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Effect of Supplementation of Onion Peel Powder as a Herbal Feed Additive on Carcass Traits, Sensory Evaluation and Cost Economics of Japanese Quails

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ABSTRACT

The present study was carried out during November to December, 2023 at poultry unit, livestock farm complex, NTR College of Veterinary Science, Andhra Pradesh, to evaluate the effect of supplementation of onion peel powder (OPP) as an herbal feed additive on the performance of Japanese quail. 225 day-old Japanese quails were distributed randomly into five treatments with three replicates containing fifteen birds each and were fed with five experimental diets T_1 (Basal diet), T_2 (Basal diet+10 g kg^{-1} OPP), T_3 (Basal diet+20 g kg^{-1} OPP), T_4 (Basal diet+30 g kg^{-1} OPP) and T_5 (Basal diet+40 g kg^{-1} OPP) from day old to five weeks of age and were maintained under uniform management conditions. Two birds per replicate were slaughtered at the end of 5th week. The study showed that the carcass traits like pre-slaughter live weight, heart weight, and carcass weight significantly increased (p<0.01) with increasing levels of OPP. The study found that supplementing OPP in diets from 0 to 40 g kg^{-1} did not affect dressing percentage, liver, gizzard, giblet weights and sensory evaluation compared to other treatment groups. Quail fed with 40 g kg^{-1} OPP had significantly lower feed cost kg^{-1} gain. The study indicates that OPP can be safely supplemented up to 40 g kg^{-1} in the diet without any negative impact on the performance of Japanese quail.

KEYWORDS: OPP, Japanese quails, carcass traits, dressing percentage, feed cost

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1. INTRODUCTION

The poultry business has experienced unprecedented expansion over the last three decades and important components of the agricultural economy. India ranks fourth in total production of poultry meat in the world (Anonymous, 2019). This has occurred because of increased intake of eggs and meat due to their availability and low cost. Poultry outperform other domesticated animals in terms of maintaining a high feed conversion rate is essential for birds to grow more quickly and attain market weight earlier (Diaz et al., 2019). In India, commercial quail farming has the potential to generate a substantial income and job possibilities. Quails are small-sized birds whose rearing system is easy, simple and adapt to almost all types of climates. Indian climate is suitable for raising quail commercially. At present quail has become the third largest avian species in number only next to chickens and ducks in the country. Quail has a carcass made up of 76% of meat, 14% of skin, and 10% of bone. Quail has the highest meat-to-bone ratio among the poultry species (Gecgel et al., 2015).

It has been realized that the natural feed sources like herbs and its extracts overcome the adverse effect of stress on broiler performance (Aderanti et al., 2024 and Yigit et al., 2014). According to (Goodarzi et al., 2013), organosulfur compounds in onions may have boosted broiler performance by increasing nutrient absorption. Onion extract exhibited non-toxic and non-pathogenic effects on animals and considered as feed additive. Antibody production was higher in chicken blood serum if we supplemented onion in their feed. Onion (*Allium cepa*) belongs to the family Amaryllidaceae. It comprises the active principle quercitin, allylic, and allicin sulfide complex, which possesses anticancer, antioxidant, antimicrobial, anti-diabetic, hypocholesterolemic, hypolipidaemic (Muhammad et al., 2023). Factors affecting the impact of natural antioxidants on broiler meat are inclusion level, environmental conditions, basal diet and potential associations with the condition of rearing (Kirkpinar et al., 2014). Onion meal inclusion in chicken diets has been shown to improve gut morphology and carcass quality of poultry meat (Ur Rahman et al., 2017; br Nainggolan et al., 2024, Al-Ramamneh, 2018). Carcass charecteristics of meat are the major factors that attract consumers to buy meat (Yang et al., 2005; Tella et al., 2023). In experimental mice with hypercholesterolemia, dramatically lower serum cholesterol levels (Vidyavati et al., 2010). Likewise, rats blood cholesterol levels decreased when supplemented with onions (Baksh et al., 2011). Onions have a hypocholesterolemic impact because they either boost the liver absorption of high-density lipoprotein (HDL) or decrease the production of cholesterol (Goodarzi et al., 2013).

High feed costs which are partially attributable to the price fluctuations of feed ingredients present a major challenge to successful poultry production. This often results in the use of feed ingredients and feed additives that are cheap and of low quality in an effort to improve nutrient exploitation by the bird (Aji et al., 2011; Mammo, 2012; Mulugeta et al., 2019). Adding feed additives to poultry diets maximizes nutrient exploitation by the bird thereby improving growth performance (Frankic et al., 2009) and feed conversion efficiency (Mulugeta et al., 2019).

Onion is most frequently used as powder or extracts (Liguori et al., 2017; Pareek et al., 2017). Onion waste comprising of skin/peel, two external fleshy leaves, top and bottom part, is generated in considerable amounts during industrial processing, and these wastes are rich in bioactive compounds/phytochemicals (Benítez et al., 2011). Keeping in view of the significant importance of OPP and quail meat gaining importance, the current study was proposed to evaluate the effect of supplementation of onion peel powder at varying levels on the carcass traits, meat quality and cost economics of production of Japanese quail.

2. MATERIALS AND METHODS

2.1. Experimental site

The present experiment was planned during November to December, 2023 to study the effect of dietary supplementation of Onion peel powder on the performance of Japanese quail. The biological trial was carried out at the Poultry unit, Livestock Farm Complex, N.T.R. College of Veterinary Science, Gannavaram (A.P). Laboratory analysis was carried out at the Department of Animal Nutrition, N.T.R. College of Veterinary Science, Gannavaram (A.P).

2.2. Procurement of feed ingredients

Onion peels procured from the local market were dried and powdered in Willey's grinder for incorporation into quail diets. Maize, Soybean meal, trace minerals, stone grit, methionine, vitamins, salt, liver tonic, toxin binder, coccidiostat, DCP, and palm oil were procured from the local market and were ground, mixed in the feed mixing plant attached to Department of Animal Nutrition.

2.3. Proximate analysis

The chemical composition of feed ingredients utilized in this experiment and the experimental diets were determined as per Anonymous (2007), while the calcium and phosphorus contents were estimated. The gross energy of Onion Peel powder was estimated using a Bomb Calorimeter and the Metabolizable energy value of Onion Peel powder was derived by using formula. (ME (kcal kg^{-1})=Gross energy (cal g^{-1})×0.82.)

2.4. Preparation of basal diets

Experimental diets were prepared as T_1 (Basal diet), T_2 (Basal diet+10 g kg^{-1} Onion peel powder), T_3 (Basal diet+20 g kg^{-1} Onion peel powder), T_4 (Basal diet+30 g kg^{-1} Onion peel powder) and T_5 (Basal diet+40 g kg^{-1} Onion peel powder). The basal diets were prepared as per the nutrient requirements of poultry (Anonymous, 1994) for Japanese quail.

2.5. Experimental birds and their management

Two hundred-and twenty-five-day-old Japanese quail chicks were weighed individually and randomly divided into five equal groups of three replicates each with 15 chicks per replicate. Each group was allotted to one of the dietary treatments at random. The experiment was conducted from 0–5 weeks of age. All the quail chicks were housed in 5-tier battery cages throughout the experiment. Feed and water were provided *adlibitum*. Feed was offered regularly and the feed left was weighed once a week to quantify the feed intake. B-complex vitamins were added to the water for three days during the first week. The experiment was carried out under uniform management practices for a period of five weeks.

2.6. Data collection

2.6.1. Carcass characteristics

At the end of the trial period (5th week), two birds per replicate and thus a total of six birds per treatment were randomly selected, weighed, and slaughtered. The data on carcass yield, dressing percentage, ready-to-cook yield, and weight of heart, liver, and gizzard were collected, weighed, and recorded. Thus, relative weights (% of live body weight at slaughter) of carcass yield plus total edible organs were calculated.

2.7. Estimation of meat quality parameter

2.7.1. pH

The pH of the meat sample was determined by following the method of Trout et al. (1992) using a deluxe digital pH meter (model 101E). A representative sample of 5 g was homogenized with 45 ml of distilled water in a laboratory blender for about one minute. The pH was recorded by immersing the combination glass electrode of a digital pH meter in the homogenate. Before the measurement of pH, the pH meter was calibrated with buffer solutions of pH 4 and pH 7 as per user manual instructions to avoid errors.

2.8. Extract release volume (ERV)

Homogenize 20 g of meat with 100 ml of distilled water for 2 minutes. Poured the homogenate directly into the funnel lined with Whatman filter paper No.1, folded thrice to make eight sections. Allowed the homogenate to seep between the folds and then collected the extract in a 100 ml graduated cylinder for 15 minutes.

2.9. Water holding capacity (WHC)

The water-holding capacity of the meat samples was measured according to the method as described by Wardlaw et al. (1973). A 20 g finely chopped meat sample was placed in a centrifuge tube containing 30 ml NaCl (0.6 M) and was stirred with a glass rod for 1 minute. The tube was then kept at refrigeration temperature (4±1°C) for 15 minutes, stirred again, and centrifuged at 3000 rpm using a refrigerated centrifuge for 15 min. The supernatant was measured and the amount of water retained by samples was expressed as WHC in percentage.

Water holding capacity (%)=(Area of expressed water/Area of pressed meat sample)×100

2.10. Sensory evaluation of meat

The meat samples were cooked and subjected to a nine-member taste panel for sensory evaluation of color, appearance, flavor, juiciness, tenderness, and overall acceptability on a nine-point Hedonic scale according to Cross et al. (1978).

2.11. Cost economics

The relative economics of rearing quails up to 5 weeks of age by supplementing Onion peel powder as growth promoter varying levels in the diets was calculated based on the actual ingredient cost at the prevailing market.

2.12. Statistical analysis

Statistical analysis of the data was carried out according to the procedures suggested by Snedecor et al. (1994). The data obtained were subjected to one-way ANOVA. Differences between means were tested at the 5% probability level using Duncans (1955) LSD test.

3. RESULTS AND DISCUSSION

3.1. Pre-slaughter live weight (g)

The mean results of (±S.E) pre-slaughter live weights of Japanese quail reared from day-old to five weeks of age by feeding OPP is significantly higher in the T_5 group compared to all other treatments are presented in table 1.

3.2. *Liver weight (%)*

The present study revealed that supplementation of OPP at 0, 10, 20, 30, and 40 g kg^{-1} diet from day old to five weeks had no significant effect (p>0.05) in liver weights presented in Table 1. In line with the present findings, Goodarzi and Nanekarani (2014), An et al. (2015), Keohavong and Bounyavong (2017), Olusola et al. (2018), Farahani et al. (2015), Aditya et al. (2017) and Omar et al. (2020) reported that Onion extract supplementation had no significant effect (p>0.05) on liver weight.

Table 1: Mean (±S.E) carcass traits of J. quail fed with varying levels of OPP from day old to five weeks

Treatment (OPP g kg^{-1})	Carcass traits						
	Pre slaughter live weight(g)	Liver weight (%)	Heart weight (%)	Gizzard weight (%)	Giblet weight (%)	Carcass weight (g)	Dressing percentage
T_1 (0)	195.33^{b}±1.73	1.14^{b}±0.05	2.46±0.09	2.57±0.27	6.43±0.22	126.53^{b}±1.94	64.77±1.13
T_2 (10)	197.50^{b}±2.99	1.22^{b}±0.07	2.68±0.23	2.70±0.15	6.61±0.32	129.28^{b}±1.31	65.46±0.29
T_3 (20)	198.00^{b}±1.76	1.21^{b}±0.05	2.86±0.14	2.76±0.12	6.95±0.29	130.57^{b}±0.77	65.95±0.30
T_4 (30)	205.50^{a}±1.23	1.30^{ab}±0.06	2.86±0.35	2.70±0.20	7.00±0.47	137.28^{a}±1.75	66.80±0.99
T_5 (40)	205.83^{a}±2.58	1.45^{a}±0.06	3.13±0.24	2.94±0.08	7.02±0.19	138.96^{a}±2.62	67.51±0.73
SEm±	1.402	0.032	0.104	0.078	0.219	0.858	0.507
N	6	6	6	6	6	6	6
P	0.001	0.020	0.363	0.708	0.607	0.001	0.249
SS	**	*	NS	NS	NS	**	NS

Values in column bearing different super scripts differ significantly ** (p<0.01), *(p<0.05), NS (p>0.05)

Contrary to present findings Goliomytis et al. (2014) reported that 1 g kg^{-1} Quercetin supplementation resulted in significantly (p<0.05) improved liver weights. Al-Ramamneh et al. (2018) reported that the addition of 2.5% onion to the diet resulted in a substantial (p<0.05) increase in liver weight.

3.3. Heart weight (%)

The present study revealed that supplementation of OPP at (0, 10, 20, 30, and 40) g kg^{-1} diet from day old to five weeks presented in Table 1, there was no significant difference (p>0.05) in heart weights. Farahani et al. (2015), Aditya et al. (2017), Tella et al. (2023) and Omar et al. (2020) reported that supplementation of Onion extract had no significant (p>0.05) change in heart weight. Contrary to the present findings, Olusola et al. (2018) reported that the Onion skin meal (100 g kg^{-1}) fed group had substantially (p<0.05) increased heart weight than the other treatments. Keohavong and Bounyavong (2017) reported that the supplemented Onion extract group had significantly (p<0.05) lowered heart weight.

3.4. Gizzard weight (%)

The present study revealed that supplementation of OPP at 0, 10, 20, 30, and 40 g kg^{-1} from day old to five weeks had no significant effect (p>0.05) in gizzard weights though numerically higher gizzard weights with an increase in levels of onion peel powder were observed are presented in table 1.

Contrary to the present findings, Keohavong and Bounyavong (2017) and Omar et al. (2020) reported that supplementation of 2.5%, 1%, and 1 g kg^{-1} Onion extract significantly (p≤0.001) increased gizzard weight.

3.5. Giblet weight (%)

The giblet weight ranged from 6.43 to 7.02 among different treatments on supplementation of OPP at 0, 10, 20, 30, and 40 g kg^{-1} from day old to five weeks presented in table 1.

3.6. *Carcass weight (g)*

The carcass weight ranged from 126.53 to 138.96 g among different treatments on supplementation of OPP at 0, 10, 20, 30, and 40 g kg^{-1} from day old to five weeks are presented in table 1.

3.7. *Dressing percentage (%)*

The present study revealed that supplementation of varying levels of OPP at 0, 10, 20, 30, and 40 g kg^{-1} from day old to five weeks presented in table 1, had no significant effect (p>0.05) on dressing percentage. In accordance with the present findings, Farahani et al. (2015) and Omar et al. (2020) reported that there was no significant (p>0.05) difference in dressing percentage by supplementing onion extract. Kazeem et al. (2021) opined that Onion leaf powder supplementation had no significant (p>0.05) difference in dressing percentage. Contrary to the present findings, Keohavong and Bounyavong (2017) reported that supplementing with 1% onion extract was significantly (p<0.05) higher dressing percentage.

There are theories that say essential oils can help with digestion. The fact that herbs and spices (Onion) help in the digestion of feed which increases nutrient absorption and in turn increases body weight and the size of organs can be increased is well established according to previous studies. These might be the reasons for improved carcass traits (Goodarzi and Nanekarani, 2014) on supplementation of OPP.

3.8. pH

The present study revealed that supplementation of OPP in the diet had no effect on the pH value of meat in quail.

Table 2: Mean (±S.E) meat pH, ERV, and WHC of Japanese quail fed with varying levels of OPP from day old to five weeks

Treatment (OPP g kg^{-1})	pH	ERV	WHC
T_1 (0)	5.30±0.38	19±0.40	23.3±0.34
T_2 (10)	5.42±0.53	21±0.40	24.3±0.14
T_3 (20)	5.30±0.30	20±0.30	25.0±0.11
T_4 (30)	5.62±0.31	23±0.30	22.4±0.21
T_5 (40)	5.97±0.29	25±0.20	21.4±0.14
SEm±	0.330	0.316	0.272
N	6	6	6
P	0.192	0.116	0.325
SS	NS	NS	NS

The pH ranged from 5.30 to 5.97 which is within the normal range for quail meat are presented in table 2. The results were like the findings of Goliomytis et al. (2014) who reported that supplementation of quercetin had no significant effect (p>0.05) on pH. An et al. (2015) indicated that there was no significant difference (p>0.05) in pH on supplementation of Onion extract, Olusola et al. (2018) reported that supplementation of Onion skin extract and Onion skin meal had no significant (p>0.05) difference in pH. Kazeem et al. (2021) reported that supplemented onion leaf powder did not have a significant (p>0.05) difference in pH.

The addition of antioxidant supplements has no impact on the pH of broiler meat. This may be because pre-slaughter stress on the animal and post-slaughter handling of the meat affects the pH of the meat, and the pH of the meat may have indicated varied glycogen reserves before slaughter, according to Simitzis et al. (2008).

3.9. *Extract release volume (erv)*

ERV ranged from 19 to 25 ml among different treatments on supplementation of OPP at 0, 10, 20, 30, and 40 g kg^{-1} diet from day old to five weeks are presented in table 2.

3.10. Water holding capacity (whc)

WHC content ranged from 21.4 to 25.0% among different treatments on supplementation of OPP at 0, 10, 20, 30, and 40 g kg^{-1} diet from day old to five weeks are presented in table 2.

3.11. Effect of dietary supplementation of onion peel powder on sensory evaluation of meat

The present study revealed that supplementation of OPP in the diet had no effect (p>0.05) on sensory parameters of quail meat but resulted in better color, tenderness, juiciness, and flavor values compared to the control which used to overall acceptability of the quail meat are presented in table 3. According to (br Nainggolan et al., 2024) does not affect the color.

3.12. Cost economics

The feed cost kg^{-1} gain in quail decreased in all treatment groups as compared to the control. The lowest feed cost kg^{-1} gain was recorded at 40 g kg^{-1} OPP are presented in table 4.

The decreased feed cost kg^{-1} gain in the 40 g kg^{-1} OPP group of quail observed in the present study might be attributed to better feed efficiency and increased weight gains as compared to the other groups. Due to the presence of sulfur compounds and high palatability, increased weight gains on supplementation which in turn leads to high profits.

Similarly, Aji et al. (2011) reported that supplementing 25

Table 3: Mean (±S.E) scores for sensory evaluation of meat of Japanese quail fed with varying levels of OPP from day old to five weeks

Treatment (OPP g kg^{-1})	Color	Flavor	Juiciness	Tenderness	Overall acceptability
T_1 (0)	7.33±0.33	7.17±0.54	7.33±0.42	7.67±0.55	7.17±0.30
T_2 (10)	8.00±0.36	7.50±0.50	7.50±0.67	7.33±0.55	7.50±0.50
T_3 (20)	8.17±0.30	7.83±0.74	7.67±0.76	8.00±0.68	7.83±0.30
T_4 (30)	7.83±0.30	7.67±0.55	7.87±0.55	7.50±0.34	8.00±0.36
T_5 (40)	8.33±0.21	8.17±0.47	7.83±0.30	8.83±0.40	8.33±0.33
SEm±	0.143	0.246	0.238	0.238	0.171
N	6	6	6	6	6
P	0.221	0.791	0.977	0.300	0.237
SS	NS	NS	NS	NS	NS

NS-non significant (p>0.05)

Table 4: Mean (±S.E) cost economics of Japanese quail fed with OPP from day old to five weeks

Treatment (OPPg kg^{-1})	Cost economics				
	Cost of feed 100 kg^{-1} (₹)	Cumulative feed intake (g)	Cost of feed $bird^{-1}$ (₹)	Body weight gain (g)	Feed cost kg^{-1} live weight gain (₹)
T_1 (0)	47.70	630.74	30.08	182.67	164.04
T_2 (10)	47.80	628.36	30.03	189.62	158.02
T_3 (20)	47.90	625.35	29.95	189.07	158.10
T_4 (30)	48.00	624.40	29.97	195.53	153.33
T_5 (40)	48.10	623.72	30.00	198.00	151.26

1US$=INR 83.24 (average value of December, 2023)

and 50 mg of onion considerably (p<0.05) reduced feed cost compared to control.

4. CONCLUSION

Increasing OPP levels in Japanese quails significantly increased carcass traits like live weight, heart weight, and carcass weight. However, supplementation of OPP from 0 to 40 g kg^{-1} in diet did not affect dressing percentage, liver, gizzard, and giblet weights. Meat quality parameters like pH, ERV, and WHC remained unaffected. Sensory evaluations showed no significant differences in color, flavor, juiciness, tenderness, or overall acceptability. Feed cost kg^{-1} gain was significantly lower in quails fed with 40 g kg^{-1} OPP.

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