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Yogurt as Probiotic: Comparative Effect on Growth Performance of Broiler Japanese Quail (*Coturnix Japonica*)

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A B S T R A C T

Yogurt is a natural source of gut-friendly bacteria. It has a considerable body of evidence that supports the significant positive effects of yogurt as probiotics on quail production performance and health. Yogurt containing bacteria can improve quail economic indexes and resistance to pathogens. With this objective, 240 growing Japanese quails were randomly distributed into three groups A_1 (control), A_2 (Yogurt), and A_3 (Protexin) (4 replicates/treatment of 20 birds) to investigate the effect of yogurt as a probiotic source. Birds were allowed to be fed ad libitum with a commercial quail ration. Yogurt and Protexin were mixed at the rate of 5 ml/L (5ml into 1 lt. water) and 1g/L (1gm into 1 lt. water) in A_2 and A_3, respectively. Six (6) weeks of investigation showed a significantly higher result in yogurt than in the other two groups. Body weight had a significant difference between the control and protexin groups. Body weight gain (g) was significantly heavier in A_2 at the finisher phase. No significant effect was observed in feed intake, but FCR (Feed Conversion Ratio) was significantly lower in A_2, but no significant effect was noticed between A_1 and A_3. The mortality percentage was higher in the control group (2.66%) and lowest in yogurt (1.03%). Carcass characteristics were significantly heavier in A_2 than A_1 and A_3. Non-carcass characteristics illustrated significant differences among the three groups, but a non-significant difference was observed in head weight. The gross return per bird was higher in A_2 (12.05 BDT), whereas it was 6.55 BDT and 7.08 BDT for A_1 and A_3. With those observations, it can be concluded that yogurt successfully enhanced overall broiler performance and gross return of Japanese quail.

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Introduction

Feed remains a key component for poultry industries as it is directly associated with the net return. Poultry business profitability somehow depends on feed cost. The economic efficiency of feed conversion to meat is the main focus of making the poultry industry profitable. It has been reported that about 60-70% of total input cost is spent on feed purchases (Thirumalaisamy et al., 2019; Farooq et al., 2001). During the COVID-19 pandemic and subsequent lockdown, an unprecedented emergency and sudden suffering created major constraints on high poultry input costs (ranked 6th) and feed supply shortages (ranked 9th) (Hossain et al., 2021). An aim to reduce feed costs will be to boost farm production. Holding this challenge, many pieces of research have been adopted to minimize the feed cost; there were two aims on a priority base. The first aim was to reduce feed consumption with regular growth and the second one was to use consumed feed with maximizing production efficiently. After a long time, several solutions have been concluded like mixing supplements and additives in feed, enhancing feed digestion, absorption, and production.

Probiotics Greek meaning is bios/life. It is a cluster of desirable live microorganisms like *Lactobacillus acidophilus*, *Lactobacillus casei*, *Bifidobactunium bifidum*, *Aspergillus oryzae*, and *Torulopsis*, which are more efficient in increasing intestinal microflora suppressing health pathogens (Mohan et al., 1995). According to the FAO definition (FAO, 2001), probiotics are live microorganisms with health benefits when administered adequately. Probiotics are produced commercially and used in poultry feed as an alternative to in-feed antibiotics (IFAs). Several sources confirmed that probiotics had a therapeutic effect on growth performance (Mountzouris et al., 2010; Koenen et al., 2004), reduced pH, and synthesized vitamins (Fuller, 1989). It is also used in removing gastrointestinal abnormalities (Kutlu and Gorgulu, 2001) and prevents contamination of carcass by intestinal pathogens during processing (Hose and Sozzi, 1991; Juven et al., 1991).

Yogurt is the best-fermented dairy product that efficiently exhibits broad probiotic characteristics in poultry industries. It predominantly contains Lactobacilli and other beneficial bacteria, which help break down CHO, proteins, and fat in food. It increases the digestibility and absorption of metabolized feed ingredients. Lactobacilli are gut favorable bacteria attached to intestinal epithelial cells that could aid in inhibiting the development of pathogens. It also helps in immune activation by increasing macrophage activity.

Yogurt is a probiotic used since scientists are searching for an alternative to IFAs. It is a natural and very common probiotic for chicken farming operations. Still, it is rarely practiced in Japanese quail (*Coturnix coturnix japonica*) farming, but it has a similar effect to broiler and layer quails. This study was undertaken to perceive the effect of yogurt as a probiotic on Japanese broiler quail performance and compare the performance with commercially available probiotic protexin and their cost-benefit analysis.

Materials and Methods

Yogurt Preparation and Protexin

Yogurt is a simple ecosystem in which interactions between two thermophilic lactic acid bacteria, *Streptococcus thermophilus,* and Lactobacillus *delbrueckii subsp. bulgaricus (Lb. bulgaricus)* is critical to production (Courtin & Rul, 2004). The milk was heated to 180°F for homemade yogurt and then allowed to cool to 112-115°F. A yogurt starter (the good quality bacteria) was added. Combine the yogurt starter and the remaining milk in a mixing bowl. Finally, the mixture was incubated for 7-9 hours at 37°C. Yogurt used to be kept in the fridge to cool and set for subsequent experiments.

Protexin is a multistrain commercial probiotic made up of seven bacterial strains and two yeast strains: *Lactobacillus plantarum, Lactobacillus bulgaricus, Lactobacillus acidophilus, Lactobacillus rhamnosus, Bifidobacterium bifidum, Streptococcus thermophilus, Enterococcus faecium* (Siadati et al., 2017)

Birds Allocation and Experimental Treatments

An experiment was conducted at Khadim Youth Training Center at Brahmanbaria, Bangladesh, in June-July 2018 to know the efficiency of yogurt on broiler Japanese quail production and make a comparison with Protexin (Elanco Bangladesh Ltd.).

A total of 240-day old Japanese quail chicks were

procured from a local market and allocated into three groups, A1, A2, and A3, to treat control, yogurt, and protexin (Taable 1). Further, each group was subdivided into 4 replication. Each replication had 20 birds, and they were assigned to a floor pen (40×40 cm^2). The room temperature was kept constant at 32°C for the first week, then gradually decreased by 3°C weekly until it reached 22°C, where it remained until the end of the experiment (Khaksar et al., 2012). Throughout the investigation, the quails were subjected to a continuous lighting program of 23L:1D. (Kermanshahi et al., 2015). Birds were kept in pens with the same management like adequate feeder, drinker, lighting materials, etc. Commercial quail feed was supplied ad-libitum along with water (Table 2) ad-libitum along with water. Homemade yogurt was added 5ml/L of water, and commercially available protexin was also mixed with 1 gm/L of water.

Growth Performance and other Parameters

Three birds were randomly picked from each replication fork for investigation. Feed intake was recorded daily by subtracting feed refused from offered. Body weight, body weight gain, and FCR were recorded weekly. Mortality percentages were recorded during the entire experiment. At the end of the experiment (6 weeks later), 36 birds 3 from each replication were slaughtered to calculate and record the dressed weight, dressing percentage, and carcass characteristics. At long last, a cost-benefit analysis was reported based on the sum of feed and day-old chick purchased, probiotic and miscellaneous costs subtracted from net income.

Statistical Analysis

The effect of dietary probiotic treatments on body weight, body weight gain, feed intake, body weight gain, FCR, and carcass characteristics was tested through one-way ANOVA in a randomized design. The mean difference of different parameter values was calculated by using (LSD) Least Significant Difference with a 5% level of significance. All data were analyzed by using SPSS for Windows release (Version 28.0, SPSS Inc., Chicago, IL, USA).

Table 1. Group details

Group	Treatments
A_1	Control
A_2	Yogurt
A_3	Protexin

Table 2. Composition of the diets fed to the experiment quails

Feed ingredients	Amount of 100 kg mixed feed
Maize	48.00
Rice polish	6.00
Til oil cake	4.00
Fish meal	4.00
Soybean meal	33.00
Meat and bone meal	2.5
Dicalcium Phosphate	0.50
Limestone	1.00
Methionine	0.20
Lysine	0.10
Premix	0.30
Common salt	0.40
Total	100
Nutritional value	
Metabolizable energy, kcal/kg	2900
Crude Protein %	22.00
Crude Fiber %	5.00
Fat %	3.00
Moisture %	12.00
Ca %	1.20
P %	0.48

Results and Discussion

Body weight and Weight Gain

The supplementation of probiotics in the quail diet increased body weight (BW). The mean BW was significantly higher (P<0.001) in A_2 than in A_1 and A_3. A significant difference between A_1 and A_3 was observed from 1 to 6 weeks (Table 3). This result does not agree with Miles et al. (1981a), who reported feed supplemented with a probiotic culture containing *L. acidophilus* and other lactobacilli has no significant differences in body weight growth. But Kumararaj et al. (1997) observed improved live body weight in quails due to supplementation of commercial probiotics. However, Yalcin et al. (2000) found no significant difference in live body weight in quails of different treatment groups fed with probiotics. The result of mean body weight gain (BWG) was significantly (P<0.001) heavier in A_2 in comparison to A_1 and A_3 at the 3rd, 5th, and 6th weeks, the result also significantly differs for the 1st and 4th weeks (P<0.05) (Table 3). Although the BWG between A_1 and A_2 did not considerably vary initially, but it did at the finisher phase. This result is comparable with Strompfova et al. (2005), who investigated the effect of *Lactobacillus fermentum* in Japanese quail dietary supplements, which increased the daily weight gain by 14%. Probiotics sources such as bacterial sporolac (*Lactobacillus sporogenes*) and fungal (yeast) origin were added alone. Still, combined with standard quail, the ration was reported to increase live body weight gain significantly. This statement did not agree with Mahajan et al. (1999); Homma and Shinohara (2004), who said commercial probiotics did not affect body weight gain.

Feed intake and FCR

The experiment result showed that yogurt and protexin as probiotics do not affect Japanese quail mean feed intake (FI). There were no significant differences (P>0.05) among the three groups (Table-4). This result is advocated by earlier findings by Homma and Shinohara, (2004), who reported bacillus containing probiotics and commercial probiotics (protexin) do not affect FI. Ayasan et al. (2006) also recorded protexin did not affect feed intake by broiler Japanese quail, but Kheiri et al. (2015) showed that using of protexin in feed increased feed intake (FI) compared to the control group. In this study, data also revealed that the FCR value in A_2 was significantly lower (P<0.05) than in A_1 and A_3 (Table-4) from 1st to 6th weeks, but there was no significant difference between A_1 and A_3. These findings agreed with Kheiri et al. (2015), who pointed out significant differences (p<0.05) in feed conversation ratio (FCR) with the treatment of protexin. Although, Miles et al. (1981a) stated that feed mixed with a probiotic culture containing *L. acidophilus* and other lactobacilli existed no significant difference in feed efficiency. Ayasan et al. (2006) also observed no positive effect of protexin on feed conversion of Japanese quail. But Coskun et al. (2018) reported that yogurt supplementation in the drinking water of quails increased the Lactic acid bacteria count in the cecum.

Table 3. Body weight (g) and body weight gain (g) of Japanese quail (Mean±SEM).

Group	Body weight (g)				Body weight gain (g)			
	A_1	A_2	A_3	P-values	A_1	A_2	A_3	P-values
Probiotic	Control	Yogurt 5 mL^{-1} of water	Protexin 1g L^{-1} of water		Control	Yogurt 5 mL^{-1} of water	Protexin 1g L^{-1} of water	
1 wk	23.01±0.17^{b}	25.79±0.30^{a}	24.22±0.25^{c}	<.001	12.82±0.30^{ab}	13.49±0.24^{a}	12.18±0.28^{b}	.007
2 wk	35.83±0.27^{b}	39.28±0.39^{a}	36.40±0.30^{b}	<.001	19.27±0.50^{b}	23.10±0.50^{a}	20.51±0.59^{b}	<.001
3 wk	55.10±0.39^{b}	62.38±0.31^{a}	56.92±0.38^{c}	<.001	22.88±0.45^{a}	23.46±0.55^{a}	22.70±0.36^{a}	.482
4 wk	77.99±0.47^{b}	85.84±0.33^{a}	79.62±0.40^{c}	<.001	23.12±0.79^{b}	26.72±0.63^{a}	24.88±0.65^{ab}	.003
5 wk	104.50±0.45^{b}	108.96±0.62^{a}	104.70±0.52^{b}	<.001	23.78±0.62^{b}	26.34±0.79^{a}	24.81±0.76^{b}	<.001
6 wk	128.49±0.45^{b}	135.31±0.48^{a}	131.32±0.49^{c}	<.001	23.50±0.59^{b}	28.11±0.54^{a}	24.77±0.58^{b}	<.001

Note: Superscripts alphabets on different means within columns show a significant difference (P<0.05)

Table 4. Feed intake (g) and FCR of Japanese quail (Mean±SEM).

Group	Feed Intake (g)				FCR (Total feed consumed/Total weight of the product)			
	A_1	A_2	A_3	P-values	A_1	A_2	A_3	P-values
Probiotic applied	Control	Yogurt 5 mL^{-1} of water	Protexin 1g L^{-1} of water		Control	Yogurt 5 mL^{-1} of water	Protexin 1g L^{-1} of water	
1 wk	1.19±0.05^{a}	2.14±0.06^{a}	2.11±0.05^{a}	.658	1.54±0.05^{b}	1.10±0.02^{a}	1.21±0.03^{c}	<.001
2 wk	7.61±0.42^{a}	7.65±0.57^{a}	7.67±0.52^{a}	.780	2.77±0.22^{b}	2.33±0.27^{a}	2.67±0.30^{b}	<.001
3 wk	13.37±0.39^{a}	12.48±0.31^{a}	12.53±0.40^{a}	.180	4.20±0.60^{b}	3.56±0.47^{a}	3.97±0.59^{b}	.028
4 wk	17.68±0.59^{a}	17.69±0.63^{a}	18.17±0.84^{a}	.224	5.15±0.20^{b}	4.32±0.20^{a}	5.13±0.15^{b}	.005
5 wk	21.84±0.28^{a}	21.77±0.37^{a}	21.74±0.31^{a}	.085	6.48±0.22^{b}	5.57±0.20^{a}	5.73±0.19^{ac}	.008
6 wk	20.06±0.36^{a}	20.85±0.22^{a}	20.49±0.48^{a}	.343	6.00±0.15^{b}	5.21±0.11^{a}	5.81±0.16^{b}	.001

Note: Superscripts alphabets on different means within columns show a significant difference (P<0.05); FCR: Feed Conversion Ratio

Table 5. Mortality percentage of Japanese quail

Group	Probiotic applied	Mortality percentage
A_1	Control	2.66
A_2	Yogurt 5 ml/L of water	1.06
A_3	Protexin 1g/L of water	1.73

Table 6. Carcass characteristics (Dressing percentage, dressed weight, thigh meat, breast meat, drum stick, wing weight), non-carcass characteristics (liver, gizzard, head weight). (Mean±SEM).

Group	A_1	A_2	A_3	P-values
Probiotic	Control	Yogurt 5 ml/L of water	Protexin 1g/L of water	
Dressed weight(g)	75.00 ± 0.47^b	84.37 ± 0.75^a	78.04 ± 0.78^c	<.001
Dressing Percentage	58.37 ± 0.33^b	62.35 ± 0.46^a	59.41 ± 0.41^b	<.001
Thigh meat(g)	9.64 ± 0.28^b	12.33 ± 0.21^a	10.49 ± 0.21^c	<.001
Breast meat(g)	26.31 ± 0.24^b	28.57 ± 0.26^a	26.68 ± 0.15^b	<.001
Drum stick(g)	8.86 ± 0.31^b	10.86 ± 0.27^a	9.05 ± 0.20^b	<.001
Wing weight(g)	7.05 ± 0.30^b	8.22 ± 0.43^a	6.53 ± 0.16^b	.002
Liver(g)	6.52 ± 0.61^b	7.51 ± 0.70^a	7.24 ± 0.51^{ab}	.002
Gizzard(g)	6.09 ± 0.19^b	7.84 ± 0.20^a	7.01 ± 0.26^c	<.001
Head(g)	9.12 ± 0.18^a	8.71 ± 0.32^a	9.17 ± 0.27^a	.438

Note: Superscripts alphabets on different means within columns show significant difference (P<0.05)

Table 7. Economics of broiler Japanese quail production under different treatments

Parameters	Control	Yogurt	Protexin
Feed Cost (BDT)	261	280	272
Chick cost (10BDT/chick)	800	800	800
Feed additives (BDT)	0	150	250
Miscellaneous Cost(BDT)	1135	1135	1135
Total input cost (BDT)	2196	2365	2457
Net outcome (BDT)	2720	3327	3024
Net income (BDT)	524	962	567
Net Income/bird (BDT)	6.55	12.05	7.08

BDT: Bangladeshi Taka

Mortality

Mortality data were recorded in terms of percentage for each treatment group. A total of 12 birds died in A_1, which was slightly higher than in A_2 and A_3. The result revealed that mortality percent were 2.66, 1.03, and 1.73 in A_1, A_2, and A_3, respectively (Table 5). These results agree with Samanta and Biswas (1995), who reported mortality percent is lower in groups treated with probiotics. However, Miles et al. (1981b) found no difference in mortality in quails fed with probiotics of different groups.

Carcass and non-carcass Characteristics

The result presented in Table. 6 reveals that the dressing percent was significantly higher (P<0.05) in A_2 (62.35±0.46g) than in A_1 (58.37±0.33g) and A_3 (59.41±0.41g). Mean dressed weight was 75.00±0.47g, 84.37±0.75g, and 78.04±0.78g in A_1, A_2, and A3, respectively. It was significantly higher in A_2 (P<0.05) than A_1 and A_3. Mean thigh meat, breast meat, drum stick, and wing weight were significantly heavier (P<0.05) in A_2 than in A_1 and A_3. There was no significant difference between A_1 and A_3 for all recorded values of carcass characteristics. Three parameters values, such as liver, gizzard, and head, were noted for non-carcass characteristics comparison (Table 6). A_2 had significantly higher mean liver and gizzard weight (P<0.05) than A_1 and A_2. No significant difference (P>0.05) existed in head weight for all three groups. This presented result reveals an agreement with Bandy and Risam (2001); Kabir et al. (2004), who reported significant (P<0.05) improvement in dressing percentage in groups supplemented with probiotics. Abou-Kassem et al. (2021) also experimented that using *Bacillus toyonensis* and *Bifidobacterium bifidum as* feed supplements enhanced the meat quality of quails. Kheiri et al. (2015) recorded that protexin could increase carcass yield. Rehman et al. (2020) reported apart from dressing percentage, no interaction of probiotics was observed for carcass, breast, thigh, heart, liver, and gizzard weight.

Cost-benefit Analysis

One of the objectives of this experiment was to estimate the feasibility of probiotics in Japanese quail rearing in terms of economics. To analyze the cost and benefit, all parameters were calculated in a round figure of Bangladeshi Taka (BDT) (Table 7). This experiment revealed that total input cost, including feed cost, chick purchase cost, feed additives cost, the miscellaneous cost was 2196 BDT, 2365 BDT, and 2457 BDT for A_1, A_2, and A_3, respectively. The net outcome after selling the birds was 2720 BDT, 3327 BDT, and 3024 BDT for A_1, A_2, and A_3, respectively. Finally, the cost-benefit analysis was concluded by shearing the net income per bird was BDT 6.55, 12.05, and 7.08 for groups A_1, A_2, and A_3. The cost-benefit study of the experiment showed a higher net income per bird in A_2 than in A_1 and A_3. No difference between A_1 and A_3 has been observed, but net income per bird is slightly higher in A_3 than in A_1. These findings agree with Kumari et al. (2001), who reported cost-effective feeding with probiotics.

Conclusions

It can be concluded that the use of yogurt in Japanese quail production had a positive influence on growth, carcass characteristics, feed efficiency, and economics than control and protexin. It is a source of beneficial microorganisms and more organic than protexin. Yogurt has a probiotic potential so it can be used as a probiotic in Japanese quail production.

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Disclosure Statement

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