Original Research

Effect of Dietary Incorporation of Acid Treated Fish Silage on the Performance and Carcass Characteristics of Broiler Japanese Quails (*Coturnix coturnix japonica*)

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Abstract

The research work was carried out to evaluate the effect of dietary incorporation of acid treated fish silage on the performance and carcass characteristics of broiler Japanese quails. A total of 192, one-week old broiler Japanese quail chicks of either sex were randomly distributed into four dietary treatment groups with four replicates in each. The dietary treatments were supplied with standard broiler Japanese quail diet containing T1-0% fish silage (Control diet), T2- diet incorporated with 5% fish silage, T3 - diet incorporated with 10% fish silage and T4- diet incorporated with 15% fish silage. The weekly body weight, body weight gain, weekly feed consumption were statistically significant (P<0.05) and higher in control group than that of the birds fed with fish silage. The dietary inclusion of 5% fish silage showed similar feed efficiency, with that of the control and better when compared with other treatments. The carcass characteristics, serum biochemical parameters such as total protein, calcium, phosphorus and cholesterol fractions (HDL, LDL, and VLDL) were not influenced by the dietary incorporation of fish silage except, the decrease marked in breast meat yield with an increase in fish silage incorporation. As the feed cost per kg of diet incorporated with fish silage was comparatively lower than the control diet, it was concluded that incorporation of fish silage @5% in the diet of quail was economic showing better feed efficiency than the other groups.

Key words: Biochemical Parameters, Carcass Characteristics, Fish Silage, Japanese Quail

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Introduction

In this era of diversification and rising competition in the poultry sector of India, quail farming is making an impressive debut. Quails are also hardy and easy to handle and can accommodate to various agro climatic regions which again suits to the requirements of Indian farmers. Being wild in nature the quails are generally resistant to almost all diseases prevailing in Indian climatic condition. The low floor space requirement of quail encourages the small or marginal farmers for quail farming. Further, the health conscious consumers of modern Indian societies also prefer quails as a source of lean meat having relatively low fat and cholesterol than that of other poultry meat. Having a coastline of about 8118 km and vast inland water bodies of about 75.81 lakh hectare (ICAR, 2013), India is one of the most potential country for fish farming. A total of 9.58 million tonnes of fish is produced per year in India including marine and fresh water source (ICAR, 2013). With an annual increase of 5.96% per year in fish production, India is now the second highest fish producing country (FAO, 2013-14) in the world. The processing of fish mainly generates waste products such as scales, fins, viscera and the bones consists of about 60% of total weight of fish (Gildberg,1993). It generates a total of more than two million tonnes of waste per year which is a major cause of environmental pollution (Kjos *et al.*, 2000).

The fish wastes can be converted to fish meal, which can be a solution to the problem but again high cost involved in fish meal preparation and its periodic scarcity has encouraged the people to go for preparation of some alternative protein feed stuffs from fish wastes (Fagbenro and Jauncey, 1998). Fish silage has been recommended as an alternative source for utilization of fish wastes or fish industry by-products providing with a high quality of protein (30-40% CP) source for feeding animals (Zinudheen *et al*., 2009).

Keeping the above facts into consideration, this study was carried out to assess the effect of dietary incorporation of fish silage on production performance and serum biochemical parameters of Japanese quail.

Materials and Methods

Ethical Approval

This study was duly approved by the Institutional Animal Ethics Committee, OUAT, College of Veterinary Science and Animal Husbandry, Bhubaneswar - 751 003, Odisha, India.

Experimental Program

The present biological trial was conducted at the Central Institute for Women in Agriculture (ICAR), Bhubaneswar for 4 weeks from the past week of March 2016 to mid of April 2016 during early to mid-summer. A total of 192, 7-day-old, broiler Japanese quails of either sex were procured from the Central Poultry Development Organization, Bhubaneswar and were randomly distributed in to four dietary

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treatment groups with four replicates in each group with 12 chicks in each replicate. The dietary treatments were standard broiler Japanese quail diet containing T1-0% fish silage (Control diet); T2- diet incorporated with 5% fish silage, T3 - diet incorporated with 10% fish silage and T4- diet incorporated with 15% fish silage. All the diets were isocaloric (2900 kcal of ME/kg) and iso-nitrogenous (24% CP). Each diet was fed *adlibitum* to one of the treatment group during the experimental period of 7-35 days of age.

Preparation of Acid Treated Silage

Dressing waste (intestine and gills) of fresh water fishes were collected from a local fish market of Unit-IV in Bhubaneswar, Odisha. The fish wastes were thoroughly washed in water and were ground to fine paste with the help of meat grinder. Acid silage was prepared by acidifying the paste with 1.5% formic acid and 1.5% hydrochloric acid. 15ml formic acid and 15ml concentrated hydrochloric acid were mixed with 1 kg fish silage. Butylated Hydroxytoluene (BHT) (200 ppm) was added to prevent auto oxidation & 0.1% potassium sorbate was added as mould inhibitor. 0.2 g BHT and 1 g potassium sorbate were mixed with 1 kg fish silage. Ensilation process was aided by incubating the materials in air tight plastic containers at room temperature (28-30^{o} C). The silage was stirred twice daily to ensure the uniform distribution of acid.

Table 1: Formulation of diets with fish silage

Ingredients (Parts/quintal)	Control diet	Diet with 5% fish silage	Diet with 10% fish silage	Diet with 15% fish silage
Maize	58.1	53	51	47.9
Fish silage	-	5	10	15
Deoiled rice bran	-	3.05	3.2	3.9
Deoiled soybean meal	38.5	35.1	32.2	29.5
Choline chloride 50%	0.12	0.12	0.15	0.15
Salt	0.2	0.25	0.25	0.25
Sodium bicarbonate	0.2	0.2	0.2	0.2
Calcite powder (Ca=34%)	1.34	1.4	1.25	1.25
Dicalcium phosphate	1.28	1.6	1.56	1.56
ABDK vitamin	0.025	0.025	0.025	0.025
DL-Methionine	0.12	0.13	0.13	0.14
B-complex	0.03	0.025	0.025	0.025
Mineral mixture	0.12	0.12	0.12	0.12
TOTAL	**100**	**100**	**100**	**100**

*Composition: Each 1 kg Trace min-CB contains Manganese: 90g, Zinc: 80g, Iron: 90g, Copper: 15g, Iodine: 2g, Selenium: 300 mg; *5kg fish silage (20 kg liquid silage), 10kg fish silage (40 kg liquid silage), 15 kg fish silage (60kg fish silage)*

Traits Measured

Group body weight and feed consumption were recorded at weekly intervals. Feed conversion ratio (FCR) was derived by dividing the feed consumed with the weekly body weight gain. At the end of the experiment,

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8 birds from each treatment were selected randomly and sacrificed by cervical dislocation to study the carcass traits and expressed as percentage pre-slaughter live weight.

Collection of Blood and Analysis of Serum Sample

Two birds from each replicate were selected on random basis at the end of experiment (5 weeks of age). About 2 ml of blood was taken from the jugular vein of each selected bird by puncturing it with 24 gauze needle. Blood samples were collected in sterilized dry centrifuge tubes without any anticoagulant and then kept in room temperature for 2 h. After 2 h, the tubes were kept in incubator at 37°C for 30 min and then centrifuged at 3000 rpm for 15 min to separate the serum. The separated serum samples were kept in sterilized tubes marked and then preserved at −10°C for further analysis.

The Serum Biochemical Parameters

The serum biochemical parameters including total protein, albumin/globulin (A/G) ratio, calcium, phosphorous, total cholesterol, high density lipoprotein-cholesterol (HDL-C), very low density lipoprotein-cholesterol (VLDL-C), low density lipoprotein-cholesterol (LDL-C), triglyceride, ALT, and AST were estimated by following the procedures described in the reagent kit supplied by Span diagnostics limited, a product of ARKRAY Health Care Private limited, Surat, India, by using Biochemistry autoanalyzer.

Mortality

Daily mortality of broiler Japanese quails was recorded in case of each treatment group. The mortality percentage of each treatment was calculated. The dead birds were then sent for autopsy to find out the cause of death and were disposed of by maintaining proper hygiene and sanitation.

Statistical Analysis

The data pertaining to various parameters were subjected to statistical analysis by using Statistical Package for Social Science version 17.0 under completely randomized design employing one-way analysis of variance. The means of different treatments were compared with Duncan's multiple range test, and significance was considered at $p<0.05$ level (Duncan, 1955; Snedecor and Cochran, 1989).

Result

The mortality of broiler Japanese quail chicks under different treatments is presented in Table 2. The mortality rate of broiler Japanese quails up to 5 weeks of age varied between 6.25% to 8.33% among the different dietary treatments. However, no effects of diets were noticed on the mortality of the birds. The body weights of the quail-chicks under different groups in 1st week of age were found to be similar showing proper randomization of birds among the dietary treatment groups. In the second week, the mean body weight among the dietary groups varied significantly ($P<0.05$). The body weight of birds of control group

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(diet without acid treated fish silage) was significantly higher (P<0.05) than the treatment groups irrespective of the level of inclusion of acid treated fish silage (5%, 10%, 15%). Among the birds under treatment, the body weight of birds fed with 5% incorporated fish silage weighed significantly higher than that of the birds those were fed with 10% and 15% of fish silage in the diet. However, there was no significant difference observed between the birds fed with 10% and 15% of fish silage in the diets, respectively. Similar trend was observed in the mean body weight of birds of different treatments in third, fourth and fifth week of age, respectively. Dietary inclusion of acid treated fish silage at different levels (5%, 10%, 15%) significantly (P<0.05) and linearly reduced the body weight (5%inclusion>10%inclusion>15%inclusion).

Table 2: Weekly mean body weight (g) of broiler Japanese quails under different treatment

Age in weeks	T_1 (Control diet without fish silage)	T_2 (Diet with 5% fish silage)	T_3 (Diet with 10% fish silage)	T_4 (Diet with 15% fish silage)	SEM	P Value
1	24.48	24.45	21.27	23.32	0.715	0.546
2**	55.03^{c}	47.40^{b}	33.89^{a}	31.17^{a}	1.511	0.001
3**	93.05^{c}	79.40^{b}	56.62^{a}	54.72^{a}	2.587	0.001
4	123.35^{c}	103.29^{b}	74.21^{a}	70.08^{a}	3.441	0.001
5	147.59^{c}	135.45^{b}	101.52^{a}	93.34^{a}	3.662	0.001

$^{a, b, c,d}$ *Means with different superscripts in the same row differ significantly **P<0.01; SEM - Standard error of mean*

The body weight gain during 1-5 weeks of age varied significantly (P<0.05) among the groups. The body weight gain recorded variedfrom 70.1g to 123.1g in different groups with a steady decrease in the body weight gain with the increase in the level of fish silage incorporated (0%inclusion>5%inclusion >10%inclusion >15%inclusion) in diet.

The feed intake of birds from period 1 to 5 week was significantly different (P<0.01) among the treatments in descending order starting from T_1 (control group: 434.19 g) to T_4 (288.66 g). The cumulative consumption of feed linearly decreased with the increase in fish silage level from 0 to 15% in diet of quails. The weekly cumulative FCR from 1-5 weeks period in the birds of T_1 and T_2 was statistically similar (i.e. 3.53).The birds of T_4 have shown significantly poor (P<0.05) FCR than that of T_2. Throughout the period of study, the cumulative FCR of the birds of T_1 was lower (P<0.01) than that of T_3 and was higher (P<0.01) than the other groups.

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Table 3: Mean body weight (g) gain, feed consumption (g) per bird and feed conversion ratio of broiler Japanese quails under different treatment

S. No.	Parameters (1-5 week of age*)	T_1(without fish silage)	Fish Silage			SEM	P Value
			T_2 (5% fish silage)	T_3 (10% fish silage)	T_4 (15% fish silage)		
1	Body weight gain	123.10^{d}	110.98^{c}	80.25^{b}	70.01^{a}	3.539	0.001
2	Feed consumption (g) per bird	434.19^{d}	391.97^{c}	347.35^{b}	288.66^{a}	12.376	0.001
3	Feed conversion ratio	3.53^{a}	3.53^{a}	4.33^{c}	4.12^{b}	0.104	0.001

The mean carcass characteristics of slaughtered Japanese quails from different treatments having varied level of acid treated silage incorporation are given in Table 4. There was no significant change in blood loss in different treatments ($P>0.05$).The feather loss in T_4 was higher ($P<0.05$) than T_2 and similar with T_1 and T_3. Eviscerated yield in T_4 was significantly lower ($P<0.05$) than T_1, T_2 and T_3 which were similar. The weight of liver in T_4 was higher ($P<0.05$) than T_1 and similar with T_2 and T_3. However, the weight of heart in T_4 was lower ($P<0.05$) than T_1 being at par with T_2 and T_3. The weight of giblet in T_4 was higher ($P<0.05$) than T_1 and similar with T_2 and T_3. However, the breast meat yield inT_1 was significantly higher ($P<0.01$) than T_2, T_3 and T_4. The breast yield in T_4 was also lower than T_2 and T_3 which were similar.

Table 4: Carcass characteristics (g) of broiler Japanese quails under different treatments

Particulars	T_1(Control diet without fish silage)	T_2(Diet with 5% fish silage)	T_3 (Diet with 10% fish silage)	T_4 (Diet with 15% fish silage)	SEM	P Value
Blood loss	3.72	3.76	3.89	3.02	0.144	0.132
Feather loss*	13.32^{ab}	12.27^{a}	13.88^{ab}	14.72^{b}	0.307	0.029
Eviscerated yield**	62.01^{b}	62.52^{b}	61.20^{b}	58.19^{a}	0.556	0.019
Liver	2.55^{a}	2.89^{ab}	2.80^{ab}	3.24^{b}	0.112	0.18
Heart	0.78^{b}	0.76^{ab}	0.73^{ab}	0.65^{a}	0.019	0.097
Gizzard	2.19	2.47	2.43	2.42	0.064	0.434
Giblet *	5.52^{a}	6.12^{ab}	5.96^{ab}	6.31^{b}	0.125	0.136
Breast**	23.86^{c}	21.44^{b}	21.40^{b}	19.23^{a}	0.453	0.001

**(Giblet = Heart+ Gizzard +Liver); $^{a, b,c}$ Means with different superscripts in the same row differ significantly **P<0.01;SEM - Standard error of mean*

The serum biochemical parameters of broiler Japanese quails under different dietary treatments are given in Table 5. Serum total protein, globulin level was not altered by supplementation of fish silage with different levels. However, serum albumin level was lower ($P<0.01$) in T_2 and T_3 as compared to T_1. The serum Calcium and Phosphorus level were unaffected by incorporation of fish silage with different rate of supplementation. Serum triglycerides levels were not affected by supplemental fish silage in T_2, T_3 and T_4.

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However, the level were lower (P<0.05) than T_1. The cholesterol level was higher (P<0.01) in T_4 than other groups. The concentration of serum HDL, LDL and VLDL were unaffected by supplementation of fish silage with different level. The activity of serum enzyme in T_3 and T_4 (AST) was higher (P<0.01) than T_1 and T_2 which were at par. However, ALT activity was statistically similar in all the four groups i.e. T_1, T_2, T_3 and T_4, respectively.

Table 5: Serum biochemical profiles of broiler Japanese quails under different treatments at 5th week of age

Particulars	T_1 (Control diet without fish silage)	T_2 (Diet with 5% fish silage)	T_3 (Diet with 10% fish silage)	T_4 (Diet with 15% fish silage)	SEM	P Value
Total protein(g/dl)	5.76	5.09	5.2	5.38	0.169	0.536
Albumin(g/dl)**	2.46^{c}	2.19^{a}	2.32^{b}	2.39^{b}	0.026	0.001
Globulin(g/dl)	3.31	2.9	2.88	2.99	0.16	0.785
A/G Ratio	0.85	0.76	0.83	0.84	0.045	0.922
Calcium(mg/dl)	10.7	8.67	10.01	9.12	0.4	0.29
Phosphorus(mg/dl)	5.35	4.34	5.01	4.74	0.194	0.311
Triglycerides(mg/dl)*	144.22^{b}	112.63^{a}	109.76^{a}	133.80^{a}	7.25	0.038
Cholesterol(mg/dl)**	129.32^{a}	101.73^{a}	151.18^{a}	175.30^{b}	8.833	0.01
HDL(mg/dl)	119.22	112.63	109.76	107.8	5.33	0.741
VLDL(mg/dl)	28.84	22.52	21.95	21.56	1.451	0.248
LDL(mg/dl)	35.24	40.58	39.39	45.94	2.571	0.284
AST(U/L)**	88.50^{a}	101.95^{a}	141.53^{b}	134.72^{b}	5.79	0.001
ALT(IU/L)	33.65	31.29	31.62	30.38	0.708	0.402

*$^{a, b, c}$ Means with different superscripts in a row differ significantly, *P<0.05, **P<0.01;SEM - Standard error of mean, HDL- High density lipoprotein, VLDL- Very low density lipoprotein, LDL- Low density lipoprotein, AST-Aspartate Transaminase, ALT-Alanine Transaminase.*

The chemical composition of meat is given in Table 6. The moisture, protein and fat content of the meat samples varied non-significantly (P>0.05) among the dietary treatments. However, there was a significant difference in the total ash content. The total ash content of the meat sample in the T_4 i.e. birds fed with 15% acid treated silage were significantly higher (P<0.05) compared to all other dietary treatments.

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Table 6: Proximate analysis of Meat (breast) sample of broiler Japanese quails (on as such basis)

Composition (%)	T_1 (Control diet without fish silage)	T_2 (Diet with 5% fish silage)	T_3 (Diet with 10% fish silage)	T_4 (Diet with 15% fish silage)	SEM	P Value
Moisture	71.58	71.64	71.66	71.2	0.18	0.421
Crude Protein	26.41	26.52	26.42	26.8	0.14	0.694
Ether Extract	0.76	0.78	0.7	0.98	0.06	0.708
Total Ash*	1.25^a	1.24^a	1.22^a	1.74^b	0.08	0.048

$^{a, b, c, d}$ *Means with different superscripts in the same row differ significantly; SEM - Standard error of mean*

Discussion

The mortality rate of birds under different treatment was within the normal range, although the minor variation in between the treatments which might be due to summer stress during the period of experiment. Al-Marzooqi *et al.* (2010) found a low mortality for all dietary treatments which supported the present findings. Body weight of all the birds irrespective of treatment groups was similar at the beginning of the experiment, which indicates that increase in body weight might not be because of difference in initial body weight. A significant difference ($P<0.05$) in body weight was observed from second to fifth week of age due to inclusion of fish silage in the diet of broiler Japanese quails. The body weight linearly decreased due to graded level of incorporation of acid treated fish silage (AFS). This finding was in agreement with Ganegoda *et al.* (1982) who observed that there was comparatively low body weight gain in case of broiler chicks fed with fish silage than those fed with fish meal. Avila *et al.* (1973) also reported that replacement of fish silage with that of soybean meal showing a marked depression in growth of broilers. On the other hand, no significant difference in mean body weight gain at fifth week of age of the quail birds was observed by Magana *et al.* (1999) due to dietary incorporation of 15% fish silage in broiler. The cumulative body weight gain was significantly lower in the groups with higher fish silage inclusion which was in agreement with Darsana *et al.* (2009). However, Al-Marzooqui *et al.* (2010) reported significant increase in body weight and body weight gain by feeding fish silage at the rate of 10 and 20%.

The feed consumption was significantly different ($P<0.05$) and was in a linearly decreasing mode with increase in the level of fish silage added to the diet (0% inclusion>5% inclusion>10% inclusion>15% inclusion) in the present study. In contrast to the present findings, Espe *et al.* (1992) and Smitha *et al.* (2005) reported no significant difference in cumulative feed intake among control group to that of the birds fed with fish silage. The cumulative feed conversion ratio (CFCR) between T_1 and T_2 was statistically non-significant which was in agreement with Collazos *et al.* (2007) and Ramirez *et al.* (2013). Thus it is inferred that AFS at 5% level in the diet of broiler chicks had no influence on CFCR. In contrary, Newkola and Sim (1990) and Raj *et al.* (1996) reported better feed efficiency in broiler chicks fed with 5 and 50% fish silage, respectively than that of the chicks fed with control diet. The cumulative feed conversion ratio of T_3 and T_4

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were significantly lower than that of T_1 and T_2, which was similar to that of Kjos *et al.* (2000). On the other hand, Balios *et al.* (2003) reported that there was a better feed conversion ratio in case of broiler birds incorporated with 2.5 and 5 % fish silage, respectively in two treatments.

There was no significant difference in the eviscerated yield due to inclusion of AFS upto 10% in the diet of broiler quails. This finding was in accordance with Al-Remirez *et al*. (2013) who reported no significant difference in eviscerated yield of quails fed diet incorporated with fish silage. There was a significant difference in the relative weight of liver, heart and giblet due to dietary incorporation of AFS at 15% level. The breast meat yield also reduced significantly in the 15% AFS dietary group compared to all other dietary groups ($T_1>T_2=T_3>T_4$). The findings of the present study thus suggested that 15% AFS incorporation in the diet of broiler Japanese quails had an adverse effect on carcass characteristics of quails.

The total protein value in the serum ranges between 5.09 to 5.76 g/dl among the groups which was in agreement with Ozcelik *et al.* (2004) and these values were non-significant among the groups. The albumin value among the groups varied significantly ($P<0.05$) the control group being the highest which was contrary to Boitai (2015) in which the control group was having a lesser amount of albumin than the treatment groups. The calcium and phosphorus level in the serum did not differ significantly due to dietary incorporation of AFS up to 15% implying that the mineral availability was adequate in the diet. A significant decrease in serum triglycerides was observed due to inclusion of AFS irrespective of the levels in the diet which was contrary to Alparslan *et al.* (2006). The total cholesterol concentration did not vary significantly up to 10% AFS but at 15% AFS, a significant ($P<0.05$) increase in cholesterol concentration was marked. This finding was in agreement with Boitai (2015) where an increase in total cholesterol concentration was observed due to higher level of AFS in the diet of broiler chicken. However, it was contrary to Alparslan *et al.* (2006) who reported no significant difference in cholesterol level among the groups having 0, 4 and 6% incorporation of fish silage. No difference in the different cholesterol fractions (HDL, VLDL and LDL) could be noticed in the serum of quails due to incorporation of AFS in the diet. No difference was observed in the ALT activity in the serum which was in agreement with Alparslan *et al.* (2016). The AST activity in the serum increased due to 10% AFS and above in the diet. Since major activity of transaminase is seen in liver, any condition leading to large scale degeneration of cells would result in liberation of these enzymes into the circulating blood stream (Panda *et al.*, 2004). Incorporation of 10% AFS in diet might have increased the metabolic activity of liver cells which might have synthesized and degraded more of dispensable amino acids leading to higher concentration of AST enzymes in the serum (Karadas *et al.*, 1999).

There was no significant difference marked in the crude protein and ether extract content of the breast meat sample leading to the conclusion that dietary incorporation of 5, 10 and 15% fish silage, respectively had no effect on the proximate composition of meat. There was a higher total ash % estimated in case of the

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group fed with 15% of incorporated ASF. The higher total ash in 15% AFS group might be due to the higher mineral content in the fish viscera which might have been absorbed by the system and got deposited in the meat. No information in literature is available on the effect of AFS on meat composition of broiler Japanese quails. Further, AFS inclusion in the diet had a beneficial effect on meat ash content.

Conclusion

Based on the overall findings of the study, it was concluded that supplementation of fish silage at the rate of 5% of the diet in broiler Japanese quails not only reduced the cost of production but also provided a means to mitigate pollution generated from fish waste.

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