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Effect of Onion Powder in Diets of Japanese Quail on Serum Antioxidant Properties and Carcass Traits

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ABSTRACT

An experiment was carried out to assess the incorporation of onion powder (OP) in diets of Japanese quail on serum biochemical parameters, liver function antioxidant properties and meat quality. Day old quail chicks (N=150) were randomly allotted into five treatment groups each with four replicates of ten birds. Experimental diet was prepared by incorporation of OP at 0, 0.5, 1.5 and 2 percent levels, and made isocaloric and iso nitrogenous rations and fed for a period of 5weeks. At the end of 5th week blood was collected from two birds per replicate and serum was analysed. At the end of the trial two birds per replicate a total of 30 birds were slaughtered to assess the carcass traits. Results of this study indicated that significant decrease in serum cholesterol, triglycerides, LDL-C, VLDL-C and significant increase in HDL-C with increase in OP in diet from 0.5 to 2%. A significant increase in superoxide dismutase activity and decrease ($P<0.01$) in malondialdehyde activity was noticed with increase in OP in diet. Whereas carcass traits were not influenced by incorporation of OP in diets. Basing on the results it can be concluded that OP can be incorporated safely up to 2% level without any adverse effects on liver, oxidative damage of meat as well as carcass traits.

KEY WORDS: Antioxidant properties, Carcass traits, Lipid profile, Onion Powder, Quail.

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INTRODUCTION

Japanese quail (*Coturnix coturnix japonica*) farming is gaining importance because quail show early sexual maturity and have small body size, which results in their needing less housing space, food and their easy adaptation to various rearing conditions (Randall and Bolla, 2008). Quails are popular for their high protein (26%) and less fatty (3%) meat (Shinde et al.,2014). Chemical spoilage of meat is mainly due to oxidation, resulting in rancidity and/or deterioration of the nutritional quality, colour, flavour, texture and safety of foods/meat (Antolovich et al.,2002).Several researchers reported phytobiotic effects of different herbs (Dhama et al.,2015) on growth performance, gut physiology and immune response in birds (Chand et al.,2014; Tanweer et al.,2014; Khan et al.,2016; Tehseen et al.,2016). Onion (*Allium cepa*) belongs to family Amaryllidaceae with various biologically active phyto-molecules e.g. phenolic acids, flavonoids, cepaenes, thiosulfinates and anthocyanins (Goldman et al.,1996, Lanzotti, 2006).

The present study was carried out to evaluate the effect of incorporation of onion powder as feed additive in the diet of J. Quail on meat quality and anti oxidant properties.

MATERIALS AND METHODS

One-hundred-and-fifty-day old quail chicks were obtained, weighed individually and wing banded and were divided into five treatment groups. Each treatment contained three replicates with ten birds per replicate were allotted at random and the birds were fed with the experimental diets for a period of five weeks. Experiment was conducted as per Institute animal ethics committee guidelines.

Diets

Diets were prepared with incorporation of onion powder (OP) at 0, 0.5, 1.0, 1.5 and 2.0% levels. All the diets were prepared isocaloric and iso nitrogenous as per NRC (1994). The birds were maintained under uniform management conditions. Ingredient and nutrient composition of onion experiment diets are presented in Table 1.

Table 1. Ingredient and nutrient composition (%) of quail experimental diets

Constituent	T1	T2	T3	T4	T5
Maize	51.70	51.40	51.00	50.70	50.30
DORB	6.50	6.30	6.10	5.80	5.70
Soybean meal	38.70	38.70	38.80	38.90	38.90
Onion powder	0.00	0.50	1.00	1.50	2.00
DCP	0.85	0.85	0.85	0.85	0.85
Shellgrit	1.30	1.30	1.30	1.30	1.30
Salt	0.25	0.25	0.25	0.25	0.25
Trace min mix	0.15	0.15	0.15	0.15	0.15
Feed additives*	0.55	0.55	0.55	0.55	0.55
Total	100	100	100	100	100
Feed cost/kg (₹)	30.22	31.13	32.06	33.00	33.90
	Nutrient composition (analyzed values)				
ME(Kcal/Kg)$	2900	2901	2900	2901	2899.90
CP %	24.0	23.9	24.0	24.0	24.0
Calcium (%)	1.53	1.56	1.57	1.56	1.58
Available Phosphorus (%)	0.49	0.48	0.48	0.51	0.50

DORB: De-oiled Rice bran. DCP: Di Calcium Phosphate, CP: Crude Protein, ME: Metabolizable Energy.
*Feed additives include lysine, DL-Methionine, Vitamin AB_2D_3, Choline Chloride, Coccidiostat, Toxin Binder, Enzyme and Liver Tonic at 0.1, 0.1, 0.1, 0.05, 0.05, 0.05, 0.05 and 0.05 kg per 100 kg diet, respectively. $Calculated value

Parameters

At the end of the experiment two birds per replicate a total of six birds per treatment were selected for collection of blood. Serum was separated and tested for serum profile, and antioxidant profile. At the end of study period (5th week), two birds per replicate and thus a total 6 birds per treatment were randomly selected, weighed and slaughtered. The data on dressing percentage, carcass yield, ready-to-cook yield and percent weights of heart, liver and gizzard were recorded.

Statistical analysis

Statistical analysis of the data was carried out according to the procedures suggested by Snedecor and Cochran (1989) through software (version 23.0; SPSS, 2015) by applying one-way analysis of variance through generalized linear model and the treatment means were ranked using Duncan's multiple range test with a significance at $P<0.05$ (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition of Onion Powder

The percent DM, OM, CP, EE, CF, NFE, TA and AIA of onion powder were 90.3, 96.1, 10.5, 1.60, 5.77, 78.2, 3.82 and 0.18, respectively. The per cent calcium and phosphorous content of onion powder were 0.86 and 0.16, respectively.

Serum biochemical profile

There was no significant variation in serum protein, albumin, globulin and A/G ratio and serum glucose in quails when fed with various levels of OP in diet (Table 2). In agreement with our results Iqbal and Bayram (2021) reported no effect of onion juice up to 1% through drinking water on serum total protein in laying hens.

Table 2. Effect of dietary incorporation of onion powder at different levels on serum total protein, albumin, globulin (g/dl), A/G Ratio and Glucose

Treatment	Total protein (g/dl)	Albumin (g/dl)	Globulin (g/dl)	A/G Ratio	Glucose (mg/dl)
T1	3.93±0.15	1.41±0.05	2.52±0.19	0.58±0.07	121±1.81
T2	4.03±0.2	1.38±0.05	2.64±0.22	0.54±0.05	119±2.44
T3	3.95±0.15	1.32±0.03	2.63±0.17	0.51±0.04	118±3.43
T4	3.86±0.14	1.30±0.03	2.55±0.16	0.52±0.04	119±3.89
T5	4.0±0.14	1.29±0.05	2.70±0.15	0.48±0.03	117±2.26
SEM	0.06	0.21	0.07	0.02	1.21
n	6	6	6	6	6
SS	NS	NS	NS	NS	NS

NS: Non significant

In contrast to the present study, Omer et al. (2019) reported significant (P<0.05) decrease in serum total protein in laying hens supplemented with natural bio active mixture (juices of lemon, onion and garlic (LOG) at portions of 1.00, 1.00 and 0.123/L drinking water) at 2 and 3% level in diet.Similarly, Al-Ramamneh (2018) showed significant (P<0.01) decrease in serum albumin (5.30 to 4.82 mg/dl) when a combination of garlic and onion was added at 2.5 kg/ton each to basal diet of broilers when compared to the control. Whereas, Omer et al. (2019) reported significant(P<0.05) increasein serum albumin at 1% level and decrease in serum globulin at 2 and 3% level of inclusion when diets were supplemented with 0, 1, 2 and 3 % of LOG (juices of lemon, onion and garlic).

In line with the present results no significant difference in serum glucose was observed by Aditya et al.(2017) in broilers and Iqbal and Bayram (2021) in laying henssupplemented with different levels of onion extract (0, 5, 7.5 and 10g/kg) in basal diet and onion juice up to 2 percent in drinking water, respectively. In contrast Goodarzi et al.(2013) and Farahani et al.(2015) observed significant (P <0.05) decrease in serum glucose in broilers supplemented with fresh onion and onion extract, respectively. Likewise, Abduljabbar and Abdoulrahman (2018) reported significantly (P<0.05) reduced blood glucose levels in laying quails supplemented with 2ml of onion oil per kg diet.

Serum lipid profile

The serum total cholesterol content decreased (P<0.05)from T1 to T5 with increased level of incorporation of onion powder from 0 to 2.0 per cent in the diet (Table 3).Similar to the findings of the present study Vidyavati et al.(2010) in rats, Anet al.(2015) and Al-Ramamneh (2018) in broilers, and Omeret al.(2019) and Hidayat et al.(2021) in laying hens reported reduced serum cholesterol by supplementing the diets with onion powder or onion extract or onion peel in phytobiotic mixture. Allicin, an active substance in onion has hypo cholesterolemic property (Corzo-Martinez et al.2007) which inhibit hepatic cholesterol biosynthesis by enhancing cholesterol turnover to bile acids (Srinivasan and Sambaiah, 1991) or inhibiting cholesterol absorption from intestinal lumen (Slowing et al.2001). In contradiction to the present results Iqbal and Bayram (2021) reported significant increase (P<0.05) in serum cholesterol in laying hens provided with onion juice in drinking water at 0.25 to 2 per cent when compared to control.However, Goodarzi et al.(2013), Farahani et al.(2015) and Yuanita et al.(2019) found no significant difference in serum cholesterol in broilers supplemented with fresh onion or onion extract in diet or in drinking water.

The serum triglyceride levels were significantly (P<0.01) decreased from T1 to T5 with increased

level of incorporation of onion powder from 0 to 2.0 percent in the diet (Table 3).In agreement with the present findings several researchers reported decreased serum triglycerides with the inclusion of fresh onion in the diet and onion extract in diet or in drinking water (Goodarzi et al.2013, An et al.,2015, Farahani et al.,2015, and Al-Ramamneh, 2018). The decrease in serum triglycerides could be due to sulphur containing principles of onion which oxidize thiol compounds either present free or combined with a protein and NADPH which are necessary for lipid synthesis (Sebastian et al., 1979).On the other hand, Aditya et al.(2017) and Yuanita et al.(2019) observed no significant variation in serum triglyceride content among different groups supplemented with onion extract to basal diet.

Table 3. Effect of dietary incorporation of onion powder at different levels on serum lipid profile

Treatment	Total Cholesterol(mg/dl)	Triglycerides (mg/dl)	HDL-C(mg/dl)	LDL-C(mg/dl)	VLDL-C(mg/dl)
T1	$189^{a}\pm2.24$	$133^{a}\pm1.25$	$80.8^{c}\pm1.40$	$81.7^{a}\pm3.22$	$26.7^{a}\pm0.25$
T2	$184^{ab}\pm2.66$	$124^{b}\pm1.58$	$80.5^{c}\pm1.48$	$79.4^{ab}\pm2.78$	$24.9^{b}\pm0.31$
T3	$180^{b}\pm1.42$	$115^{c}\pm1.73$	$84.9^{b}\pm1.31$	$72.5^{bc}\pm1.92$	$23.0^{c}\pm0.34$
T4	$177^{b}\pm2.16$	$112^{c}\pm0.90$	$87.6^{ab}\pm1.23$	$67.4^{c}\pm2.15$	$22.5^{c}\pm0.18$
T5	$177^{b}\pm3.69$	$111^{c}\pm1.77$	$89.6^{a}\pm1.22$	$65.5^{c}\pm3.50$	$22.38^{c}\pm0.35$
SEM	1.35	1.67	0.87	1.65	0.33
n	6	6	6	6	6
SS	*	**	**	**	**

^{abc}Values in column bearing different superscripts differ significantly **($p<0.01$), *($p<0.05$) NS: Non significant

The serum HDL cholesterol content was significantly ($P<0.01$) highest in T5 and lowest in T2 when compared to other groups (Table 3).In agreement with the present findings several researchers concluded that supplementation of onion powder or onion extract in diet or in drinking water increased serum HDL-cholesterol (Vidyavati et al.,2010, Goodarzi et al.,2013, Farahani et al.,2015 and Al-Ramamneh, 2018). On the other hand, supplementation of onion extract in basal diet of broilers (Aditya et al.,2017 and Yuanita et al.,2019) and onion juice in drinking water of layer hens (Iqbal and Bayram, 2021) reported that there was no significant difference in serum HDL- cholesterol content.

The LDL cholesterol content in serum decreased ($P<0.01$) from T1 to T5 with increase in the level of incorporation of onion powder from 0 to 2.0 per cent in the diet (Table 3).These observations were correlated with the findings of Vidyavati et al.(2010) and Al-Ramamneh (2018) who reported dietary supplementation of onion, decreased the LDL cholesterol in serum of rats and broilers, respectively.In contrast to the present study Iqbal and Bayram (2021) reported increased ($P<0.05$) serum LDL cholesterol in laying hens provided with onion juice in drinking water at different levels compared to control.Moreover, Goodarzi et al.(2013) and Farahani et al. (2015) inferred no significant difference in serum LDL cholesterol content in broilers supplemented fresh onion in diet or onion extract in drinking water, respectively.

The VLDL cholesterol content in serum decreased significantly ($P<0.01$) from T1 to T5 with increased level of incorporation of onion powder from 0 to 2.0% in the diet (Table 3). In line with the present findings, Bhavani (2018) reported that significantly ($P<0.05$) decreased serum VLDL cholesterol content in Japanese quails, when provided diet with garlic powder.

Liver and kidney function

There was no significant variation in AST, ALT values in serum among different treatment groups

(Table 4). In corroboration with the present findings no significant difference in serum AST were reported by Anet al.(2015) in broilers supplemented with onion extract in diets and Iqbal and Bayram (2021) in laying hens provided with onion juice through drinking water.In contradiction with our study Omer et al. (2019) observed significant decrease (P<0.05) in serum AST, ALT content (U/L) in laying hens supplemented with varying levels of LOG (juices of lemon, onion and garlic) in diet.

Table 4. Effect of dietary incorporation of onion powder at different levels on liver and kidney function

Treatment	AST(IU/L)	ALT(IU/L)	BUN (mg/dl)	Creatinine(mg/dl)
T1	21.9±0.61	23.4±2.08	4.28±0.41	0.41±0.05
T2	21.2±1.70	22.8±1.62	4.58±0.50	0.40±0.51
T3	23.3±0.99	22.5±1.27	4.33±0.41	0.43±0.02
T4	23.7±1.48	20.1±1.58	4.64±0.44	0.41±0.03
T5	23.0±1.28	23.2±2.09	4.55±0.21	0.41±0.04
SEM	0.76	0.55	0.17	0.01
n	6	6	6	6
SS	NS	NS	NS	NS

NS: Non significant

Incorporation of onion powder up to 2.0 per cent in the diet had no effect (P>0.05) on BUN content of quails (Table 4). Similarly, Babu and Srinivasan (1997) reported no significant difference in plasma urea (mg/dl) content of normal albino rats fed diets containing 3% of freeze dried onion compared to control. Further, they observed significantly (P <0.05) reduced plasma urea level in diabetic albino rats fed diets supplemented with 3% freeze dried onion in comparison to diabetic rats fed control diet and ascertained decreased plasma urea content in onion fed diabetic rats was due to reduced protein catabolism.As elevated BUN is associated with tissue protein catabolism, poor quality of dietary protein or excess intake of dietary protein, non-significant differences in BUN levels in the present study indicates incorporation of onion powder up to 2 per cent in quail diets had no effect on protein quality of diet and protein metabolism of the birds.

A non significant effect on serum creatinine level was observed among the treatment groups by incorporation of OP in diet (Table 4). In line with our results Babu and Srinivasan (1997) reported non-significant difference in serum creatinine level of normal albino rats fed diets containing 3% of freeze-dried onion compared to control and further inferred significantly reduced (P<0.05) serum creatinine level in diabetic albino rats fed diets supplemented with 3% freeze dried onion in comparison to diabetic rats fed control diet.However, serum creatinine levels are used as a measure of glomerular filtration rate and as an index of renal function (Perrone et al.,1992), non-significant difference in serum creatinine of the present study indicates no harmful effect of onion on renal health.

Antioxidant properties

Significantly (P<0.01) highest superoxide dismutase activity was observed in T4 and T5 groups when compared to other treatment groups (Table 5). In correlation with the present findings Yuanita et al. (2019) reported increased serum SOD activity (*P*<0.05) in broilers fed diets with Dayak onion extract and probiotic *Lactobacillus acidophilus* (EpLa) mixture at different levels. Likewise, Omar et al.(2020) also reported a significant (P<0.01) increase in the serum superoxide dismutase (U/ml) activity in all the phenolic rich onion extract (PROE) supplemented broilers. Increased SOD activity in the present study can be attributed to phenolic compounds and flavonoids (allicin, quercetin, capherol, caffeic acid, gallic acid, para coumaric acid,

vanillic acid and salicylic acid) of onion which have potent anti-oxidant property (Omar et al.,2020). In contrast to this a non-significant (P>0.05) increase in catalase value was observed from T1 to T5with increased level of incorporation of onion powder from 0 to 2.0 per cent in the diet (Table 5). Likewise, Omar et al.(2020) found a significant (P<0.01) increase in the serum catalase (U/ml) activity in all the phenolic rich onion extract (PROE) supplemented broilers at 1, 2 and 3 g/kg basal diet, compared to control group without supplementation of PROE.

The MDA content was significantly (P<0.01) decreased from T1 to T5 with increased level of incorporation of onion powder from 0 to 2.0 per cent in the diet. However, the differences were not significant (P>0.05) among T2, T3 and T4 treatment groups. Similarly, Olusola et al. (2018) reported decreased (P<0.05) release of TBARS like MDA in chicken meat of broilers fed diets with onion skin extract and onion skin meal, compared to control diet. Yuanita et al. (2019) also reported that dietary inclusion of Dayak onion extract and probiotic *Lactobacillus acidophilus* (EpLa) mixture decreased (*P*<0.05) serum MDA levels in broilers.

Table 5. Effect of dietary incorporation of onion powder in diets of quail at different levels on antioxidant properties (super oxide dismutase, catalyse and malondialdehyde

Treatment	SOD (U/g)	CAT (U/g)	MDA (nmol/ml)
T1	381^{b}±29.41	66.3±9.85	1.32^{a}±0.03
T2	428^{b}±28.64	67.3±8.36	1.16^{b}±0.01
T3	513^{b}±73.46	69.6±8.09	1.17^{b}±0.01
T4	850^{a}±40.14	70.3±5.78	1.17^{b}±0.01
T5	736^{a}±40.92	73.6±9.18	1.07^{c}±0.02
SEM	38.6	3.50	0.01
n	6	6	6
SS	**	NS	**

^{abc}Values in column bearing different superscripts differ significantly ** (P<0.01), NS: Non-significant

Further, Babu and Srinivasan (1997) reported reduced (P<0.05) plasma MDA (nmol/ml) in diabetic albino rats fed diets containing 3% of freeze-dried onion compared to control diet fed to diabetic albino rats whereas non-significant difference in MDA level was reported in normal albino rats fed diets supplemented with 3% freeze dried onion in comparison to rats fed control diet. The reduced MDA level in the present study might be due to phenolic compounds and flavonoids of onion, which acts as natural free radical scavenging compounds that might inhibits the oxidative chain reaction by inactivating free radicals formed during peroxidation of lipids (Schwarz et al.,1996).

Carcass characteristics

There was no significant difference (P>0.05) among different treatments in carcass yield (g), dressing percentage and ready to cook yield (g) (Table 6).Similarly, Aji et al. (2011), Goodarziand Nanekarani (2014), An et al.(2015) and Aditya et al.(2017) reported no significant difference in carcass yield of broilers provided onion powder or onion extract in diet or in drinking water. Omar et al.(2020) also found non-significant difference in dressing percentage of broilers fed diets with different levels of PROE. In contrast Ramamneh (2017) and Al-Ramamneh (2018) reported significantly increased carcass yield of broilers provided onion extract up to 7.5% in drinking water (P<0.001) and onion powder and garlic powder at 2.5 kg/ton each in basal diet (P<0.05), respectively.

The weight of heart was significantly (P<0.05) differed between treatment groups with higher value in T5 and lower value in T3.Significantly (P<0.05) higher heart weight (g) was observed in quails fed diets with 2% onion powder incorporation. In support

to the present observation Olusola et al.(2018) reported significantly (P<0.05) higher heart weight (g) in broilers fed onion skin meal supplemented at 100g/kg basal diet compared to control. In contrary Farahani et al. (2015), Aditya et al.(2017), Adam (2019) and Omar et al.(2020)reported no significant difference in heart weight (%) with supplementation of onion extract or dry onion in drinking water or feed.

Present study reported no significant (P>0.05) difference in weights of liver, gizzard and giblet among different treatments. In agreement with the present study no significant difference was reported by Goodarziand Nanekarani (2014), An et al.(2015), Farahani et al. (2015), Aditya et al.(2017), Olusola et al. (2018) in liver weight (g) and Omar et al.(2020) in gizzard and liver weight of broilers supplemented with onion extract or onion skin meal in drinking water or in basal diet. In contrast, Al-Ramamneh (2018) reported significantly higher (P<0.05) liver weight and of broilers fed basal diet plus 2.5 kg/ton each garlic and onion powder in comparison with control group.

Table 7. Effect of incorporation of onion powder on quail diets on carcass parameters

Treatment	Carcass yield(g)	Dressing (%)	Ready to cook yield (g)	Heart (g)	Liver (g)	Gizzard (g)	Giblet (g)
T1	113±4.02	63.6±0.95	121±4.36	1.46^{bc}±0.13	2.57±0.31	3.47±0.17	7.51±0.50
T2	111±4.72	62.2±1.26	119±5.18	1.60^{abc}±0.15	2.78±0.38	3.54±0.18	7.93±0.53
T3	113±2.34	64.6±0.85	120±2.56	1.42^{c}±0.07	2.25±0.20	3.28±0.24	6.96±0.40
T4	128±6.73	65.7±2.43	137±7.10	1.85^{ab}±0.15	3.08±0.31	3.90±0.24	8.84±0.54
T5	122±2.98	64.7±0.71	130±3.03	1.93^{a}±0.11	2.43±0.22	3.90±0.26	8.30±0.30
SEM	2.18	0.61	2.34	0.65	0.13	0.10	0.22
n	6	6	6	6	6	6	6
SS	NS	NS	NS	*	NS	NS	NS

^{abc}Values in column bearing different superscripts differ significantly ** (p<0.01), NS: Non-significant

CONCLUSION

The present study indicated that onion powder can be included up to 2.0 per cent level in the diet without any adverse effect on performance of quails.

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