculus (cm)	0.50±0.06	0.57±0.03	0.53±0.07	0.53±0.33
Ventriculus (cm)	2.33±0.18	2.23±0.03	2.20±0.06	2.17±0.07

T_0 = Control, T_1 = Treatment 1, T_2 = Treatment 2, T_3 = Treatment 3.

Table 5. Mean ± SEM thickness of proventriculus and ventriculus in growing Japanese quails fed graded levels of *Moringa oleifera* as partial replacement for soya beans meal.

Parameters	Treatments			
	T_0 (0%)	T_1 (5%)	T_2 (10%)	T_3 (15%)
Proventriculus (mm)	3.56±0.19	2.32±0.68	2.43±0.49	2.42±0.33
Ventriculus (mm)	8.23±1.39	10.03±0.12	8.64±1.64	8.11±1.45

T_0 = Control, T_1 = Treatment 1, T_2 = Treatment 2, T_3 = Treatment 3.

DISCUSSION

The finding of non-significant difference in the mean body weight gain and feed intake of the present study in the four treatments were similar to the earlier reports of Gadzirayi et al. (2012) in broiler chickens fed with different levels of moringa leaf meal. This study confirms previous findings that indicated Moringa Leaf Meal promoted good growth and productivity in poultry is attributed to its nutrients and phytochemicals (Kakengi et al., 2007).

The findings on FCR of the control group (T_0) to be numerically lower than the quails of T_1 and T_2 but the PE, PEF, and PN of T_1 were higher than the control group (T_0) are in line with the reports of Fuglie (1999) and Ebenebe et al. (2012) who reported high performance of livestocks fed on moringa based diet. This finding might be due to natural enzymes in moringa which facilitate digestion of fibrous food in animals and improve bioavailability of nutrients (Foild et al., 2011).

The significantly lower FCR of the control group (T_0) than those of T_2 and T_3 but with higher PE, PEF, and PN as moringa leaf meal inclusion increased, is similar to the reports of Ash and Petaia (1992) and Olugbemi et al. (2010) that increasing inclusion level of moringa leaf meal in broiler diets results in depressed growth performance. This observation could be generally traced to increasing fibre content of the diet which may have impaired nutrient digestibility and absorption (Ige et al., 2006). The negative effect of the anti-nutritional factors and phytochemical compounds present in *Moringa oleifera* leaf meal on the quails could be responsible for decreasing the performance.

The non-significant difference found in mean spleen weights, mean breast weights, mean thigh weights, mean drumstick weights, mean wing weights and mean liver weights of the growing Japanese quails in the four treatments are similar to the finding of Zanu et al. (2012) and Safa and Tazi (2012) who indicated that, none of the parameters measured for carcass characteristics in birds fed with diets containing *Moringa oleifera* leaf meal was significantly affected by inclusion of Moringa leaf meal. However, the significant difference observed in the weight of the heart between T_1 and other treatments are contrary to the non-significant difference reported by Safa and Tazi (2012) in broiler chicks.

The finding of non-significant difference on the many GIT parts gross morphometry could not be compared to the findings of other workers due to paucity of available relevant literature however, the findings indicated that inclusion of graded levels of *Moringa oleifera* leaf meal into diets of Japanese quails up to 15% as partial replacement for soybean meal has no apparent adverse morphometric effects on GIT.

The finding of significant difference observed in the present study in the length of jejunoileum of T_1 than that of the control group (T_0) could mean that more intestinal villi that are responsible for feed absorption might be more in T_1 than in $T_{0.}$ This probably explains the better feed utilization observed in this study in the T_1 compared to T_0 and remaining treatments.

CONCLUSION

The mean initial body weights, mean final body weight, and mean total weight gains of the four treatments were significantly different from one another. However, FCR, PE, PEF and PN significantly varied across the four treatments; with T_1 having the best of the four treatments. The mean spleen weights, mean breast weights, mean thigh weights, mean drumstick weights, mean wing weights and mean liver weights of the growing Japanese quails in the four treatments were not significantly different from one another except the heart weight of T_1. The mean weights, lengths, width and thickness of proventriculus, ventriculus, duodenum, jejunoileum, caeca and colon of the growing Japanese quails in the four treatments were not significantly different from one another, except the lengths of jejunoileum. It is therefore concluded that in growing Japanese quails, *Moringa oleifera* leaf meal may replace dietary soya bean meal up to 15%, with optimum level of 5% and no apparent adverse effects on GIT morphometry.

Competing interests

The authors have no competing interests to declare.

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