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# SUPPLEMENTATION OF HERBAL SEEDS TO IMPROVE THE GROWTH PERFORMANCE AND DIGESTION IN JAPANESE QUAIL (*COTURNIX COTURNIX JAPONICA*)

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## ABSTRACT

The demand for free range and organic poultry products is on the rise and there is a discouraging trend of using poultry reared on feed containing antibiotics as growth promoters. The growing concerns about the use of antibiotics is not baseless though as there are fare chances that they may leave residues in animal tissues and can cause drug-resistance among pathogens. Therefore, the use of natural growth promoters in poultry feed is getting popularity and demand for scientific research is intensifying. The present study was planned to investigate the use of natural growth promoters in Japanese quail diet. The treatments were designated as follows: A (5g *Curcuma longa* (Turmeric), B (5g *Capsicum annum* (Red Pepper), C (10g *Nigella sativa* (Black Cumin), D (10g *Pimpinella anisum* (Anise seed), E (Combination of treatments A, B, C and D) and F (Control). The data were recorded on following parameters: Body weight, feed conversion ratio, dressing percentage, giblet weight, digestibility coefficients for CP (crude protein), CF (crude fiber), EE (ether extract) and NFE (nitrogen free extract), and nutritive value of DCP% (digestible crude protein), TDN% (total digestible nutrients), ME (metabolizable energy) and mortality. The results showed best feed conversion ratio (FCR) (2.15±0.02), better digestibility coefficients of CP (84.02±1.3), CF (27.97±0.3) and NFE (87.96±1.8), higher nutritive value of TDN% (68.81±1.2) and ME (2895±20), and lowest mortality (2.33±0.50) for birds fed on 5g Turmeric i.e. treatment A. Use of Black Cumin (treatment C) produced highest body weight (122.5±0.2), better FCR (2.31±0.02), good dressing percentage (56.7±0.4) and higher gizzard (2.7±0.01) and intestinal weights (7.5±0.02) than control. Nevertheless, the best dressing percentage (59.5±0.4) was obtained in case of feeding Anise seed i.e., treatment D. However, treatments B and E did not show significant improvement in any of the observed parameters. Results concluded that use of natural herbs and seeds such as Turmeric, Black Cumin and Anise seed is beneficial for quail growth production.

***Keywords*:** Natural growth promoters, growth rate, broiler quails, livability.

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## 1. INTRODUCTION

From last few decades, antibiotics are being used in poultry feed to improve growth performance. However, due to their continuous use there is always a threat that bacteria may become resistant and spread to humans directly or indirectly. For this reason, the European Union (EU) has banned the use of growth promoter antibiotics in poultry feed since 2006 (Murugesan et al. 2014).

Medicinal plants are being used in different areas. About 21% of world population depend on these plants as a source of food and medicine (Khalil and Kharma 2005; Pliego et al. 2020; Cong et al. 2022). Medicinal plants have been spread for centuries as food and being used effectively in humans (Osman et al. 2010), as they have some effective substances such as flavonoids, terpenides, phenols, carotenoids and soaps (Craig 1999). Marjoram is a medicinal plant belongs to the oral family that plays an important role in inhibition of cancer cells and removal of free radicals through its antioxidant activity (Keck and Finley 2004), The Rosemary is a medicinal plant that acts as an anti-microbial and anti-inflammatory agent as it has the cathese (Peter 2004). Similarly adding marjoram leaves powder, rosemary leaves powder and their mixture in feed on the productive qualities of Japanese quail (Mossa et al. 2019).

The replacement of antibiotic growth promoters with natural growth promoters has gained considerable attention over the years. Therefore, the search for suitable replacement is identifying. For this purpose, different

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forms of prebiotics, probiotics, organic acids, enzymes, minerals and herbs have been tested and proposed to be used in poultry feed around the world. Nevertheless, special attention has been paid to natural herbs and their extracts due to their variety of usage, availability and economics (Kral et al. 2011). Herbs have great potential to replace antibiotic growth promoters because they have antimicrobial, coccidiostat and anthelmintic-like pharmacological properties that may potentially improve growth performance by optimizing feed intake and gut health (Cruz Martínez et al. 2017; Lee et al. 2021; van Wietmarschen et al. 2022; Chen and Si-Yong 2022; Anyaegbunam et al. 2022). Herbs also favor beneficial bacteria and influence gastric secretion which improve gut health (Mossa et al. 2019; de Macedo et al. 2020).

Japanese quail farming is growing rapidly around the world, and it has attained special position due to its cheaper production, unique flavor, low maintenance cost, disease resistance and short generation interval (Narinc 2013). The demand for quail meat is rising day by day necessitating better performing birds and improved feed to support this increased production is intensifying. So, the use of different growth promoters in the quail diet has become mandatory. Nonetheless very limited information is available about the use natural growth promoters in quail yet intensive studies are available in other poultry species such as chicken broilers etc. Therefore, in order to explore the potential use of natural herbs as growth promoter in quail diet, we had planned this study and we hypothesized that use of natural herbs will increase growth rate and digestion.

## 2. MATERIALS AND METHODS

### 2.1. Housing and Management

Mixed sex Japanese quail chicks (n=540; 1 week old) were housed in an open sided shed with floor pens containing sand as litter material. Quails were reared under uniform conditions of humidity, temperature, ventilation, and water supply. Further, 18/6 hours light/dark cycle and *ad-libitum* feed (Table 1) were observed. The average night and day temperature ranged 33-38°C during study and ceiling fans were used to provide extra ventilation during peak heat hours.

### 2.2. Experimental Design

Quails were randomly divided into 12 groups of 45 chicks each and intern each group was allotted to one of the 6 treatments as followed A=5g *Curcuma Longa* (Turmeric), B=5g *Capsicum annum* (Red Pepper), C=10g *Nigella sativa* (Black seed), D=10g *Pimpinella anisum* (Aniseed), E=Combination of A, B, C and D diets and E Control. Two replicates per treatment were used. At day 14, 21 and 28 of age, data on body weight gain and feed consumption were recorded from individual pens. Growth rate and feed conversion ratios were calculated. Data on feed and excreta digestibility were recorded from day 21- 28 of age. At the end of the trial, two birds from each replicate were slaughtered and carcass characteristics and giblet weights were recorded.

**Table 1:** Feed formulation of control diet fed to the quails from day 7 to 28

| Ingredients used | Percentage | Nutrients | Value% |
|---|---|---|---|
| Maize | 55.70 | Ca | 0.80 |
| Rice Polishing | 6.10 | Available P | 0.30 |
| Canola Meal | 1.97 | Phytate P | 0.34 |
| Soybean meal | 30.68 | Total P | 0.65 |
| Corn gluten 60% | 6.10 | Crude Fiber | 4.38 |
| Lime stone | 1.09 | Linoleic acid | 1.42 |
| DL-Methionine | 0.12 | Methionine | 0.50 |
| L-Lysine | 0.20 | Lysine | 1.30 |
| Threonine | 0.16 | ME Kcal/kg | 2900 |
| DCP | 1.28 | CP | 24 |
| Vitamin Supplement | 1.30 | | |
| Rock Salt | 0.30 | | |

### 2.3. Performance data

Data on body weight gain were collected by weighing individual birds and expressed as weekly body weight in grams per replicate per treatment. To record feed consumption, a measured quantity of feed was offered to the birds each time and feed refusal and wastage were recorded. Daily feed intake data were pooled to calculate weekly feed consumption per replicate per treatment. FCR was calculated as the amount of feed consumed per unit live body weight by the following formula. $FCR = Feed\ consumed\,(g)/body\ weight\ gain\ (g)$

### 2.4. Nutrient Digestibility

The digestibility trial was carried out from day 21 to 28 of age. The indirect marker method was used. For this purpose, acid insoluble ash (Celite®) was added to the diet at rate of 1%. The polythene sheets were placed under

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each pen and droppings were collected twice a day. Feces samples were stored at -20°C for further processing. Dry matter, crude protein, crude fiber, ether extract, ash and nitrogen free extract of experimental diets were determined using proximate analysis methods already described (AOAC 2000). Following formula was used to calculate digestibility:

$$\text{Digestibility coefficient (\%)} = 100 - 100\left[\frac{\%\text{ marker in feed}}{\%\text{ marker in feces}} \times \frac{\%\text{nutrient in feces}}{\%\text{ nutrient in feed}}\right]$$

### 2.5. Carcass data

At the end of the trial, two birds from each replicate were randomly selected and slaughtered after recording initial body weight. The carcass weight was recorded to obtain dressing percentage. The weights of liver, heart, gizzard and intestine were also recorded.

### 2.6. Statistical Analysis

The data were analyzed using analysis of variance (ANOVA) in a Completely Randomized Design (CRD). The Duncan's Multiple Range Test (DMRT) was used to separate means with significant differences. All analyses were performed using General Linear Models (GLM) procedure of Statistical package for the Social Science (SPSS) version 18.0 (SPSS 2013).

## 3. RESULTS

### 3.1. Effect on Growth Performance

The mean final body weight did not differ significantly (P<0.05) between the treatments however, there was significant effect on FCR. The best FCR was observed for quails of treatment A where it was significantly (P<0.05) better than treatments B, E and F (Table 2).

**Table 2:** Effects of herb seeds on various performance parameters in Japanese quails

| Parameters | Treatment Groups | | | | | |
|---|---|---|---|---|---|---|
| | A | B | C | D | E | F |
| Body weight | 117.8±0.2a | 111.0±0.2a | 122.5±0.2a | 117.0±0.2a | 116.3±0.2a | 110.6±0.2a |
| FCR | 2.15±0.02a | 2.37±0.02b | 2.31±0.02ab | 2.23±0.02ab | 2.37±0.02b | 2.34±0.02b |
| Carcass data | | | | | | |
| Dressing% | 52.6±0.4a | 53.2±0.4a | 56.7±0.4ab | 56.2±0.4ab | 59.5±0.4b | 57.5±0.4b |
| Liver wt (g) | 3.14±0.02a | 2.34±0.02b | 2.39±0.02bd | 2.47±0.02cd | 2.10±0.02e | 2.57±0.02f |
| Heart wt (g) | 0.81±0.01a | 0.77±0.01b | 0.77±0.01b | 0.75±0.01b | 0.75±0.01b | 0.72±0.01c |
| Gizzard wt (g) | 2.82±0.01a | 3.1±0.01c | 2.7±0.01a | 2.50±0.01b | 2.14±0.01d | 2.57±0.01b |
| Intestine wt(g) | 7.3±0.02ac | 6.7±0.02b | 7.5±0.02a | 7.5±0.02a | 6.5±0.02b | 7.08±0.02c |
| Digestibility coefficients % | | | | | | |
| Crude Protein | 84.02±1.3 | 82.78±1.2 | 83.11±1.3 | 83.56±1.3 | 82.56±1.2 | 82.13±1.2 |
| Crude Fiber | 27.97±0.3a | 25.31±0.2b | 27.11±0.3a | 27.21±0.3a | 25.21±0.2b | 24.23±0.2b |
| Ether Extract | 82.01±1.8a | 85.01±1.8b | 84.51±1.7b | 86.01±1.8b | 84.31±1.7b | 84.97±1.7b |
| Nitrogen Free Extract | 87.96±1.8a | 85.45±1.8a | 86.01±1.8a | 85.95±1.8a | 85.87±1.8a | 84.11±1.8b |
| Nutritive value | | | | | | |
| Di Calcium Phosphate% | 16.89±0.5 | 16.85±0.5 | 16.80±0.5 | 16.53±0.5 | 16.43±0.5 | 16.37±0.5 |
| Total Digestible Nutrients % | 68.81±1.2a | 66.94±1.2a | 67.21±1.2a | 67.31±1.2a | 66.85±1.2a | 65.97±1.2b |
| Metabolizable Energy (Kcal/kg) | 2895±20a | 2815±20ac | 2845±20a | 2855±20a | 2799±20bc | 2783±20bc |
| Mortality | 2.33±0.50a | 4.66±0.63b | 4.21±0.59b | 3.33±0.48bc | 2.98±0.53ac | 3±0.48ac |

Means±SD without common alphabets in a row differ significantly (P<0.05). The treatments in various groups were Group A (5g *Curcuma longa* (Turmeric), Group B (5g *Capsicum annum* (Red Pepper), Group C (10g *Nigella sativa* (Black Cumin), Group D (10g *Pimpinella anisum* (Anis seed), Group E (Combination of treatments A, B, C and D) and Group F (Control).

### 3.2. Effect on Hematology

The mean hematological figures did not differ significantly (P<0.05) between the treatments however, there was non-significant effect on HGB. The best HGB was observed for quails of treatment F where it was significantly (P<0.05) better than treatments B, E and F (Table 3).

### 3.3. Effect on Organs Development

The treatment effect was significant (P<0.05) for dressing percentage and giblet weights (liver, Heart, gizzard and intestinal weights) (Table 2). The dressing percentage was significantly (P<0.05) lower for treatments A and B compared with all other treatments while results were comparable between treatments C, D, E and F. The liver and

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heart weights were highest (P<0.05) for treatment A while all other treatments had lower (P<0.05) values than control diet. Conversely, the quail fed on control diet had the lowest (P<0.05) values for heart weight. The gizzard

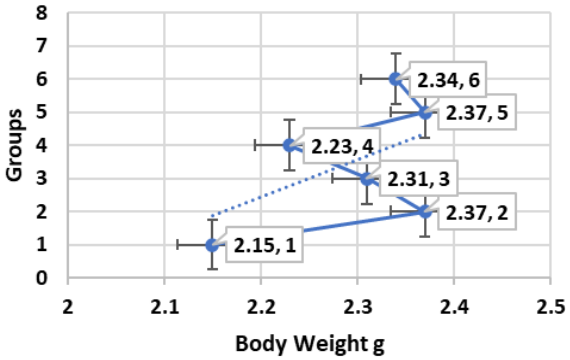


**Fig. 1:** Effect of treatments on group body weights.

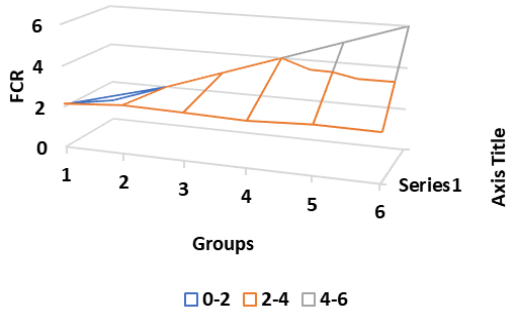


**Fig. 2:** Effect of treatments on group FCR.

**Table 3:** Effects of herb seeds on blood parameters in Japanese quails

| Group | A | B | C | D | E | F | SEM | Sig. |
|---|---|---|---|---|---|---|---|---|
| GRA | 10.857a | 5.33b | 4.51b | 5.34b | 10.8a | 7.52ab | ±1.42 | 0.01 |
| GRA% | 10.86ab | 8.43bc | 6.33c | 8.73bc | 15.03a | 12.33ab | ±1.4 | 0.007 |
| HCT | 32.64a | 30.02ab | 29.73ab | 27.5bc | 27.36bc | 28.25bc | ±1.2 | 0.03 |
| HGB | 11.76 | 11.83 | 11.13 | 11.3 | 11.4 | 11.96 | ±0.51 | 0.77 |
| MCH | 63.93ab | 61.03b | 61.33b | 64.03ab | 64.5ab | 62b | ±1.27 | 0.04 |
| MCHC | 40.63 | 39.5 | 37.2 | 40.26 | 41.86 | 42.36 | ±1.19 | 0.1 |
| MCV | 141.33c | 155abc | 166.33a | 156ab | 154.33abc | 149.67bc | ±4.65 | 0.03 |
| P% | 6.4d | 12.75bc | 15.36ab | 8.26cd | 12.28bcd | 15.46ab | ±1.96 | 0.003 |
| PDW | 32.96 | 30.26 | 29.38 | 28.87 | 31.93 | 28.45 | ±2 | 0.66 |
| PLT% | 6.4d | 12.75bc | 15.36ab | 8.26cd | 12.28bcd | 15.46ab | ±1.96 | 0.003 |
| PLT | 17 | 21 | 22.33 | 16.33 | 24.33 | 19.33 | ±2.85 | 0.12 |
| RBC | 2.31a | 1.94b | 1.84bc | 1.78bc | 1.77bc | 1.92b | ±0.09 | 0.006 |
| WBC | 50.45 | 61.55 | 63.28 | 57.80 | 69.44 | 55.06 | ±5.9 | 0.13 |
| Triglyceride | 33.4 | 47.8 | 56.2 | 30.3 | 43.9 | 22.3 | ±11.7 | 0.37 |
| Cholesterol | 218 | 120.3 | 157.6 | 141.6 | 173.6 | 100.6 | ±23 | 0.07 |
| HDL | 34.7 | 27.5 | 50.6 | 37.2 | 41.2 | 33.9 | ±4.82 | 0.12 |
| LDL | 176.5 | 83.2 | 95.7 | 98.3 | 123.6 | 62.2 | ±22.3 | 0.07 |

Means±SD without common alphabets in a row differ significantly (P<0.05). GRA (Glucocorticoid-remediable aldosteronism), HCT (Hematocrit), HGB (hemoglobin), MCH (Mean corpuscular hemoglobin concentration), MCV (Mean corpuscular volume), P% (peripheral blood), PDW (Platelet distribution width), PLT (Platelets), RBC (Red blood cells), WBC (White blood cells), LDL (Low density lipoproteins), HDL (High density Lipoproteins).

weight was highest for treatment B and A, respectively and it was lowest for E. The highest intestinal weight was observed for treatments C and D followed by A and F. The treatments B and E had lower (P<0.05) intestinal weight than control diet.

### 3.4. Effect on Nutrient Digestibility and Absorption

Digestibility coefficient values for CF, EE and NFE varied significantly (P<0.05) between the treatments, however, no difference was observed for CP (Table 2). The digestibility coefficient of CF was statistically similar among treatments A, C and D but significantly higher compared with all other treatments. The digestibility coefficient of EE was significantly lower for treatment A while all other treatments were statistically similar. The NFE digestibility coefficient was lowest for control diet while other treatments did not differ significantly. Nevertheless, there was no difference regarding the nutritive value of DCP between the treatments, while TDN was lowest (P<0.05) for treatment F and ME was lowest for treatment E and F. The highest (P<0.05) morality was observed for treatment B followed by treatment C, D, F, E and A.

## 4. DISCUSSION

As a whole treatment A had the best FCR, better digestibility coefficients for CP, CF, NFE, higher nutritive value of TDN% and ME, and lowest mortality. These observations suggest that addition of turmeric in quail diet is beneficial. Though there is not much data available in quail to compare with, yet studies are available in other

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species such as chicken broilers which has shown increase in body weight, feed intake and FCR with the use of turmeric (Al-Sultan et al. 2003; Durrani et al. 2006; Raghdad and Al-Jaleel 2012; Nm et al. 2018; Ekine et al. 2019; Sugiharto 2020; Oluwafemi et al. 2021; Ogbuewu et al. 2022). In addition to that turmeric has also been reported to reduce mortality and increase dressing percentage (Raghdad and Al-Jaleel 2012; Mondal et al. 2015). We did not observe a significant increase in body weight by the use of turmeric, but we had better FCR. The question that why better FCR did not lead to higher body weight gain in quails is not clear however the possible causes might be:

1. We used turmeric in powder form, there is possibility that use of its extract could be more beneficial.
2. It might be since the use of turmeric reduces fat pad, hence gives lower body weight due to more lean meat.
3. We used only one level of turmeric and we do not know whether an increase or decrease in its concentration in the quail diet could be beneficial. Nevertheless, an increase in liver weight in this study indicates that lower level might be better.

Use of black cumin produced highest body weight compared with all other treatments, better FCR than control, good dressing percentage and higher gizzard and intestinal weights than control in this study (Arif et al. 2019; Aydogan et al. 2020; Haq et al. 2020; Devi et al. 2022; Asghar et al. 2022). Black cumin seeds have been used as a natural growth promoter in many trials of broiler and they were found to boost body weight (El-Ghammry et al. 2002; Hassan et al. 2004), FCR (Takruri and Dameh 1998; Abu-Dieyeh and Abu-Darwish 2008) and carcass characteristics (Guler et al. 2006; Toghyani et al. 2010). Black cumin is famous for its medicinal properties, and reported to have alkaloids, many pharmacologically active substances like thymol, nigellicine-N-oxide, di-thymoquinone, thymoquinone and carvacrol etc. and volatile and fixed oils that might make it an effective growth promoter (Nasir et al. 2005). The better growth observed in quails by using black cumin seeds might be due to its aforementioned properties.

The utmost use of anise seed in animals is as antibacterial, antifungal, insecticidal, muscle relaxant, analgesic, laxative and antioxidant (Ashry et al. 2022; Bakhshi et al. 2022). However, it has also been tested as growth promoter in fewer studies and has been found to improve FCR in broilers. In this study, however, we did not observe any better FCR by the use of anise seed instead we had observed highest dressing percentage for this quail group (El-Ashram S and Abdelhafez 2020; Hammod et al. 2020; Mohamed et al. 2020).

The use of red pepper in broiler diet has been shown to increase feed intake, body weight gain and FCR. Furthermore, it has been reported to increase liver size (Shahverdi et al. 2013; Islam et al. 2018; Reda et al. 2020; Abd El-Hack et al. 2022). However, we did not find any significant effect of feeding red pepper on quails. The possible reason might be the suboptimal level of red pepper we used in this study so, there is need to figure out best suitable level to get better growth performance in quails.

## Conclusion

We concluded that the use of herbal medicinal plants is beneficial for quail performance however, there is need to optimize their level of inclusions in the diet.

### Author's Contribution

Umar Farooq: Provided quail birds and shed facility. Riaz Mustafa: Helped in lab work and write up. Muhammad Farooq Khalid: Shed management. Muhammad Auon: Shed management. Zia-ur-Rehman: Over all supervision of research. Umair Mahmood: Hematology expert. Abdul Wahaab: Data analysis. Noor Ul Huda: Food science team member. Muhammad Khalid Bashir: Data analysis. Jibran Hussain: Quail farming expert. Shahid Mahmood: Quail farming expert.

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