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Research Article

Effect of dietary supplementation of probiotic and *Curculigo orchioides* rhizome powder on egg quality parameters and biochemical composition of Japanese quail (*Coturnix coturnix japonica*)

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ABSTRACT

The present study evaluated the effect of probiotic and *Curculigo orchioides* medicinal plant powder as dietary supplementation on growth performances, egg production, egg quality parameter and chemical composition in Japanese quail. The supplemented feed was treated as comprised of, six groups with different concentration. Body weight (BW), Body weight gain (BWG), feed consumption (FC) and feed conversion ratio (FCR) were weekly determined. Number of eggs laying per bird in each replicate was recorded daily. External and internal qualities of collecting eggs were measured freshly. The growth performance of body weight, weight gain and feed consumption was increased and FCR was averagely decreased, significantly ($P<0.05$) differ in combining dietary treated group and different concentration of treated groups when compared to control. Egg production, egg weight, length, width, shape index, shell weight, shell weight %, shell thickness were significantly ($P<0.05$) increased with different concentrations of treated probiotic and medicinal plant powder groups when compared to control. Internal quality like albumen and yolk-weight, length, width, albumen-index, yolk-index, yolk-color, Haugh unit score were significant ($P<0.05$) different from various concentrations of dietary treated groups with combined treated group when compared to control. Throughout, the experiment biochemical analysis of the egg cholesterol was decreased in low level of medicinal plant groups, while the crude protein concentration level was increased in combining treated groups significantly ($P<0.05$) different when compared to control. Thus, it is concluded that low level of the probiotic treated group and combines treated group was improved body weight, body weight gain, feed efficacy (FCR) and egg production, Whereas low levels of *C. orchioides* medicinal plant powder treated group and combine treated group to evaluate significant improved egg quality traits, Haugh unit and egg yolk cholesterol % and albumen crude protein % possibly excellent fed constituent for Japanese quail.

Keywords: Probiotic, *Curculigo orchioides*, growth performance, egg quality, Japanese quail.

INTRODUCTION

Japanese quail are the smallest farmed avian species. It was well known for its commercial egg and meat production with a short generation interval. Quails are popular in Japan and china in North America and in some European countries[1,46]. The world annual egg production has registered an unprecedented increase in the recent year. The world egg output in 1985 was 30.2 million tons in the same way 23.6 million tons

in 1975. As well as the poultry egg production has tremendously improved to reach a new record of egg output with 65.5 million tons in 2013. India is a predominant country in one of the leading egg production. Eggs are a good source of protein compared to other source of animal protein[47]. The chief sources of protein are albumen, yolk and shell membranes. Furthermore, simple proteins are usually predominant in albumen and conjugated proteins are in the yolk[1].

The egg is the multipart biological structure distinguished and formulated from nature for reproduction of birds. It affords a complete diet of the entire nutrients. Scientific reports on their nutritional qualities have assured that an egg has lifelong important role in the nutritional supply. At the same time natural feed additives of plant source are usually believed to be harmless, healthier and less hazard for humans and animals[2].

Antibiotic are used as growth promoters which causes undesirable effects in poultry production[3]. Recently, many countries have a propensity to exclude antibiotics because of their side effects on both birds and humans. Several researchers[4-6] have investigated the beneficial effects of feeding probiotics on poultry as a possible alternative to antibiotics for growth promotion and improvement of feed efficiency. Probiotic are acting as a good alternative for antibiotics.

Curculigo orchioides is popularly known as black musali in India. The rhizomes as well as tuberous roots are extensively used in indigenous medicine in India. The genus *Curculigo* belongs to the family hypoxidaceae and consists of approximately 20 species exclusively of tropical origin[7]. It has been used as an antioxidant, antimicrobial activity[8] and immunomodulatory performance[9].

The antimicrobial effect of plant/plant extracts is well recognized and their potential as an alternative to antibiotic due to the direct effect on pathogenic bacteria has been investigated[10,11]. The medicinal plant *C. orchioides* rhizome powder has been used as growth promoters in Japanese quail. They found that plant rhizome diet improved the nutritive value of the bird by increasing body weight, improved feed conversion ratio and along with better economic efficiency.

In recent years, breeding of quail has taken an important place in poultry production. Moreover, controversial results have been reported regarding the use of biological additives to poultry diets[3,12,13]. Therefore, this study was performed to investigate the effects of probiotic and *C. orchioides* medicinal plant powder supplementation on feed consumption, feed efficiency, egg production, exterior and interior egg quality of Japanese quail.

MATERIALS AND METHOD

Animal Collection:

One day old, a total of 180 Japanese quail chicks were collected from the breeding farms of Tamil Nadu Veterinary and Animal Science University at Namakkal district, Tamil Nadu, India.

Experimental Design:

The dietary treatment was started with 10 days old quail chicks, which had been incubated for its growth for 12 weeks were subjected to this experiment. Six treatment groups each treatment three replicates and 10 birds per replicate. Birds in each replicate were placed into cage having 50×45 cm in height for 12 weeks of experimental period. A lighting schedule was 24 hours for the first 3 weeks. Then, birds were allowed to access *ad labium* to feed and water. The experimental design consists of 6 dietary treatments groups were,

Basal diet (G1),
Basal diet with *Curculigo orchioides* rhizome powder 5gm/kg (G2),
Basal diet with *Curculigo orchioides* rhizome powder 10gm/kg (G3),
Basal diet with Probiotic 5gm/kg (G4),
Basal diet with Probiotic 10gm/kg (G5),
Basal diet with *Curculigo orchioides* rhizome powder 10gm/kg with Probiotic 10gm/kg (G6).

The basal diet was formulated according to National Research Council[14]. It contained 17.7 % crude protein and 2817 Kcal ME/kg breeder diet. Record with kept for body weight, feed consumption, feed conversion ratio and egg production through the experimental period. The quails were matured in 6 weeks, after the eggs were collected to conducting the experiment.

Egg quality traits:

Eggs were collected daily and quality determination was done. Soft-shelled, cracked and small eggs were not used in the study. Measurements of egg quality were taken on average of 10 eggs from each treatment groups. Eggs were weighed through the 0.01g sensitive electronic scale.

External egg quality and internal egg quality traits:

A vernier caliper was used for external and internal quality measuring the length, width of the egg, yolk diameters, length and width of the thick albumen. The external quality of shell thickness was measured at 3 different locations (middle, broad and narrow ends) measured using a micro screw gauge and the mean value was considered as its the thickness. The height of the thick albumen and yolk were recorded

with triploid stand micrometer. Yolk color intensity was evaluated and scored according to the Roche yolk color fan (1, light yellow; 15, orange).The average of the 2 measurements of thick albumen height (one near to yolk and the other at the end of dense albumen) communally by egg weight was used to calculate. The Haugh unit scores for each individual egg according to Haugh[15]. The shape index, Shell weight%, Shell thickness, Albumen index[16], Albumen weight %, Yolk Index[17],Yolk weight %,Yolk color and Haugh Unit score[15,18] of collected eggs were determined using the method of Kemal *et al*.,[19]. The weight of the albumen, yolk and shell were calculated in relation to egg weight and expressed in percentage.

Yolk cholesterol and Albumen crude protein measurements:

Yolk cholesterol were extracted by the method of Folch *et al*.[20] as modified by Washburn and Nix[21] from three eggs of each replicate. The protein content of food stuff is estimated ultimately by first determining the nitrogen content. Albumen crude protein was extracted is used to the procedure of digestion and distillation. The total N_2 present in a sample is determined by the Kjeldahl method[22].

Statistical analysis:

Data were analyzed by one-way ANOVA (P<0.05) with completely randomized design. Comparison of parameters was performed with the Duncan's multiple range test and data were analyzed using the SPSS® for windows (version 16.0, 2010) computing program[23].

RESULTS

During the experimental period 12 weeks, the effect of probiotic and *C. orchioides* medicinal plant powder on the productive growth performance and egg quality traits of laying Japanese quail hens.

Growth Performance:

The Body Weight (BW) Body weight gain (BWG) of quails fed with the combined diet of *C. orchioides* and probiotics with different concentration and in different forms which showed different results compared to control **(Fig 1& 2)**. The result showed that the supplementation of 10gm plant powder/kg and 5gm probiotic/kg diet respectively, brought about the significant improvements in egg production. Feed consumption did not exhibit any significant effect and feed conversion ratio was better improvement on in the lower level of the probiotic and high level of medicinal plant powder diets when compare to control group **(Table 1& Fig 3)**.

External quality of Eggs:

During the experimental period, Japanese quail egg weight was the most consistently changing trait. The mean value of physical (External) characteristics of eggs quality results showed **(Table 2)**, among egg weight, egg length, egg width, egg shape index, shell weight, shell weight % and shell thickness are significant (P<0.05) increased different concentration treated groups and combine treated group when compared to control.

Internal quality of Eggs:

The mean value of physical (Internal) characteristics of eggs was resulted in **(Table 3)** internal egg qualities between albumen weight, albumen weight %, Albumen- length, width, height, albumen index and also yolk weight, yolk weight %, yolk- height, width, yolk index, yolk color and international quality unit of Haugh Unit score are mean values differently in treated groups significantly differently (P<0.05) then comparable to control group. Haugh unit are higher in 5 gm plant rhizome group (87.13±0.66) when compared to control (80.29±0.37) and other trade groups **(Table 3)**.

Cholesterol and protein in egg:

Japanese quail egg biochemical estimation of total cholesterol is very low in the treated group 10gm *C. orchioides* medicinal plant rhizome (54.96±0.50) compared to control (58.43±2.38), respectively. The means of the biochemical estimation of egg albumen crude protein was higher in the combine diet treatment group of 10gm probiotic and 10gm *C. orchioides* medicinal plant rhizome (79.92±0.01) whereas compared to control group (72.80±0.60) significantly (P<0.05) different **(Fig 4)**.

DISCUSSION

The growth performance of the different level of probiotic and *C. orchioides* medicinal plant rhizome powder combination works together used of these drug elements of achieving from cooperating for an enhanced effect. These combinations were more effective than they were each used in an isolated economically expression. These beneficial effects make them useful as potential natural animal feed additives[24].

In this study, Probiotic supplementation to the diet of quail breeders has significant increases the live weight in poultry species[13,25]. The highest egg production was achieved in probiotic supplementation group as in the studies reporting the improvements of egg production in laying hens by probiotic[12,26]. Due to the elongated small and large intestinal lengths as well as the probiotic suppressing effects on undesirable bacteria and stimulating effects

on the growth of beneficial bacteria in the intestines which increase absorptive capacity may be increased in egg production[27].

As well as *C. orchioides* plant powder may be due to the presents of phenolic active compounds during antimicrobial activity. Several medicinal plants have been used because of their antimicrobial traits, which are caused by compound synthesized in the secondary metabolism of the plant[28]. The improvement of body weight as well as feed efficiency is due to the active resources found in herbal, for the reason that greater efficiency in the utilization of feed, resulting in enhanced growth of quails. There is an evidence to recommend that herbs, spices and various plant extracts have flavor and digestion stimulating factors, also reported earlier[29].

Langhout[30] suggested that the improvement in body weight of birds achieved thyme could be attributed to its positive effect on nutrient digestibility. Other factors which may possibly have contributed to the beneficial effects of the herbal products on the growth performance of birds correlated well with the earlier observations[31] and the higher feed intake was to compensate energy requirement for growth which leads to increased body weight with the *C. orchioides* plant powder. Bozkurt *et al.*, recommended the supplementation of diet with essential oil mixture provided increment in egg shell weight[32]. In the same way we study correlated with the Ali *et al.*, who worked with the thyme as the diet in quail birds, thyme is well known for its antioxidant activity and calcium storage which helps in increasing shell weight and shell thickness[33].

Park *et al*., reported that utilized amounts of thymus powder fed 2.0% whereas egg production and egg weight numerically increased in hens, although there were statistical differences in terms of feed intake and feed conversion ratio[34]. Contrary to our experiment, the studies of quails treated in oregano oil Danli *et al*.[35] and Parlat *et al.* [36] advised that the improved FCR. Throughout the experimental animals, the better FCR values observed in the group supplemented with 10gm/kg *C. orchioides.* There are no studies in the literature mentioned the effect of *C. orchioides* on the FCR values and a Haugh unit of eggs.

Table 1
Effect of Probiotic and *C. orchioides* dietary supplementation on growth Performance and egg production of Japanese quail

Parameters	G1	G2	G3	G4	G5	G6
Feed intake/ Feed consumption (gm/quail)	18.86 ± 0.68^{b}	21.65 ± 0.21^{a}	20.31 ± 0.37^{a}	20.76 ± 0.48^{a}	19.77 ± 0.78^{b}	20.11 ± 0.24^{a}
Feed conversion ratio (gm feed/ g wt gain)	2.92 ± 0.10^{a}	2.61 ± 0.11^{b}	2.67 ± 0.12^{b}	2.52 ± 0.07^{c}	2.60 ± 0.11^{b}	2.31 ± 0.04^{c}
Egg production%	72.31 ± 1.41^{c}	79.21 ± 0.78^{a}	74.42 ± 1.48^{c}	79.23 ± 0.79^{a}	75.46 ± 0.65^{b}	77.20 ± 0.72^{b}

Mean ± S.E (a,b,c) within a row differ at P<0.05.

Table 2
Effect of Probiotic and *C. orchioides* dietary supplementation on external egg quality parameters of Japanese quail

Egg Parameter	G-1	G-2	G-3	G-4	G-5	G-6
Egg Weight(g)	10.42 ± 0.44^{c}	11.49 ± 0.09^{b}	12.73 ± 0.05^{a}	12.96 ± 0.42^{a}	12.40 ± 0.64^{a}	12.91 ± 0.39^{a}
Egg Length (mm)	3.16 ± 0.18^{c}	3.53 ± 0.11^{a}	3.59 ± 0.01^{a}	3.34 ± 0.08^{a}	3.22 ± 0.20^{b}	3.48 ± 0.12^{a}
Egg Width (mm)	2.58 ± 0.02^{c}	2.76 ± 0.07^{b}	2.94 ± 0.01^{a}	2.77 ± 0.09^{b}	$2.64 \pm 0.04b^{c}$	2.95 ± 0.11^{a}
Egg Shape index	79.21 ± 1.28^{c}	80.34 ± 2.40^{b}	81.89 ± 0.54^{b}	85.21 ± 0.21^{a}	80.44 ± 1.36^{b}	83.51 ± 0.47^{a}
Shell Weigh (g)	1.21 ± 0.11^{c}	1.35 ± 0.02^{b}	1.74 ± 0.01^{a}	1.83 ± 0.16^{a}	1.42 ± 0.10^{b}	1.60 ± 0.08^{b}
Shell Weight %	10.85 ± 0.10^{c}	11.81 ± 0.18^{a}	11.14 ± 0.10^{b}	11.90 ± 0.72^{a}	11.56 ± 0.80^{b}	11.89 ± 0.68^{a}
Shell Thickness (mm)	0.20 ± 0.05^{b}	0.35 ± 0.01^{a}	0.34 ± 0.01^{a}	0.38 ± 0.08^{a}	0.27 ± 0.01^{b}	0.45 ± 0.04^{a}

Means Mean ± S.E (a, b, c) within a row differ at P<0.05.

Table 3
Effect of Probiotic and *C. orchioides* dietary supplementation on internal egg quality parameters of Japanese quail

Egg parameter	G1	G2	G3	G4	G5	G6
Albumen weight (g)	5.15 ± 0.34^{c}	6.36 ± 0.08^{b}	9.49 ± 0.06^{a}	7.41 ± 0.42^{b}	6.96 ± 0.37^{b}	7.28 ± 0.39^{b}
Albumen weight %	33.64 ± 2.81^{c}	55.45 ± 0.97^{a}	60.35 ± 0.37^{a}	56.12 ± 0.95^{a}	49.62 ± 0.82^{b}	54.24 ± 0.90^{a}
Albumen length (mm)	44.96 ± 1.48^{a}	44.75 ± 0.07^{b}	45.31 ± 0.06^{b}	44.91 ± 0.22^{a}	44.85 ± 0.08^{a}	44.91 ± 0.06^{a}
Albumen width (mm)	33.02 ± 1.39^{c}	44.01 ± 0.17^{a}	39.04 ± 0.13^{a}	33.54 ± 0.12^{b}	33.09 ± 0.11^{c}	36.21 ± 0.09^{b}
Albumen height (mm)	3.51 ± 0.18^{c}	3.61 ± 0.34^{b}	3.64 ± 0.36^{b}	3.70 ± 0.48^{a}	3.65 ± 0.38^{b}	3.72 ± 0.42^{a}
Albumen index	0.11 ± 0.01^{c}	0.13 ± 0.01^{b}	0.15 ± 0.02^{a}	0.14 ± 0.01^{a}	0.13 ± 0.01^{b}	0.16 ± 0.03^{a}
Yolk weight (g)	3.74 ± 0.14^{b}	3.87 ± 0.24^{a}	3.48 ± 0.06^{c}	3.94 ± 0.27^{a}	3.78 ± 0.20^{b}	3.86 ± 0.22^{a}
Yolk weight %	31.62 ± 0.90^{b}	32.86 ± 1.24^{a}	28.57 ± 0.41^{c}	32.35 ± 1.21^{a}	31.78 ± 1.18^{b}	32.88 ± 1.24^{a}
Yolk height (mm)	10.05 ± 0.14^{c}	10.28 ± 0.18^{b}	10.39 ± 0.27^{b}	10.52 ± 0.32^{a}	10.42 ± 0.28^{a}	10.36 ± 0.22^{b}
Yolk width (mm)	25.33 ± 0.06^{b}	25.46 ± 0.08^{b}	25.21 ± 0.13^{b}	25.66 ± 0.15^{a}	25.56 ± 0.14^{a}	25.47 ± 0.08^{b}
Yolk Index	0.40 ± 0.01^{b}	0.42 ± 0.02^{b}	0.45 ± 0.04^{a}	0.46 ± 0.03^{a}	0.42 ± 0.02^{b}	0.47 ± 0.06^{a}
Yolk color	3.11 ± 0.51^{c}	3.32 ± 0.18^{b}	3.39 ± 0.24b	3.46 ± 0.38^{a}	3.42 ± 0.34^{a}	3.65 ± 0.47^{a}
Haugh Unit (%)	80.29 ± 0.37^{b}	87.13 ± 0.66^{a}	85.10 ± 0.70a	83.89 ± 0.52^{a}	81.89 ± 0.32^{b}	82.52 ± 0.28^{b}

Mean ± S.E (a,b,c) (a, b, c) within a row differ at P<0.05.

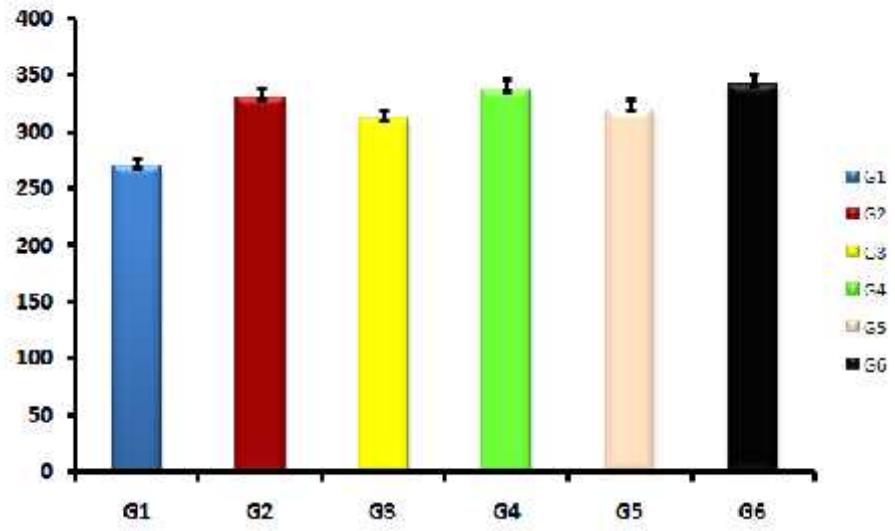

Fig 1
Effect of Probiotic and *C. orchioides* dietary supplementation on body weight of Japanese quail

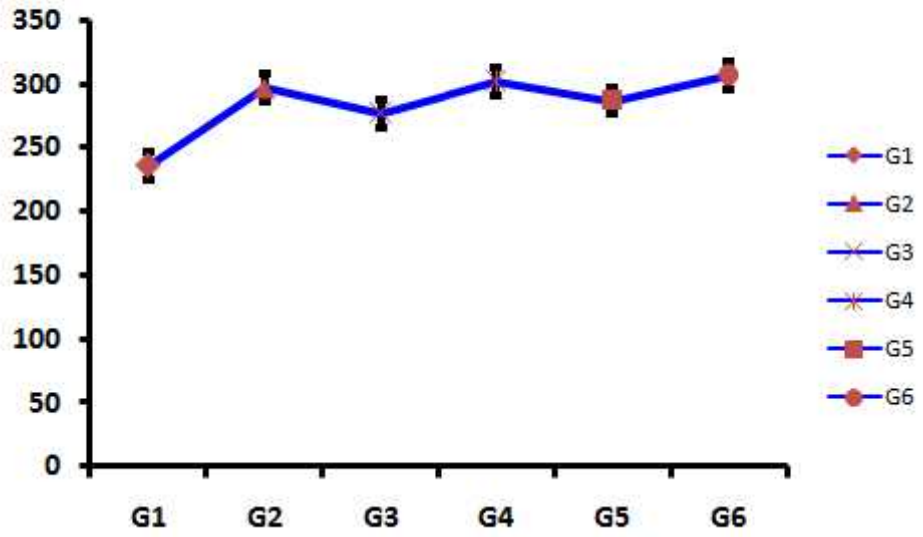

Fig 2
Effect of Probiotic and *C. orchioides* dietary supplementation on body weight gain of Japanese quail

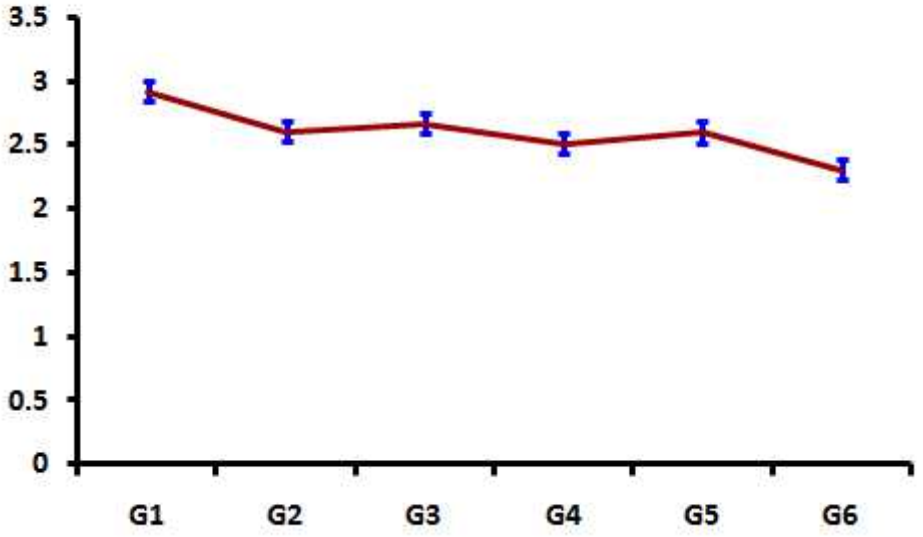

Fig 3
Effect of Probiotic and *C. orchioides* dietary supplementation on feed conversion ratio of Japanese quail

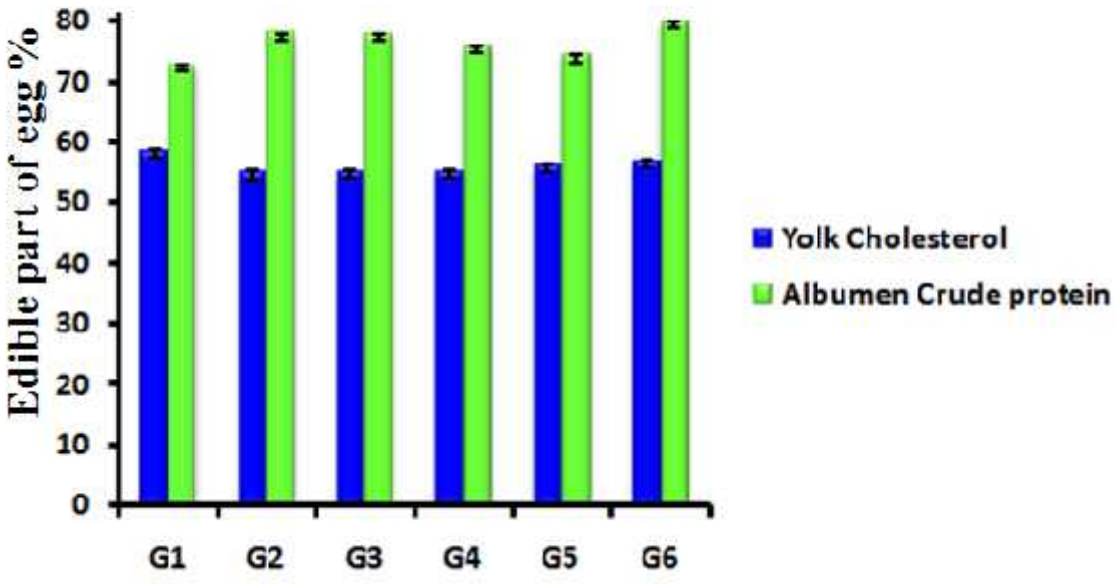

Fig 4
Effect of Probiotic and *C. orchioides* dietary supplementation on chemical composition of Japanese quail eggs

Shahryar *et al*., reported that there is a significant increase in egg yolk percentage of the 3% thyme group and increase in egg weight[37]. It increases digestion and absorption of nutrients because of having menthol[38]. The complete egg has been Yolk, albumen, egg shell and shell membranes are chemically conversion of nutrients from the hen to egg follow two pathways on the ovary and the oviduct involves the synthesis. The export of proteins able to bind specific molecules, throughout egg embryo was developed specific mechanisms to activate previously stored vitamins and minerals by means of transmitting proteins. Nutrient absorption, metabolism, and endorsement are different with hen's inheritance[3,39].

Herbal plant powder could encourage the digestive system in poultry, because improve the function of digestive enzymes as well as liver efficacy and increase the pancreatic. Expansion of the metabolism of herbal plant powder, generally carbohydrates and proteins in the major nutrient would increase growth rates[40]. Many medicinal plants and their extracts are used widely in poultry diets because the herbs have biological activities and stimulate the digestive system[41].

Inclusion of probiotic quail diets at different levels of dietary feed, decreased egg cholesterol values in the yolk[42,43]. This observation highlights the potential of improving egg production may be due to its role in improving the apparent metabolizable energy and digestion of protein[44,45]. Hence, In our study was combine a diet of treated group whereas shell weight (1.60 ± 0.08), shell thickness (0.45 ± 0.04) and egg protein (79.92 ± 0.01) were increased as well as different concentration of the treated groups consequently recorded higher mean of egg weight, albumen weight, yolk weight and yolk cholesterol significantly different when compared to control group in during the experimental period.

CONCLUSION

Probiotic have great potential to a beneficial effect on the growth performance and hence improve the health in quails. At the same time the herbal rhizome powder has great effect on the egg quality traits. The administration of supplemented *C. orchioides* rhizome powder in the laying quail diets were low level of egg yolk cholesterol, high level of protein and improved egg production.

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