Effect of *Ocimum gratissimum* L. on Growth and Egg Size of Japanese Quail (*Coturnix coturnix japonica*, Temmick)

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**Authors’ contributions**

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

**Article Information**

DOI: 10.9734/AJOB/2020/v10i30106

**Editor(s):**
(1) Dr. Jehad M. H. Ighbareyeh, Al-Quds Open University, Palestine.

**Reviewers:**
(1) Khalid Hamid Hassan, University of Diyala, Iraq.
(2) Willan Orlando Caicedo Quinche, Universidad Estatal Amazónica, Ecuador.

Complete Peer review History: [http://www.sdiarticle4.com/review-history/61780](http://www.sdiarticle4.com/review-history/61780)

**Received 28 July 2020**

**Accepted 02 October 2020**

**Published 20 October 2020**

**ABSTRACT**

There is need to look for ingredients to be added to the poultry feed used to raise quail birds for better results on the birds and to enhance quail farming in Nigeria.

**Aim:** This study was carried out to conduct a twelve weeks feeding trial to determine the effect of feeding varying levels of *Ocimum gratissimum* on growth, egg size using two (2) weeks old Japanese quail (*Coturnix coturnix japonica*).

**Materials and Methods:** One hundred and twenty birds were allocated to four dietary treatment groups with three (3) replicates of ten (10) birds each in a completely randomized design experiment with feeding ratio of Control (C) containing 0 g/kg; T1, 20 g/kg; T2, 40 g/kg and T3, 60 g/kg of dried and ground *Ocimum gratissimum*. Feed and water were provided ad libitum throughout the experimental period.

**Results:** The result obtained showed that for Weight gain (WG), Percentage weight gain (PWG), specific growth rate (SRG), feed conversion ratio (FCR), the T1, (20 g/kg) had the highest values (122.56 g, 234%, 0.623 and 23.49 respectively) while T3, (60 g/kg) had the least values (81.92 g, 122.56 g, 234%, 0.623 and 23.49 respectively).
INTRODUCTION

Over the years, there has been significant gap between the production and need of animal protein to feed the ever-growing population of Nigeria [1]. Nigeria over the years has not been able to meet the Food and Agricultural Organisation (FAO) recommended minimum protein intake of 35 g per person per day [2]. Low protein consumption in the developing countries including as a result of poverty and overpopulation has encouraged greater interest in the production of fast growing farm animals [3]. To halt this negative trend, efforts have been directed towards boosting the livestock industry with micro livestock having prolific tendency, short gestation period, short generation interval and rapid growth [4].

There is therefore, the need to look inward and integrate into our farming system some non-conventional meat sources [5]. The number of poultry in the world is large and domestic chickens contribute 90% to poultry production [6]. Factors such as inadequate supply of day chicks, disease, high cost of drugs and the time taken to raise the birds led to search for an alternative cheaper source of poultry production and this led to subsequent introduction of quail birds in Nigeria [7]. The Japanese quail was introduced to Nigeria in 1992 [8]. The purpose was to diversify the poultry sub-sector and help supplement domestic chicken production through massive quail farming by Nigeria farmers. The advantages of quail farming includes minimum floor space, low investment, comparatively sturdy birds, early market age and sexuality, high rate of egg production and less feed requirement [9].

Japanese quail is the smallest avian species farmed for meat and egg production [10] and it has assumed worldwide importance not only as a laboratory animal [11] but also as supplier of meat and eggs especially for the rural poor and landless. The Japanese quail is an excellent and cheap source of animal protein for Nigeria [12] and has caught the attention of scientists and researchers in the recent times [13]. Distinct characteristics of the Japanese quail which include rapid growth thus enabling the quail to be marked for consumption at 5 - 6 weeks of age, early sexual maturity which results in short generation interval, disease resistance, less capital requirement, high rate of lay and much lower feed and space requirement than domestic fowl [14] have further given the birds advantages and attention. Quails attain sexual maturity early and lay between 5-6 weeks of Age [15] and it lays 200-300 eggs in their first year of lay [16]. Quails are highly prolific and hardy [15] which make them adaptable to the tropical environment. The meat is lean and the egg is low in cholesterol [17].

Besides, Quail meat and egg are tastier than chicken and has less fat contents. It has been shown to promote body and brain development in children and nursing mothers [9,18]. Among other birds, the meat and eggs of quails have less fat content and has been suggested as good quality meat source for diabetic patients and those with high blood pressure [19]. Quail eggs contain 3 or 4 times as much nutritional value as chicken eggs do, and they have 13% protein while chicken eggs have only 11% [20]. Currently there is no commercial feed for quails in Nigeria livestock feed industry as against chicken so as a result, most quail farmers have to use commercial Turkey and Chicken Layer’s feed containing 26.28% and 17% crude protein (CP) to feed quail layers respectively [21]. So there is need to look for ingredients to be added to the

<table>
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<th>Value</th>
<th>Description</th>
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| 156% | 0.487, 34.92 respectively | as a result of weight loss. But the C, (0 g/kg) had the highest value of 9.149 for protein efficiency ratio (PER) as T₃, (60 g/kg) had the least value (5.535). T₂ (40 g/kg) had the highest values for mean egg weight, length, width (10.01, 8.77 and 7.81 respectively) while T₁, (20 g/kg) had the least values (8.84, 7.63 and 6.70 respectively). Weight gain, feed utilization indices and egg size were the response criteria that were monitored, recorded and subjected to Anova and T-test. There were significant difference (P≤0.05) observed for mean weight gain, percentage weight gain, specific growth rate, food conversion ratio, protein efficiency ratio, circumference of the widest point of the eggs at long axis (length) while no significant difference (P>0.05) were observed for weight of eggs and circumference of the widest point of the eggs at short axis (width).

Conclusion: From this study, quail birds fed T₁, (20 g/kg) gave the results with no negative effect on the birds and can be recommended in Japanese quail diets.

Keywords: Quails; Ocimum gratissimum; growth; egg; feed; effect.
feed for better results on the Quail birds. This led to the search for leafy supplement resulting in selection of *Ocimum gratissimum* L. to ascertain its effect on the animal (Quail birds) product.

The perennial plant *Ocimum gratissimum* L. (*Lamiaceae*) (Scent leaf) is widely distributed in the tropics of Africa and warm temperature regions. *Ocimum gratissimum* L. (*Lamiaceae*) (Scent leaf) is a traditional vegetable condiment used in Nigeria and elsewhere to enhance good flavour and is widely used in food and oral care products. Nutritional importance of this plant centers on its usefulness as a seasoning because of its aromatic flavour [22]. *Ocimum gratissimum* elaborates nutrients that can increase weight such as carbohydrates, minerals and vitamins [23]. Based on the above, this research work was conducted to evaluate the effects of varying levels of *Ocimum gratissimum* leaf meal on growth and egg size of Japanese quail birds.

2. MATERIALS AND METHODS

2.1 Experimental Site

This study was carried out at the Animal house of Zoology Department, Nnamdi Azikiwe University, Awka of Anambra State, Nigeria.

2.2 Study Duration

This study lasted for 13 weeks. One week was used for acclimatization of the birds to the new environment. Then 12 weeks were used for the study proper and it was carried out from December 2015 to February 2016.

2.3 Experimental Leaves Procurement

The *Ocimum gratissimum* leaves were collected from Okwordu market at Onitsha, Anambra State, washed, air dried to a constant weight and then milled into fine powder to produce the Scent leaf meal (SLM).

2.4 Experimental Animals

The experimental animal, Japanese quail birds (*Coturnix coturnix japonica*) were obtained from the Chucks Agro Farm Venture Nnewi in Nnewi North Local Government Area of Anambra State. A total of one hundred and twenty (120) Japanese quail birds were used for the study. The animals were two weeks old, weighing between 40 g-41 g.

2.5 Experimental Design

The experimental cage was the colony closed cage housing system. Each of the four tiers had three partitions representing four treatments replicated thrice.

The animals were randomly distributed into four groups with three replicates on mean live weights of 40.72 g±0.23, 40.75 g±0.16, 40.81 g±0.33, 41.15 g±0.18 for each group as housing groups were based on the levels of *Ocimum gratissimum* of C- 0 g, T1- 20 g, T2- 40 g, T3- 60 g respectively.

The feed used during the study was commercial Starter and Layer Vital Feed (SVF and LVF) and Scent leaves (*Ocimum gratissimum*) dried at room temperature. The leaves were milled after room drying. The layers feed was also ground to smaller sizes for the Scent leaf meal to mix properly with the feed and for easy picking by the birds.

2.6 Data Collection

2.6.1 Qualitative phytochemical analyses of the experimental leaf

Qualitative Phytochemical Analyses of *Ocimum gratissimum* for the presence or absence of alkaloid, saponnin, flavanoid, tannin and steroid were carried out on the methanolic extract of *Ocimum gratissimum* leaves used in feeding the quails [24].

2.6.2 Proximate composition of the experimental leaf and feed

The *Ocimum gratissimum* leaves and feed with different levels of inclusion of *Ocimum gratissimum* leaf were analyzed for proximate composition at the Biochemistry laboratory of Nnamdi Azikiwe University, Awka; utilizing the methods of the Association of Official Analytical Chemist for Moisture Content (MC), Crude Protein (CP), Crude Fat (CP), Total Ash (TA), Crude fibre (F) and Carbohydrates (C) [25].

2.6.3 Mineral analysis of the experimental leaf and feed

The mineral analysis of the *Ocimum gratissimum* leaves and feed with different levels of inclusion of *Ocimum gratissimum* leaf used in this study were also analysed using a NOVA 400 atomic absorption spectrometer [25].
2.6.4 Indices of growth performance

The following indices of growth performance were studied, collected and analysed using the data collected from the weekly records of Weight gain (WG); Percentage weight gain (PWG) and Specific growth ratio (SGR) [26].

2.6.5 Indices of feed utilization

The following indices of feed utilization were studied, collected and analysed using the data collected from the weekly records of food fed and food left over; Feed conversion ratio (FCR) and Protein Efficiency Ratio (PER) [26].

2.6.6 Egg size

The eggs laid by the birds were collected in labeled egg crates in the morning and were kept in baskets at room temperature daily. The egg size data (weight of eggs laid, length and width of eggs laid) were obtained weekly and were measured using three eggs per replicate [27].

2.6.7 Statistical analysis

The data of weight gain, egg weight and the egg length and circumference at the long and short axis were subjected to Analysis of Variance (ANOVA) [28]. The mean percentage weight gains, specific growth rate, indices of feed utilization were subjected to a 2-tail test using the SPSS Statistical Package version 20. The least significant difference (LSD) was used to separate mean significant differences between treatments at the 5% significant level.

3. RESULTS

3.1 Effect of *Ocimum gratissimum* L. on Growth Performance and Feed Utilization of Japanese Quail

3.1.1 Mean weight gain of quails

The weekly mean weight gain of quail which as presented in Table 5 revealed that there is significant difference \((P<0.05)\) with \(P\)-value = 0.000. The body weight gain values observed were higher for birds on treatment \(T_1\) (20 g/kg of *O. gratissimum*) than those in the control diet \(C\) (0 g/kg of *O. gratissimum*) and then decreased with increasing levels of *O. gratissimum* inclusion, thereby showing significant difference.

3.1.2 Mean percentage weight gain

The Percentage weight gain of quail which as presented in Table 5 revealed that there is significant difference \((P<0.05)\) with \(P\)-value = 0.002. The highest values were observed for birds on treatment \(T_1\) (20 g/kg of *O. gratissimum*) and then decreased with increasing levels of *O. gratissimum* inclusion.

3.1.3 Mean specific growth rate

The Specific Growth Rate of quail which as presented in Table 5 revealed that there is significant difference \((P<0.05)\) with \(P\)-value = 0.000. The values observed for birds on treatment \(T_1\) (20 g/kg of *O. gratissimum*) were higher and then decreased with increasing levels of *O. gratissimum* inclusion.

3.1.4 Mean food conversion ratio

This result as presented in Table 5 showed that there is a significance difference \((P<0.05)\) in the mean food conversion ratio of Quail birds fed varying levels of *Ocimum gratissimum* for 12 weeks as \(P\)-value (\(P=0.003\)) was calculated.

3.1.5 Protein efficiency ratio

From Table 5, the result of the protein efficiency ratio showed significant difference \((P<0.05)\) with \(P\)-value = 0.022 as the 60g/kg treatment with highest amount of crude protein had least protein efficiency ratio of (5.535) against that of 0g/kg (C), 20 g/kg (\(T_1\)), 40 g/kg (\(T_2\)) *O. gratissimum* inclusion.

3.2 Effect of *Ocimum gratissimum* L. on Egg Size of Japanese Quail

3.2.1 Mean weight of eggs

Table 6 shows that the mean weight of eggs laid by quail fed with varying levels (g) of *Ocimum gratissimum* was not significantly different \((P>0.05)\) as \(P = 0.081\).

3.2.2 Mean Egg width of eggs

The differences in the weekly mean circumference from the widest point (Short axis) of eggs laid by quails fed with varying levels of *Ocimum gratissimum* was not significantly different \((P>0.05)\) as \(P\)-value = 0.055.
3.2.3 Mean egg length of eggs

There is a significant difference in the weekly mean circumference from the widest point (Long axis) of the eggs laid by Quails fed with varying levels of Ocimum gratissimum \( (P < 0.05) \) as \( \text{P-value} = 0.045 \).

4. DISCUSSION

From Table 1, the protein contents of the starter feed which ranged from 21.40% to 23.50% \((0 \text{ g/kg to 60 g/kg respectively})\) were all higher than 20% crude protein recommended by Murakami et al. [29] but in agreement with 24% recommended by NRC [16] for rearing period of quail birds and Haruna et al. [30] who recommended 22 - 25% and then in contrast with 26 - 28% crude protein requirement for quail chicks by Bawa et al. [21].

Treatment with 20 g/kg of Ocimum gratissimum had the value of carbohydrates content as 55.70% with slight differences compared to other treatments which reflect the low carbohydrates of Ocimum gratissimum leaves reported by Adepoju and Oyewole [31]. The high values of carbohydrates which are the primary energy source in the diet agrees with Okeke and Mogbo [27] who reported that feed with higher energy content results to higher growth rate in animals and Olubaniwa et al. [32] who stated that growing quails are able to keep body growth rate over a wide range of dietary energy levels, where quails that fed with treatments of higher carbohydrates had higher weight gain values than those fed 60 g/kg of Ocimum gratissimum with lowest carbohydrate.

In Table 2, the crude protein values agrees with the crude protein recommended by Murakami et al. [33] and NRC [16] for production period of quail birds but are lower than the crude protein (17%) recommended by Bawa et al. [21] and 20% by Babangida and Ubosi [34]. The lower crude protein is not surprising as Oboh et al. [35] reported that the protein content of Ocimum gratissimum is low. The crude fibre of 0 g/kg of Ocimum gratissimum being higher than T1, T2, T3 treatment (20 g/kg, 40 g/kg, 60 g/kg respectively) was not in line with the report of Nworgu et al. [36] that Ocimum gratissimum contain high level of crude fibre (18.52%). This could have attributed to lower and better food conversion ratio of the birds in 0 g/kg and 20 g/kg treatments and higher nutrient retention which resulted to weight gain as opined by Taiwo et al. [37] that weight gain is a function of degree of nutrient retention.

The lowest values of carbohydrates in 40 g/kg (52.70%) and 60 g/kg (52.10%) also reflected in the lowest weight gain of quails and this agrees with the report by Adepoju and Oyewole [32] who reported that the Ocimum gratissimum has low carbohydrates content which is attributed to it’s nutritional advantage for especially obese and diabetes. This could also be seen in animals as has been proved with this study on quail birds.

From Table 3, Qualitative Phytochemical Analyses of Ocimum gratissimum agrees with Abu et al. [38] who reported that Ocimum gratissimum is rich in phytochemicals such as saponin, alkanoid, flavonoids, glycocides, tannins, phenol of which most of them are potent bioactive compounds found in medicinal plants which could have attributed to the health status of the quail birds through out the study as no medication was given to them and no mortality was observed.

The Table 4, with 60 g/kg of Ocimum gratissimum had the highest values for most of the mineral analyzed except copper which was same for all treatments. The 60 g/kg of Ocimum gratissimum being the highest level of inclusion had the highest mineral contents which agree with the high mineral content findings of Edeoga et al. [23]. This study agrees with Nieman et al. [39] who reported that in animals a Ca/P ratio above 2.0 helps to increase the absorption of Calcium in the small intestine. Food is considered "good", if the ratio Ca/P>1 and "poor" if Ca/P < 0.05 [39] while Na/P ratio is 0.06 as the Ca/P values for all the treatments were all greater than 1 (Ca/P > 1) and their Na/P were equal and less than 0.06 as seen in Table 4.

With high values of iron, this study agrees with the findings of Der-Jui et al. [40] who reported that high Iron indicates that the meal could be a good source of dietary Iron to overcome nutritional deficiency of Iron.

From Table 5, quails fed with 40 g/kg of O. gratissimum inclusion \( (T_3) \) had the highest mean weight gain from week 1-7 while those fed with 20 g/kg of O. gratissimum \( (T_1) \) took the lead from week 8-12 reflecting that the O. gratissimum usage is dosage and time dependent as reported by Arhogho et al. [41];
**Table 1. Proximate analyses of the starter feed with varying levels of *Ocimum gratissimum***

<table>
<thead>
<tr>
<th>Parameters</th>
<th>C (0 g/kg)</th>
<th>T₁ (20 g/kg) (%)</th>
<th>T₂ (40 g/kg)</th>
<th>T₃ (60 g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>2.00</td>
<td>2.50</td>
<td>2.50</td>
<td>3.00</td>
</tr>
<tr>
<td>Ash</td>
<td>10.00</td>
<td>7.60</td>
<td>6.50</td>
<td>5.50</td>
</tr>
<tr>
<td>Crude Fat</td>
<td>7.00</td>
<td>8.30</td>
<td>9.10</td>
<td>9.80</td>
</tr>
<tr>
<td>Crude Fibre</td>
<td>4.00</td>
<td>3.80</td>
<td>3.30</td>
<td>3.00</td>
</tr>
<tr>
<td>Protein</td>
<td>21.40</td>
<td>22.10</td>
<td>23.00</td>
<td>23.50</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>55.60</td>
<td>55.70</td>
<td>55.60</td>
<td>55.20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**Table 2. Proximate analyses of the layers feed with varying levels of *Ocimum gratissimum***

<table>
<thead>
<tr>
<th>Analysis</th>
<th>C (0 g/kg)</th>
<th>T₁ (20 g/kg) (%)</th>
<th>T₂ (40 g/kg)</th>
<th>T₃ (60 g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>2.00</td>
<td>4.50</td>
<td>5.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Ash</td>
<td>12.50</td>
<td>14.80</td>
<td>15.20</td>
<td>15.80</td>
</tr>
<tr>
<td>Crude Fat</td>
<td>5.00</td>
<td>6.00</td>
<td>6.30</td>
<td>6.50</td>
</tr>
<tr>
<td>Crude Fibre</td>
<td>8.00</td>
<td>7.20</td>
<td>6.50</td>
<td>5.80</td>
</tr>
<tr>
<td>Protein</td>
<td>13.20</td>
<td>13.90</td>
<td>14.30</td>
<td>14.80</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>58.80</td>
<td>53.60</td>
<td>52.70</td>
<td>52.10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**Table 3. Qualitative phytochemical analyses of *Ocimum gratissimum***

<table>
<thead>
<tr>
<th>Phytochemical parameter</th>
<th>Qualitative results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavonoid</td>
<td>++</td>
</tr>
<tr>
<td>Tannin</td>
<td>+++</td>
</tr>
<tr>
<td>Steroid</td>
<td>++</td>
</tr>
<tr>
<td>Saponin</td>
<td>+</td>
</tr>
<tr>
<td>Phenol</td>
<td>++</td>
</tr>
<tr>
<td>Alkaloid</td>
<td>+</td>
</tr>
</tbody>
</table>

*Key: + = slightly present; ++ = moderately present; +++ = highly present*

**Table 4. Mineral composition of the feed with varying levels of *Ocimum gratissimum***

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Results (g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A (0 g/kg)</td>
</tr>
<tr>
<td>Calcium(Ca)</td>
<td>7.20</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>3.60</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>1.20</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>23.00</td>
</tr>
<tr>
<td>Sodium (Na)</td>
<td>0.10</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>75.00</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>6.22</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>21.30</td>
</tr>
<tr>
<td>Ca/P</td>
<td>2.0</td>
</tr>
<tr>
<td>Na/P</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Obianime and Esomonu, [42] and also it helps in increase of weight as observed by Edeoga et al. [23]. In this study, the increase in the weight is understandable because of the additional nutrients from *O. gratissimum* leaves as well as increase in feed consumption of the birds as reported by Nweze and Ekwe [43]. This is in agreement with McMullin [44], who observed that most herbs and extracts of spices work as growth promoters by killing parasites that hinder digestibility and growth performance of birds. But the reduction in weight of quails is in line with Nworgu et al. [45] findings for use of *Ocimum gratissimum* leaves for weight reduction.
From Table 5, the 60 g/kg of Ocimum gratissimum inclusion having the higher food conversion ratio values followed by the 40 g/kg of O. gratissimum based diets showed that the Control (0 g/kg) and 20 g/kg of Ocimum gratissimum were better than the 40 g/kg and 60 g/kg of O. gratissimum based diets which were having higher crude protein. This could be due to the fact that the favourable attributes of spices (O. gratissimum) can be masked when they are used in large proportions where the effect of inherent antinutritional factor like tannin and saponin become pronounced [46]. These antinutritional factors have been reported to affect utilization of nutrients and depress growth [47]. The significant better food conversion ratio of treatment 0 g/kg (C) and 20 g/kg (T1) dietary levels of Ocimum gratissimum compared to other treatment groups may be attributed to the higher weight gain values of the birds on this diet which is line with the observation by Odoemelam et al. [46] who reported lower and better food conversion ratio on birds with higher weight gain values. This could be that increase in the level of O. gratissimum had effects on the utilization of the diets by reducing absorption of nutrients.

This study also agrees with Adepoju and Oyewole [31] who reported that Ocimum gratissimum is rich in minerals and vitamins which also stimulate the appetite of the birds and the aroma from the O. gratissimum which are mainly eugenol, methyl, cinnamate, camphor and thymol [48] might have some feed digestive properties that increase the appetite of the birds.

This finding is in contrast with Murakami et al. [29]; Babangida and Ubosi [34] that reported (P> 0.05) no significant influence of dietary protein levels on feed efficiency when laying quails were fed diets with different protein levels.

From Table 5, the result of the protein efficiency ratio showed significant difference (P<0.05) as the 60g/kg treatment with highest amount of crude protein had least protein efficiency ratio of (5.535) against that of 0 g/kg (C), 20 g/kg (T1), 40 g/kg (T2) Ocimum gratissimum inclusion (7.169, 8.817, 9.149 respectively) indicative of a higher protein quality in 20 g/kg (T1) and 0 g/Kg (C) treatment [49]. This study is in agreement with Tuluen et al. [27] who indicated that feed with lowest crude protein (17%) had the highest protein conversion ratio in feeding quails with different protein levels (17% - 21%) that also resulted to good utilization of the feed by the birds since 0 g/Kg of Ocimum gratissimum inclusion (C) and 20 g/Kg of Ocimum gratissimum inclusion (T1) in this study still resulted to higher growth and better feed utilization by the Quail in their treatments.

Table 6 shows that the mean weight of eggs laid by quail fed with varying levels (g) of Ocimum gratissimum inclusion was not significantly different (P> 0.05) as P = 0.081. But on the contrary to this study, dietary protein levels have significant different (P< 0.05) effect on egg weight of quails fed different dietary protein levels as reported by Babangida and Ubosi [34]; Murakami et al. [33] who indicated that egg weight depends greatly on daily protein intake. The 20 g/kg (T1) of Ocimum gratissimum inclusion that produced the highest mean weight of quail birds still gave the highest mean egg weight which agrees with Lin et al. [50]; Bawa et al. [21] who reported that egg mass/weight can be used as criterion in assessment of nutritional status, especially if they are obtained from birds of the same age, breed and health status.

The values for the mean egg weights in all treatments were in agreement with Hubrecht and Kirkwood [51] who reported that an average egg weigh about 10 g.

The result of egg width obtained on eggs laid by quails fed with varying levels of Ocimum gratissimum showed no significant difference (p>0.05) (p = 0.055) among the dietary treatments. This result is in line with the finding of Hemid et al. [52] who reported insignificant (p>0.05) effect of dietary treatment on egg width of egg laid by quails.

The result of egg length obtained showed significant difference (p>0.05) (p = 0.045) among the dietary treatments. This result is not in line with the finding of Hemid et al. [52] who reported significant (p≤0.05) effect of dietary treatment on egg length of egg laid by quails.

Table 7 showed the Proximate composition of Ocimum gratissimum L. leaf and it was observed that the protein content was 21.75%. Proteins are important in the body for the production of hormones, enzymes and blood plasma. They are immune boosters and can help in cell division as well as in growth [53]. The high content of carbohydrates (52.10%) in the leaves makes it a good source of energy [26]. The moderate moisture contents showed that the leaves are
Table 5. Indices of growth performance and feed utilization

<table>
<thead>
<tr>
<th>Traits</th>
<th>C (0 g/kg)</th>
<th>T1 (20 g/kg)</th>
<th>T2 (40 g/kg)</th>
<th>T3 (60 g/kg)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MWG</td>
<td>120.77a</td>
<td>122.56a</td>
<td>102.52a</td>
<td>81.92a</td>
<td>0.000</td>
</tr>
<tr>
<td>MPWG</td>
<td>231%b</td>
<td>234%c</td>
<td>195%c</td>
<td>156%d</td>
<td>0.002</td>
</tr>
<tr>
<td>SPR</td>
<td>0.618b</td>
<td>0.623a</td>
<td>0.560c</td>
<td>0.487d</td>
<td>0.000</td>
</tr>
<tr>
<td>MFCR</td>
<td>23.66c</td>
<td>23.49d</td>
<td>27.94b</td>
<td>34.92a</td>
<td>0.003</td>
</tr>
<tr>
<td>MPER</td>
<td>9.149a</td>
<td>8.817b</td>
<td>7.169c</td>
<td>5.535d</td>
<td>0.022</td>
</tr>
</tbody>
</table>

abcd: means with different superscript significantly differ, P<0.05. MWG=Mean weight gain, MPWG= Mean Percentage weight gain, SPR= Specific growth rate, MFCR= Mean Food conversion ratio, MPER= Mean Protein efficiency ratio

Table 6. Effect on egg size

<table>
<thead>
<tr>
<th>Traits</th>
<th>C (0 g/kg)</th>
<th>T1 (20 g/kg)</th>
<th>T2 (40 g/kg)</th>
<th>T3 (60 g/kg)</th>
<th>SEM</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MWE</td>
<td>9.14a</td>
<td>8.84a</td>
<td>10.01a</td>
<td>9.63a</td>
<td>3.549</td>
<td>0.081</td>
</tr>
<tr>
<td>MEW</td>
<td>7.04a</td>
<td>6.70a</td>
<td>7.81a</td>
<td>7.33a</td>
<td>2.406</td>
<td>0.055</td>
</tr>
<tr>
<td>MEL</td>
<td>7.83a</td>
<td>7.63d</td>
<td>8.77c</td>
<td>8.16d</td>
<td>2.667</td>
<td>0.045</td>
</tr>
</tbody>
</table>

abcd: means with different superscript on the same row differ significantly, P< 0.05. a: means with same superscript on the row do not differ significantly, P> 0.05. MWE= mean weight of eggs, MEW= mean egg width, MEL= mean egg length

less prone to deterioration since foods with high moisture are prone to deterioration [53]. Moisture dissolves other substances and carries nutrients throughout the systems leading to effective performance of the organs [54]. Generally, dietary fibre helps in digestion and functions the body to slow down the rate of glucose absorption into the blood stream [55].

Table 8 showed the Mineral composition of Ocimum gratissimum L. leaf. The presence of Zn, Fe and Cu are necessary in leafy vegetables as they could serve as good sources of anti oxidants [56]. The presence of iron shows that the plant is essential for red blood cell production and oxygen transport in the body as supported by the work of [57]. The presence of Cu and Zn indicates that the plant is essential for: immune function, protein synthesis, blood clothing, Hormones, formation of hemoglobin and for secretion and potentiating insulin action, as it was also reported by [57]. The study also revealed the presence of macro- elements calcium, magnesium, potassium and sodium in varying quantities. Magnesium and sodium had low values. Magnesium helps in maintaining a normal heart rhythm [58]. Sodium was present and has an important role in maintaining the water balance within cells and in the function of both nerve impulse and muscles. The sodium also helps in maintenance of normal acid-base balance (59). Calcium (Ca) was present which plays an important role in building and maintaining strong bones. The studied plant of O. gratissimum is essential in building up the level of calcium in the body [59].

Table 7. Proximate composition of Ocimum gratissimum L. leaf

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Results (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>10.30</td>
</tr>
<tr>
<td>Ash</td>
<td>3.60</td>
</tr>
<tr>
<td>Crude Fat</td>
<td>5.40</td>
</tr>
<tr>
<td>Crude Fibre</td>
<td>6.85</td>
</tr>
<tr>
<td>Protein</td>
<td>21.75</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>52.10</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Table 8. Mineral composition of Ocimum gratissimum L. leaf

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Results (mg/Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (Ca)</td>
<td>0.21</td>
</tr>
<tr>
<td>Phosphorus (P)</td>
<td>0.08</td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>1.06</td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>3.85</td>
</tr>
<tr>
<td>Sodium (Na)</td>
<td>0.17</td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>2.14</td>
</tr>
<tr>
<td>Copper (Cu)</td>
<td>15.92</td>
</tr>
<tr>
<td>Zinc (Zn)</td>
<td>0.31</td>
</tr>
</tbody>
</table>

5. CONCLUSION

There was no observable negative effect on the health status of quails fed with the varying levels of Ocimum gratissimum. The survivability was 100% indicating healthy effect of the Ocimum
Ocimum gratissimum for the birds since no medication was used throughout the period of study.

Since 20 g/kg of Ocimum gratissimum is comparable with 0 g/kg (Control) diet, it can adequately be added in quails’ nutrition at the level without any negative effect on growth performance as there was significant weight gain and better food conversion rate. Unlike the 40 g/kg and 60 g/kg of Ocimum gratissimum which resulted in weight loss proving that Ocimum gratissimum is dosage and time dependent. Though 40 g/kg of O. gratissimum gave high values in the overall means of the egg size of the quail birds, still the weights of all the eggs were in line with Hubrecht and Kirkwood [51] recommendation.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge.

ETHICAL APPROVAL

All the animals used in this experiment were handled in accordance with the guidelines and ethical conduct for the used of non-human animals in research [24]. A total of 120 Japanese quail were used for the study that lasted for twelve weeks.

ACKNOWLEDGEMENTS

We also acknowledged the effort of Mr. T. Egboka of Botany Department, Nnamdi Azikiwe University, Awka for his technical assistance and directions during the identification and phytochemical analysis of the leaves. Finally, we are extremely thankful to Hon. Comrade O. L. Asolo for financing the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/61780