Indian Journal of Poultry Science (2024) 59(3): 379–383, Short Communication
https://doi.org/10.56093/ijps.v59i3.21

Effect of supplementation of onion peel powder as a herbal feed additive on growth performance and nutrient digestibility of Japanese quails

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(Received on November 09, 2023; accepted for publication on November 08, 2024)

ABSTRACT

Mujeebulla, S.MD., Susmita, T., Reddy Tirupathi R, and Kishore Raja K. Effect of supplementation of onion peel powder as a herbal feed additive on growth performance and nutrient digestibility of Japanese quails. Indian Journal of Poultry Science, 59(3): 379-83.

The goal of the current study was to assess how Japanese quail performance was affected by the use of onion peel powder (OPP) as a herbal feed additive. For this, a basal diet was prepared and was designated as T1. To this T1, graded levels of OPP were supplemented viz., 10g/kg (T2), 20g/kg (T3), 30g/kg (T4) and 40g/kg (T5). A biological trial was conducted on 225 birds for 5 weeks distributed into 5 treatments with three replicates and 15 birds per replicate and Every bird was kept in a uniform management condition. They have unlimited access to food and water. The results of the current study revealed that the mean body weights and body weight gains were increased ($p \leq 0.01$) with increasing levels of OPP supplementation. Whereas, better ($p \leq 0.01$) FCR was reported at 40g/kg OPP in the diet. The coefficient of digestibility of dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE) and crude fiber (CF) were significantly ($p \leq 0.01$) increased with increasing levels of OPP. It is concluded that OPP can safely be supplemented up to 40g/kg in the diet without any adverse effect on the performance of Japanese quail.

Keywords: Quail, Onion peel powder, Body Weight, FCR, Feed Intake, Nutrient digestibility

INTRODUCTION

The poultry business has experienced unprecedented expansion over the last three decades, and it is currently considered one of the fastest-growing components of the agricultural economy. Commercial quail farming can be a lucrative source of income and job opportunities for the rural and urban unemployed youth in India. Quails can adapt themselves to almost all types of climates and environments. Quails are currently the third largest avian species in number next to chickens and ducks in the country. The carcass of quail is made up of 76% of meat, 14% of skin, and 10% of bone. Of all the poultry species, quail has the highest meat-to-bone ratio (Gecgel et al. 2015).

According to (Goodarzi *et al.* 2013, Kothari *et al.*, 2019, and Varalakkshmi *et al.*,2023), organosulfur compounds in the onions have boosted the broiler performance by increasing the nutrient absorption. Onion (Allium cepa) has a mode of action similar to antibiotics. It comprises the active principle quercitin, allylic and allicin sulfide complex, which possesses anti-diabetic, hypocholesterolemic, hypolipidaemic, anticancer, antioxidant and antimicrobial properties (Nwogor *et al.*, 2020, Sambamurthy *et al.*, 2022, Muhammad *et al.*, 2023 and Prasad *et al.*, 1996). The inclusion of onion meals in the diets of broiler chickens improved the feed intake due to favorable taste since metabolic systems in poultry species are influenced by onion extract (Malematja *et al*, 2022).

During industrial processing, large volumes of onion waste are produced, which includes the skin/peel, two exterior fleshy leaves, and the top and bottom parts. These wastes are abundant in phytochemicals and bioactive compounds (Benítez *et al.*, 2011). Keeping in view the significant importance of OPP, a current study was proposed to evaluate the effect of supplementation of onion peel powder at different levels on growth performance and nutrient digestibility in Japanese quails.

MATERIALS AND METHODS

Preparation of the Onion peel powder

Onion peels were procured from the weekly market at Kalakada. Where the onion peels were discarded as trash, they were collected, dried, and ground in a Willey's grinder so they could be added to quail diets.

Experimental site

The biological trial was conducted at the Poultry unit, Livestock Farm Complex, N.T.R College of Veterinary Science, Gannavaram (A.P).

Preparation of basal diets

Experimental diets were T1, T2, T3, T4 and T5. The basal diet (T1) was prepared as per the nutrient requirements of poultry (NRC, 1994) for Japanese quail. OPP was supplemented to the basal diet at 10g/kg (T2), 20g/kg (T3), 30g/kg (T4), 40g/kg (T5), respectively. All the experimental diets prepared were iso-nitrogenous and iso-caloric.

Experimental birds, management and analysis

225-day-old Japanese quail chicks were purchased from a commercial hatchery at Dwarka Tirumala. They

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were weighed individually and randomly divided into 5 groups of 3 replicates each with 15 chicks per replicate. Each group was allotted to one of the dietary treatments at random. The experiment was conducted from day-old to five weeks of age. All the chicks were housed in 5-tier battery cages throughout the experiment. Feed and water were provided *ad libitum*. Feed was offered regularly and feed leftover was weighed once a week to quantify the feed intake. For three days in the first week, B-complex vitamins were added to water. For five weeks, the experiment was conducted using standard management procedures as per Institute Animal Ethical Committee (IAEC) guidelines. To maximize feed intake and weight gain in quail for meat production, lighting regimes with a photoperiod of 23 hours of light have been used.

Data collection

The body weight of individual birds and feed intake were recorded as per replicas at weekly intervals up to 5 weeks of age. Under a completely randomized design, the collected data was subjected to a one-way ANOVA (Snedecor and Cochran, 1994). The means were then compared using Duncan's (1955) multiple-range test at the $p \leq 0.05$ level.

Table 1: Ingredient composition of experimental diet fed to Japanese quails

Feed ingredients (kg)	T_1 (0)	T_2 (10)	T_3 (20)	T_4 (30)	T_5 (40)
Maize	52	51.5	51.3	51.2	51.2
Soya bean meal	42	41.7	41.5	41.3	41.3
OPP (g)*	0	250	500	750	1000
DCP	1	1	1	1	1
Shell grit	1.3	1.3	1.3	1.3	1.3
Salt	0.3	0.3	0.3	0.3	0.3
Trace mineral mix *	0.1	0.1	0.1	0.1	0.1
DL-methionine	0.08	0.08	0.08	0.08	0.08
Vitamins#	0.01	0.01	0.01	0.01	0.01
Liver tonic	0.05	0.05	0.05	0.05	0.05
Toxin binder*	0.02	0.02	0.02	0.02	0.02
Coccidiostat*	0.05	0.05	0.05	0.05	0.05
Palm oil	3.1	3.1	3.1	3.1	3.1
Total	100	100	100	100	100
	Nutrient composition (analysed values)				
ME(Kcal/kg)*	2940	2950	2970	3000	3010
Calcium	0.94	0.92	0.98	0.95	0.92
Total Phosphorus	0.53	0.57	0.58	0.62	0.59
Crude Protein%	23.76	23.88	23.79	23.69	23.86

* 0.15kg trace minerals contains - Manganese sulphate 8250 mg, Ferrous sulphate 7500 mg, Zinc sulphate 7500 mg, Cobalt sulphate 75 mg, Copper sulphate 450 mg, Potassium iodide 450 mg, Sodium selenite 75 mg.

Cost of OPP @Rs.10.00 per kg, Coccidiostat-25% Dinitro-Ortho-Toluamide, Toxin binder* - Sodium bentonite, ME*-calculated

Vitamin A-12.50 MIU, D3 -2.50 MIU, E-8g, K-1.50g, B1 -1g, B2 -5g, B6 -1.50g, B12-0.02g, Calcium D Pantothenate-5g, Folic acid- 0.25g, Niacin-12g in a 250g pack

Coefficient of digestibility

During the last 3 days of the trial, feces were collected from all 5 treatments of 3 replicates which were previously fasted for 12 hours to empty the bird's gut to mark the beginning and end of feces collection. The obtained fecal samples were weighed every day after being oven-dried for 18 hours at a temperature of roughly 105°C. The daily fecal samples from each treatment were gathered after the collection period, combined, crushed, and thoroughly mixed to create a uniform mixture. The following formula was used to determine the apparent digestibility of fecal samples that had undergone proximate analysis by the standard procedures described (AOAC, 2007).

$$\text{Apparent coefficient of digestibility} = \frac{\text{Nutrient in feed} - \text{Nutrient in feces}}{\text{Nutrient in feed}} \times 100$$

RESULTS AND DISCUSSION

The analyzed nutrient/ chemical composition of OPP used in the experiment was 95.25, 84.74, 4.25, 1.08, 25.91, 53.50, 15.26, 7.43, 0.86, 0.16% for dry matter (DM), organic matter (OM), calcium (Ca), total phosphorus (P), crude protein (CP), ether extract (EE), crude fiber (CF), nitrogen-free extract (NFE), total ash (TA), and acid in soluble ash (AIA), respectively.

Effect of OPP on growth parameters

The body weights of the birds fed OPP at 0, 10, 20, 30 and 40 g/kg diet showed no significant difference in day old, 2nd, 3rd and 4th week but significantly ($p \leq 0.05$) better in 1st and 5th week in T5 (40g/kg OPP) and no significant difference in T3, T4, T5 in 5th week as seen in table 2. In line with the present findings, Goodarzi *et al.* (2013) and Ur Rahman *et al.* (2017) reported significantly ($p \leq 0.01$) higher body weights at 0.0, 1.5, 2.0 and 2.5g/kg of onion supplemented in broilers. Similarly, Omar *et al.* (2020) stated that the inclusion of Onion extract @ 3 g/kg in a broiler diet had higher body weights significantly ($p \leq 0.05$) and Kazeem *et al.* (2021) reported that supplemented with 5g/kg onion leaf powder in broiler diet resulted in higher body weights significantly ($p \leq 0.05$). Studies have demonstrated that quails receiving herbal supplements, including onion extracts, exhibit significant increases in body weight compared to control groups, Eid *et al.* (2023).

The increase in body weight with OPP supplemented quail may be attributed to the sulfur

Table 2: Weekly body weights(g) of Japanese quails fed with varying levels of Onion Peel Powder

Treatment	WEEKLY BODY WEIGHT					
OPP(g/kg)	Day old	1st week	2nd week	3rd week	4th week	5th week
T_1 (0)	8.33±0.07	33.00^{b}±0.50	69.58±0.93	111.80±1.54	157.44±1.97	191.00^{c}±3.06
T_2 (10)	8.36±0.08	32.38^{b}±0.52	69.44±1.06	111.93±1.64	156.96±2.08	197.98^{bc}±2.39
T_3 (20)	8.47±0.09	33.20^{b}±0.55	69.64±1.06	112.38±1.77	156.16±2.31	199.61^{ab}±2.63
T_4 (30)	8.40±0.09	35.51^{a}±0.55	69.09±0.72	113.87±1.13	158.02±1.69	203.93^{ab}±2.56
T_5 (40)	8.49±0.10	36.64^{a}±0.60	70.11±1.17	114.47±1.65	160.13±1.94	206.49^{a}±2.29
SEM	0.040	0.267	0.445	0.697	0.896	1.209
N	45	45	45	45	45	45
P	0.694	0.001	0.969	0.669	0.695	0.001
SS	NS	**	NS	NS	NS	**

Values in column bearing different superscripts differ significantly ** (p≤0.01),*(p≤0.05), NS (p≥0.05).

containing compounds that are found in onions (Kurita et al. 1979) - (alliin, diallyl sulfides, quercitin and allicin) which have antibacterial and antioxidant activity that may keep birds healthy by limiting the growth of some harmful bacteria in the gastrointestinal tract while enhancing the beneficial bacteria and growth performance of broilers (Bedford, 2000).

Bodyweight gains

Body weight gain of the birds fed OPP at 0, 10, 20, 30 and 40 g/kg diet did not differ significantly (p≥0.05) during 3rd and 4th week but the cumulative body weight gains showed a significant increase (p≤0.01) with an increased level of OPP in the diet were presented in table 3.

The increased body weight gain seen in the present study might be due to the addition of the flavor of onion peel powder which improves feed palatability by Bedrníèek *et al* (2020). According to Olusola (2018), it proven that Sulphur containing compounds in onion can act similar to antibiotics and reduce the growth of some

Table 3: *Body weight gains(g) of Japanese quails fed with varying levels of Onion Peel Powder*

Treatment	BODY WEIGHT GAIN					
OPP(g/kg)	1st week	2nd week	3rd week	4th week	5th week	Cumulative
T_1 (0)	24.67^{b}±0.49	36.58^{ab}±1.01	42.22±1.81	45.64±2.44	33.56^{b}±3.60	182.67^{c}±3.08
T_2 (10)	24.02^{b}±0.52	37.07^{a}±0.96	42.49±1.92	45.02±2.30	41.02^{ab}±2.96	189.62^{bc}±2.40
T_3 (20)	24.73^{b}±0.57	36.44^{ab}±1.19	42.73±2.18	43.64±3.05	43.45^{a}±3.52	189.07^{bc}±3.29
T_4 (30)	27.11^{a}±0.57	33.58^{b}±0.73	44.78±1.34	44.16±2.11	45.91^{a}±2.84	195.53^{ab}±2.59
T_5 (40)	28.16^{a}±0.61	33.47^{b}±1.40	44.36±1.87	45.67±2.46	46.36^{a}±2.94	198.00^{a}±2.27
SEM	0.269	0.493	0.822	1.105	1.447	1.274
N	45	45	45	45	45	45
P	0.001	0.036	0.810	0.971	0.033	0.001
SS	**	**	NS	NS	*	**
P	0.001	0.036	0.810	0.971	0.033	0.001
SS	**	**	NS	NS	*	**

Values in column bearing different superscripts differ significantly ** (p≤0.01),*(p≤0.05), NS (p≥0.05).

harmful bacteria in the gut and this might be the reason for better feed efficiency and higher weight gains seen in the present study.

Feed intake (g)

Feed intake of the birds fed OPP at 0, 10, 20, 30 and 40 g/kg with increasing levels of OPP from day one to five weeks showed no significant (p≥0.05) difference in feed intake among different treatment groups as seen in table 4.

It has already been established that heating causes the sulfur-containing components of onions to produce the sweet-tasting compound bispropenyl disulfide (Gonzalez and Barrett, 2010).

Feed conversion ratio

The feed consumed per kg body weight gain (FCR) was significantly (p≤0.05) improved during 1st, 5th week of age and cumulative as presented in Table 5. Overall, better FCR was noticed in the group supplemented with OPP at 40 g/kg diet which might be due to improved nutrient digestibility but no statistical difference between T3, T4 and T5.

Table 4: Feed intake(g) of Japanese quails fed with varying levels of Onion Peel Powder

Treatment	FEED INTAKE					
OPP(g/kg)	1st week	2nd week	3rd week	4th week	5th week	Cumulative
T_1(0)	36.49±1.818	94.31±1.509	138.36±1.083	173.31±0.727	188.27±1.029	630.74±3.356
T_2(10)	38.22±0.823	95.16±0.886	137.44±1.243	171.94±1.702	185.60±1.017	628.36±4.399
T_3(20)	37.98±0.974	95.51±1.233	135.53±1.000	172.04±1.580	184.28±0.970	625.35±3.203
T_4(30)	34.82±0.962	93.78±1.766	133.35±1.932	171.91±0.471	187.20±1.315	624.40±4.772
T_5(40)	36.13±0.176	94.40±0.666	136.27±0.891	172.48±0.942	187.35±1.752	623.72±1.202
SEM	0.530	0.510	0.670	0.470	0.607	1.536
N	3	3	3	3	3	3
P	0.233	0.873	0.134	0.904	0.246	0.627
SS	NS	NS	NS	NS	NS	NS

Values in column non-significant NS (p≥0.05).

Table 5: Feed conversion ratio(%) of Japanese quails fed with varying levels of Onion Peel Powder

Treatment	FEED CONVERSION RATIO					
OPP(g/kg)	1st week	2nd week	3rd week	4th week	5th week	Cumulative
T_1 (0)	1.48^{ab}±0.04	2.58 ±0.07	3.28±0.09	3.81±0.08	5.66^{a}±0.25	3.36^{a}±0.03
T_2 (10)	1.50^{ab}±0.07	2.58±0.04	3.25±0.27	3.75±0.04	4.53^{b}±0.10	3.12^{b}±0.04
T_3 (20)	1.54^{a}±0.03	2.63±0.09	3.16±0.08	3.94±0.11	4.25^{bc}±0.09	3.10^{b}±0.04
T_4 (30)	1.30^{b}±0.08	2.79±0.06	3.07±0.15	3.90±0.05	4.09^{bc}±0.02	3.03^{b}±0.04
T_5 (40)	1.29^{b}±0.06	2.83±0.08	3.08±0.05	3.78±0.05	4.04^{c}±0.12	3.01^{b}±0.02
SEM	0.037	0.040	0.062	0.035	0.168	0.037
N	3	3	3	3	3	3
P	0.050	0.095	0.812	0.372	0.001	0.001
SS	*	NS	NS	NS	**	**

Values in column bearing different superscripts differ significantly *(p≤0.05), NS (p≥0.05), **(p≤0.01).

Effect of OPP on digestibility of nutrients:

In the current study, supplementation of OPP from 0 to 40g/kg diet stated that the digestibility of DM, OM, CP, EE and CF significantly increased (p≤0.01) while no significant increase in digestibility of NFE. The nutritional fiber (prebiotic) in onion bulbs aids in stimulating GIT development and enzyme production which leads to the breakdown of nutrients, and helps in the digestion and regulation of oxidants in feed ingredients (Bhattacharjee *et al.,* 2013).

The inclusion of onion peel powder has been linked to improved digestibility of nutrients, particularly proteins and fats, which are crucial for optimal growth(Metwally, 2023).

Table 6: Digestibility of proximate constituents of diets (%) of Japanese quails fed with varying levels of Onion Peel Powder

Treatment	NUTRIENT DIGESTIBILITY					
OPP(g/kg)	Dry matter	Organic matter	Crude protein	Ether extract	Crude fibre	NFE
T_1 (0)	67.23^{e}±0.14	70.92^{b}±0.22	45.14^{e}±0.07	79.99^{b}±0.34	22.49^{b}±0.03	85.54±0.26
T_2 (10)	68.79^{d}±0.13	71.40^{b}±0.25	48.69^{d}±0.45	78.92^{b}±1.05	22.58^{b}±1.16	86.52±0.76
T_3 (20)	70.16^{c}±0.16	72.89^{a}±0.57	50.86^{c}±0.59	78.75^{b}±0.13	23.83^{ab}±0.47	85.91±0.29
T_4 (30)	72.28^{b}±0.28	73.71^{a}±0.13	52.43^{b}±0.04	80.32^{b}±0.06	24.73^{a}±0.09	85.56±0.06
T_5 (40)	73.43^{a}±0.20	73.71^{a}±0.47	53.53^{a}±0.11	82.03^{a}±0.45	25.12^{a}±0.65	85.92±0.36
SEM	0.606	0.342	0.806	0.376	0.375	0.185
N	3	3	3	3	3	3
P	0.001	0.001	0.001	0.010	0.047	0.503
SS	**	**	**	**	**	NS

Values in column bearing different superscripts differ significantly ** (p≤0.05), NS (p≥0.05).

CONCLUSION

During the experiment period of day-old to 5 weeks, The BWG was significantly ($p \leq 0.01$) increased with increasing levels of OPP, whereas the overall feed intake did not show any significant difference when compared with the control. The coefficient of digestibility of DM, OM, CP, EE and CF were significantly ($p \leq 0.01$) increased with increasing levels of OPP up to 40 g/kg diet. On the other hand supplementation of OPP from 0 to 40 g/kg in diet did not affect NFE.

ACKNOWLEDGMENT

The authors are thankful to the Sri Venkateswara Veterinary University, Tirupathi for the financial assistance

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