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Research paper

Effect of Ginger and Garlic Supplement on Biochemical Profile and Sensory Meat Quality of Japanese Quail

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ABSTRACT

A trial was conducted to study the effect of supplementation of ginger, garlic, and their combinations in J. quail diets on biochemical profile and meat sensory quality. Day-old quail chicks (n=150) were distributed randomly into five treatments with three replicates containing ten birds each and fed with five experimental diets T_1 (Basal diet/BD), T_2 (BD+ 1% ginger), T_3 (BD+ 2% garlic), T_4 (BD+ 0.25% ginger and 0.5% garlic) and T_5 (BD+ 0.5% ginger and 1% garlic) from day one to five weeks of age. Two birds per replicate were slaughtered on day 35th, and meat and blood samples were collected accordingly. The results revealed that serum total cholesterol and triglyceride values were significantly decreased in T_3 and T_5 groups. Serum HDL cholesterol values were significantly ($p<0.05$) increased in the T_5 group. Serum LDL cholesterol values were significantly ($p<0.05$) decreased in all the treatment groups. The sensory evaluation scores were improved significantly ($p<0.05$) in treatment groups and the highest score for overall acceptability was observed in T_5. It can be concluded that for production of meat with low lipid profile and more consumer acceptance can be possible by the incorporation of ginger and garlic combination (0.5%+ 1.0% respectively) in the diets of Japanese quail.

Keywords: *Ginger, Garlic, Meat quality, Cholesterol, J. Quails.*

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INTRODUCTION

Japanese quail (*Coturnix coturnix Japonica*) farming is now gaining wide popularity in poultry industry because of less space requirement, fast growth rate and harshly nature of the birds (Nagarajan et al., 1991). The quail meat and egg are preferred over other those of species due to its better nutritional and medicinal value. Phytogenics are a group of natural growth promoters (NGP) or phytobiotic growth promoters used as feed additives, derived from herbs, spices or other plants. Ginger (*Zingiber officinale*) is a perennial plant which belongs to family Zingiberaceae. It is widely used in many countries as a food spice and as herbal remedy (Chrubasik et al., 2005). The important compounds in ginger are gingerol, gingerdiol and gingerdione which have the ability to stimulate digestive enzymes, affect the microbial activity and having anti oxidative activity (Dieumou et al., 2009). It has been reported to possess useful pharmacological potent chemical substances for use in poultry (Akhtar et al., 1984). Positive effects of ginger on blood circulation, gastric secretion, and enterokinesia were reported by Ali et al. (2008) and Incharoen and Yamauchi (2009). Garlic *(Allium sativum*), the wonder drug of herbal world, is widely used as a spice and herbal medicine for the prevention and treatment of a variety of diseases ranging from infections to heart diseases (Javandel et al., 2008). Garlic contains 33 sulfur compounds (Alliin, Diallyl sulphides and Allicin), several enzymes, 17 amino acids and minerals such as selenium (Newall et al., 1996) which are responsible for antibacterial, antifungal, antiviral, antioxidant, anti-parasitic, anti-thrombotic, anti-cancer, immuno-modulator, anti-inflammatory, hypoglycemic and vasodilator characteristics (Canogullari et al., 2010). Garlic has been approved scientifically as anti-atherosclerotic, antithrombosis, hypolipidemic, anti-diabetes, antimicrobial, anti-hypertension, etc. (Mansoub and Nezhady, 2001). It has been reported that the combined supplementation of ginger and garlic enhances the body weight gain and feed conversion ratio in broiler birds (Oleforuh-Okoleh et al., 2014). Although a lot of work has been done to know the efficiency of ginger and garlic supplement in broilers, the reports available pertaining to works on Japanese quails are very less. Keeping in view the significant importance of ginger and garlic, the present study was proposed to investigate the effect of supplementation of ginger, garlic, and their combination on serum biochemical profile and meat quality of J. quail.

MATERIALS AND METHODS

One hundred and fifty day-old Japanese quail chicks were weighed individually, wing banded, and randomly divided into five equal groups of three replicates each with 10 chicks. 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* up to five weeks of age. Basal diets were prepared to meet the nutrient requirements of quail birds as per NRC, 1994. Ginger and garlic used in this experiment were purchased from a local market [1]and were supplemented along with the basal diet from 0 to 5 weeks of age (Table.1). The combinations were basal diet (T1), basal diet +1% ginger (T2), birds with basal diet +2% garlic (T3), basal diet + 0.25% ginger & 0.5% garlic (T4) and basal diet + 0.5% ginger & 1% garlic (T5).

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The basal diets were analyzed for proximate composition as per AOAC (2005).

***Parameters*:** Blood samples were collected from two birds per replicate at the end of the experiment into anticoagulant-free vacationers and allowed to clot so that the serum got separated. The separated serum was then made clear by centrifuging at 3000 rpm for 10 minutes and stored in a refrigerator for estimation of serum parameters. At the end of the experiment i.e. 35th day, two birds per replicate a total of 30 birds were slaughtered and weights were taken. Meat samples were collected for further processing according to treatment. The meat samples were cooked and subjected to a nine-member taste panel for sensory evaluation of appearance, colour, flavour, juiciness, tenderness, and overall acceptability on a nine-point hedonic scale.

Table: 1. Composition of experimental diet fed to Japanese quail from day one to 5 weeks

Ingredients (kg)	Basal diet
Maize	49.8
Soybean meal	34
De-oiled rice bran	8.9
Fish meal	5
Di Calcium Phosphate	0.2
Shell grit	1.2
Salt	0.25
Trace minerals*	0.15
L Lysine	0.06
DL methionine	0.1
Vit A B2 D3	0.1
Choline chloride	0.1
Coccidiostat	0.05
Vit E	0.05
Liver tonic	0.04
Total	100
Crude Protein (%)(analysed)	27.51
ME (Kcal/kg) calculated	2999.98

* 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.

Statistical analysis of the data was carried out according to the procedures suggested by Snedecor and Cochran (1989). The data obtained were subjected to one-way ANOVA. Differences between means were tested at the 5% probability level using Duncan's LSD test. (Duncan 1955).

RESULTS AND DISCUSSION

Serum total protein: The mean serum total protein did not show any significant difference among the treatment groups in this study (Table.2). Similarly**,** Salmanzadeh (2015) in quails, and Hassan et al. (2019) in broilers, reported that ginger had no significant effect on serum total protein. Fadlalla et al. (2010) reported that garlic had no significant effect on serum total protein in broilers. Swain et al. (2017) in quails, and Olagoke et al. (2019) in broilers, reported that the ginger and garlic combination had no significant effect on serum total protein.

On contrary**,** Shewita and Taha (2018) reported that serum total protein was significantly ($p<0.05$) increased at 6 g/kg of ginger powder in broilers. Brzoska et al. (2015) reported that serum total protein was significantly ($p<0.05$) increased at 2.25 ml/kg liquid garlic extract in broilers.

Serum albumin and globulin: The mean serum albumin and globulin were not showed any significant difference among the treatment groups in this study (Table.2). Similarly**,** Shewita and Taha (2018) and Hassan et al. (2019) reported that ginger had no significant effect on serum albumin or globulin in broilers. Fadlalla et al. (2010) reported that garlic had no significant effect on serum albumin or globulin in broilers. Swain et al. (2017) in quails and Olagoke et al. (2019) reported that the ginger and garlic combination had no significant effect either on serum albumin or globulin in broilers.

Table 2: Serum total protein, albumin, and globulin of Japanese quail fed with ginger, garlic, and their combination at different levels from 0-5 weeks of age

Treatment	Serum Biochemical Profile		
	Total Protein (g/dl)	Serum Albumin (g/dl)	Serum Globulin (g/dl)
T1	3.87±0.16	1.81±0.14	2.00±0.28
T2	3.93±0.20	1.93±0.11	2.05±0.26
T3	3.89±0.18	1.90±0.12	2.08±0.21
T4	4.05±0.22	2.04±0.20	2.13±0.19
T5	4.17±0.23	2.12±0.10	2.18±0.10
SEM	0.08	0.06	0.09
n	6	6	6
p value	0.789	0.570	0.979

Serum Total Cholesterol: The mean serum total cholesterol values were significantly ($p<0.05$) decreased in T_3 and T_5 groups

Similarly, Salmanzadeh (2015) in quails, and Shewita and Taha (2018) in broilers, reported that serum total cholesterol was significantly ($p<0.05$) decreased at 700 mg and 6 g/kg of ginger powder, respectively. Puvaca et al. (2014) reported that serum total cholesterol was significantly ($p<0.05$) decreased at 0.5% and 1% garlic in broilers. Swain et al. (2017) in quails, and Olagoke (2019) in broilers, reported that serum total cholesterol was significantly ($p<0.05$) decreased at 0.5% of each ginger and garlic, 1.5% each of ginger + garlic in broilers, respectively when supplemented with ginger and garlic combination. On the contrary**,** Brzoska et al. (2015) in broilers reported that garlic had no significant effect on serum total cholesterol.

Serum HDL cholesterol: The mean serum HDL cholesterol values were significantly ($p<0.05$) increased in the T_5 group (Table.3). Similarly, Shewita and Taha (2018) in broilers reported that serum HDL cholesterol was significantly ($p<0.05$) increased at 2 g/kg and 4 g/kg of ginger powder. Puvaca et al. (2014) in broilers reported that serum HDL cholesterol was significantly ($p<0.05$) increased at 1% garlic supplements.

Serum LDL cholesterol: The mean serum LDL cholesterol values were significantly ($p<0.05$) decreased in all the treatment groups when compared with the control in this study (Table.3). Similarly, Salmanzadeh (2015) reported that serum LDL cholesterol was significantly ($p<0.05$) decreased at 800 mg ginger powder in quails. Puvaca et al. (2014) reported that serum LDL cholesterol was significantly ($p<0.05$) decreased at 1% garlic in broilers.

Serum triglycerides: The mean serum triglyceride values were significantly ($p<0.05$) decreased from T_3 to T_5 groups when compared with control in this study (Table.3). Similarly, Salmanzadeh (2015) in quails, and Shewita and Taha (2018) in broilers, reported that serum triglycerides were significantly ($p<0.05$) decreased at 800 mg and 2 g/kg ginger powder, respectively. Puvaca et al. (2014) reported that serum triglycerides were significantly ($p<0.05$) decreased at 0.5% garlic in broilers. Swain et al. (2017) reported that serum triglycerides were significantly ($p<0.05$) decreased at 0.5% of each ginger and garlic in quails.

Table: 3. Serum lipid profile of Japanese quail fed with ginger, garlic, and their combination at different levels from 0-5 weeks of age

Treatment	Serum Lipid Profile			
	Serum Total Cholesterol (mg/dl)	Serum HDL Cholesterol (mg/dl)	Serum LDL Cholesterol (Mg/Dl)	Serum Triglycerides (mg/dl)
T_1	207.94^{a}±9.81	89.66^{b}±4.85	52.01^{a}±3.38	153.33^{a}±6.93
T_2	179.45^{ab}±14.66	92.45^{b}±5.70	42.70^{b}±1.99	129.93^{ab}±12.86
T_3	164.90^{b}±11.40	97.90^{ab}±5.01	41.85^{b}±3.77	115.21^{b}±8.92
T_4	175.81^{ab}±10.02	99.73^{ab}±7.33	38.98^{b}±2.58	122.54^{b}±11.39

T_5	159.32^b±9.70	113.97^a±4.91	39.82^b±2.87	111.49^b±7.91
SEM	5.63	2.82	1.51	4.93
n	6	6	6	6
p value	0.048	0.048	0.035	0.046

Values in columns bearing different superscripts differ significantly *(p<0.05)

Dressing percentage: The mean dressing percentage of Japanese quails was not significantly differed among the treatment groups in this study (Table.4). Similarly, Shewita and Taha (2018), Hassan et al. (2019), and Rio et al. (2019) reported that ginger supplementation had no significant effect on dressing percentage in broilers. Fadlalla et al. (2010) and Singh et al. (2015) reported that garlic supplementation had no significant effect on dressing percentage. Umatiya et al. (2018) and Olagoke et al. (2019) observed that there was no significant effect of the ginger and garlic combination on the dressing percentage of broilers.

On contrary, Salmanzadeh (2015) in quails, and Eltazi (2014) in broilers, reported that the dressing percentage was significantly (p<0.05) increased at 900 mg and 1.5% ginger powder, respectively. Brzoska et al. (2015) and Makwana et al. (2019) reported that the dressing percentage was significantly (p<0.05) increased at 2.25 ml/kg and 0.1 % garlic powder respectively, in broilers.

Heart weight: The mean heart weights were not significantly differed among the treatment groups in this study (Table.4). Similarly, Salmanzadeh (2015) and Muhammad et al. (2017) in quails, Eltazi (2014), Shewita and Taha (2018), Hassan et al. (2019), and Rio et al. (2019) reported that ginger supplementation had no significant effect on heart weights in broilers. Majeed and Muhammad (2016) and Makwana et al. (2019) reported that garlic supplementation had no significant effect on the heart weights of broilers. Umatiya et al. (2018) and Olagoke et al. (2019) observed that there was no significant effect of the ginger and garlic combination on the heart weights of broilers. On contrary, Singh et al. (2015) reported that heart weights were significantly (p<0.05) increased at 1 % garlic in broilers.

Table 4: Carcass traits of Japanese quail fed with ginger, garlic, and their combination at different levels from 0-5 weeks of age

Treatment	Carcass Traits			
	Dressing percentage (%)	Heart weight (g)	Liver weight (g)	Gizzard weight (g)
	69.97±0.98	2.28±0.17	5.82±0.60	6.40±0.37
T_2	70.09±0.81	2.36±0.12	5.78±0.49	6.30±0.23
T_3	70.09±0.34	1.86±0.17	6.14±0.32	6.45±0.44
T_4	70.42±0.57	2.28±0.28	5.03±0.49	6.45±0.56
T_5	69.24±0.86	1.87±0.16	6.52±0.46	5.90±0.43
SEM	0.32	0.09	0.22	0.18
n	6	6	6	6
P value	0.065	0.521	0.643	0.254

Liver weight: The mean liver weights were not significantly differed among the treatment groups in this study (Table.4). Similarly, Salmanzadeh (2015) and Muhammad et al. (2017) in quails, Shewita and Taha (2018), Hassan et al. (2019), and Rio et al. (2019) in broilers, reported that ginger supplementation had no significant effect on liver weights. Singh et al. (2015), Majeed and Muhammad (2016), and Makwana et al. (2019) reported that garlic supplementation had no significant effect on the liver weights of broilers. Umatiya et al. (2018) and Olagoke et al. (2019) observed that there was no significant effect of the ginger and garlic combination on liver weights of broilers.

On contrary, Eltazi (2014) reported that liver weights were significantly (p<0.05) decreased in ginger supplemented treatment groups in broilers. Brzoska et al. (2015) reported that liver weights were significantly (p<0.05) increased at 1.5 ml/kg of liquid garlic extract in broilers.

Gizzard weight: The mean gizzard weights were not significantly differed among the treatment groups in this study (Table.4).

Similarly, Salmanzadeh (2015) and Muhammad et al. (2017) in quails, Shewita and Taha (2018), Hassan et al. (2019), and Rio et al. (2019) in broilers reported that ginger supplementation had no significant effect on gizzard weights. Brzoska et al. (2015), Singh et al. (2015), Majeed and Muhammad (2016), and Makwana et al. (2019) reported that garlic supplementation had no significant effect on gizzard weights of broilers. Umatiya et al. (2018) observed that there was no significant effect of ginger and garlic combination on gizzard weights of broilers.

On contrary, Eltazi (2014) reported that gizzard weights were significantly ($p<0.05$) decreased in ginger supplemented treatment groups in broilers.

Sensory evaluation: The mean sensory evaluation scores of Japanese quail meat were significantly ($p<0.05$) increased in treatment groups pertaining to colour, flavour, juiciness, tenderness, and overall acceptability over the control group in this study. The highest score for overall acceptability was recorded in T_5 in this study. Similarly, Singh et al. (2015) reported that sensory evaluation scores of broiler meat were significantly ($p<0.05$) increased at 2% garlic.

On contrary**,** Eltazi (2014) in broilers reported that ginger had no significant effect on sensory evaluation scores. Fadlalla et al. (2010) in broilers reported that garlic had no significant effect on sensory evaluation scores. Whereas, Rovida et al., 2020 inferred that overall sensory parameters and acceptability of spent hen meat were improved with the application of ginger extract.

All this might be due to the active principles present in Ginger that can act as a natural tenderizer and can be added to the diets of animals to improve consumer acceptance.

Table 5: Sensory evaluation score of Japanese quail meat fed with ginger, garlic, and their combination at different levels from 0-5 weeks of age

Treatment	Sensory Evaluation of Meat				
	Colour	Flavour	Juiciness	Tenderness	Overall Acceptability
T_1	$7.44^{c}\pm0.18$	$8.22^{b}\pm0.15$	$7.56^{b}\pm0.18$	$7.89^{c}\pm0.11$	$8.22^{b}\pm0.15$
T_2	$7.78^{abc}\pm0.15$	$8.33^{b}\pm0.17$	$7.67^{b}\pm0.17$	$8.11^{abc}\pm0.11$	$8.56^{ab}\pm0.18$
T_3	$7.67^{bc}\pm0.17$	$8.33^{b}\pm0.17$	$7.89^{ab}\pm0.11$	$8.00^{bc}\pm0.00$	$8.33^{b}\pm0.17$
T_4	$8.00^{ab}\pm0.17$	$8.56^{ab}\pm0.18$	$8.00^{ab}\pm0.17$	$8.33^{ab}\pm0.17$	$8.56^{ab}\pm0.18$
T_5	$8.22^{a}\pm0.15$	$8.89^{a}\pm0.11$	$8.22^{a}\pm0.15$	$8.44^{a}\pm0.18$	$8.89^{a}\pm0.11$
SEM	0.08	0.08	0.09	0.06	0.08
n	9	9	9	9	9
p value	0.016	0.033	0.033	0.023	0.047

Values in columns bearing different superscripts differ significantly *($p<0.05$)

CONCLUSION

Results indicated that Serum cholesterol and triglycerides were reduced with supplementation of a combination of ginger and garlic (0.5% & 1%) and also at 2% Garlic alone. The best sensory evaluation score of Japanese quail meat was observed for a combination of ginger and garlic (0.5% & 1%) supplementation. Thus, the present study indicated that the supplementation of ginger and garlic combinations (0.5% ginger and 1% garlic) in diets can be recommended for the production of designer meat with low cholesterol, low triglycerides, and improved meat quality.

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COMPETING INTERESTS

The authors have no known competing interests either financial or personal between themselves and others that might bias the work.

ETHICS STATEMENT

Not applicable

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