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Effects of Liquid Whey Supplementation with Water on Egg Production and Egg Quality in Layer Chickens

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ABSTRACT

Background: Liquid whey is a milk by-product and contains good quality protein and minerals. Due to lack of proper knowledge and sufficient technology it remains unutilized and thrown away as a waste. So, keeping in view of its profitable utilization, a study was planned to include liquid whey as feed supplement to layer poultry.

Methods: A study was conducted by supplementation of liquid whey to layer chickens to study the effect on egg production and egg quality. A total of 120 layer birds (indicate the age) were supplemented with liquid whey *ad libitum* in the drinking water @ 0, 5, 10 and 15% up to 90 days. The data were collected with respect to egg production and egg quality parameters.

Result: Supplementation of liquid whey in drinking water improved egg production and egg quality in laying chickens. It may be concluded that liquid whey can be supplemented with drinking water at the rate of 5% (v/v) for better egg production in layers and for production of premium quality of bigger size and weight of eggs, supplementation of whey up to 15% (v/v) can be recommended.

Key words: Egg, Layer, Production, Quality, Whey.

INTRODUCTION

The use of liquid whey in poultry feeding has an area of great interest in layer poultry production. Whey is a milk by-product , separated during cheese and whey manufacturing and are considered as waste of dairy industry (Kumar *et al*., 2018). It is a greenish yellow liquid obtained after acid coagulation or rennet coagulation of milk. Whey contains high quality proteins with high digestible indispensable amino acid score (DIAAS) and are considered as very good sources of amino acids (Herreman *et al.,* 2020). Whey protein has most beneficial nutritional properties. Protein fraction in whey is typically a mixture of beta-lactoglobulin (65 %), alpha lactalbumin (25%) and bovine serum albumin (10%). α-La contains 63.2% essential amino acids of total content and lgs as 10% of total whey protein (Deeth and Bansal, 2019; Barone *et al.,* 2020). Carbohydrate part of whey consists of milk sugar lactose and fat consists of phospholipid. Energy content in acid whey is about 59 calories/100 ml and about 66 calories/100 ml in sweet whey.

Huge quantity of whey is produced daily by channa, paneer or cheese manufacturers and thrown away as waste due to lack of proper knowledge and low cost technology for its utilization in our country results in devastating environmental problems due to increase in BOD of sewage system because for small scale product manufacturers, processing or drying of whey for further utilization is a challenging process (Mehra *et al*., 2021; Rocha-Mendoza *et al*., 2021). Thus, it is considered as most pollutant by-product of dairy industry (Moreno-Indias *et al*., 2009; Bozanic *et al.,* 2014; Barukcic *et al*., 2019). Therefore, dairy industry, responding to the sustainability and environmental demands, are searching for the ways to reutilize whey, preferably in its liquid form (Mazorra *et al*., 2020).

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So, utilization of highly nutritious whey in poultry feeding may be a profitable solution of above. Unlike mammals, birds lack the enzyme lactase (B-galactosidase) required to digest lactose. Because lactose is not completely absorbed in the intestinal tract, it is fermented by microflora in the caeca producing lactic acid and volatile fatty acids, which decrease pH and suppresses the growth of pathogenic bacteria. There is also eggs of superior quality is prerequisite for profitable marketing and for hatchability too and so high in demand (Sinha *et al*., 2017). Maddheshiya *et al*. (2020) reported that chicken reared under backyard poultry production system has superior internal and external egg traits than the poultry

under cage system. So, there is need of improve management system under cage system for better egg quality. In light of above facts, the study was planned for utilizing whey as a water supplement with the objectives to evaluate its effect on egg production and quality in laying chickens.

MATERIALS AND METHODS

The present study was conducted on 120 Gramapriya layer chickens of 6 months of age at the poultry unit of Livestock Farm Complex, Bihar Veterinary College, Patna. The experimental period for layer chickens was from 5th May to 5th August 2021. The birds were randomly divided into 4 treatment groups having 30 birds in each group. They were further divided into three replicates having ten layer birds in each replicate and kept under deep litter system of management The birds were served balanced commercial layer ration and clean water in plastic container along with required amount of liquid sour whey as per treatment groups. The plastic container was cleaned twice daily with fresh water. The layers were reared under uniform condition of management. The commercial layer ration was supplemented to layer chickens for 90 days (7th month to 9th month). The treatments consisted of drinking water supplemented with liquid whey at 0 (control), 5, 10 and 15% levels on w/w basis. The recording and sampling procedure, adopted during the experimental period were as follows-

Feed intake

A daily record of the fresh feeds offered and weigh back was maintained for each group to calculate the feed consumption. Left over of feed was weighed weekly.

Feed conversion ratio (FCR)

The feed conversion ratio was calculated by using the formula given below:

$$FCR = \frac{\text{Total amount of feed consumed (g)}}{\text{Body weight gain (g)}}$$

Egg production

Number of eggs laid per day by each group was recorded by manually counting the eggs laid.

- **Egg weight**
- Average weight of eggs laid by each group was calculated by dividing total weight of eggs laid during the period with total number of eggs laid during the period. Six eggs randomly collected from each treatment groups were weighted.
- Egg quality in terms of shape index, shell thickness, Haugh unit and yolk index was calculated as follows-
- **Shape index:** Measured by using Vernier Calliper.

$$S.I = \frac{\text{Width}}{\text{Length}} \times 100$$

(as per Carter,1968)

Eggs shell thickness: Shell thickness (mm) with membranes was measured by using a micrometre.

- **Haugh unit:** Measured by using Spherometer (As per Stadelman *et al.,* 1988).
- **Yolk index:** Measured by using Spherometer. (as per Well,1968).

The statistical data obtained were analyzed statistically as per Snedecor and Cochran (1994) under a completely randomized design by analysis of variance (ANOVA) by using General Linear Model (GLM) procedure. Difference between treatments means were compared using Duncan's multiple range test.

RESULTS AND DISCUSSION

Egg production

The average egg production percentage differed significantly ($P<0.01$) among treatments (Table 1). Up to 60th day of experimental period, irregular trend in production % was observed among different treatment groups, but average production percentage up to 90 days, was found to be the highest in 5% group over other groups control, 10% and 15% respectively. Egg production increases up to 5% level of liquid whey supplementation but increasing the level beyond it again decreased the egg production. Sathya and Muragian (2015) and Lokapirnasari *et al.* (2017) reported that a suitable condition of the digestive tract increases the metabolic process and absorption of necessary nutrients for the body and also helps in increasing production performance in layer birds. Yang *et al*. (2018) reported that dietary changes in laying chickens effect egg production and egg quality.

Weight of egg (g)

Average egg weight in all the groups differed significantly ($P<0.01$) from each other (Table 1). It was observed that as the level of whey supplementation percentage increased, egg weight also increased up to 90 days study period and was found to be the highest in 15% supplemented group. The increased weight in treatment groups might be due to the positive effect of whey supplementation on egg size and weight. This concept is supported by many researchers. In a study, it was found that increase in egg weight and egg mass weight was highly significant ($P<0.01$) by the administration of fermented whey cheese (P1) compared to the control treatment (P0). Increased egg weight was related to the content of lactic acid bacteria in the digestive tract which might have inhibited pathogenic bacteria that used protein in the small intestine. This finding is in accordance with the findings of Chaucheyras-Durand and Durand (2009) and Guclu (2011) reported increase in egg weight by whey protein supplementation in layer birds. According to Huda *et al*. (2019), the utilization of lactic acid bacteria, which was applied to animal feed, could inhibit the growth of pathogenic microbes in the small intestine leading to

protein absorption and increase in egg weight. Further, Pradikta *et al*. (2018) explained that the absorption rate of food substances in the digestive tract would work better with the help of lactic acid bacteria; food substances contained in the feed, such as protein and amino acids, would be better absorbed in the body. This protein and amino acids would be used by chickens to produce eggs. According to Istinganah *et al.* (2013), the essential factor to influence egg weight was protein and amino acid content offered as about 50 per cent of the dry matter contained in eggs is protein, therefore amino acids supplements are essential in the process of egg formation. Egg mass and egg weight also appeared to increase after supplementation with prebiotic, probiotic and EO in the diet of layers (Olgun, 2016). Whey contains high quality protein alpha Lactalbumin and Beta Lactglobulin. These protein plays an important role as better absorption and immunity booster. When supplemented with water to the layer birds, it led to improve egg weight and egg protein due to better absorption and decrease in morbidity and mortality in the whey supplemented birds over control group. Zia *et al*. (2016) reported improvement in weight of egg by selenium -yeast supplementation in poultry ration @ 0.3 mg/kg.

Egg quality

Shape index of egg

The higher shape index was observed in the whey supplemented groups and was the lowest in control (Table 2). Although irregular increase was found among treatment groups up to 45th day of trail but later up to 90th day of trial there was progressive increase in average shape index of eggs and was found highest in 15% whey supplemented group. This finding is in accordance with the findings of Bouassi *et al*. (2021), who reported improvement in shape index of egg by prebiotics and whey supplementation.

Egg shell thickness

The variations were non-significant.

Albumen quality of egg

The average value of Haugh unit observed during 90 days of experimental period which varied from 75.0 to 93.66 (Table 2). On first day of study, although treatment groups showed higher and significantly different (P<0.05) average value than control but the treatment groups didn't differ significantly (P<0.05) among themselves. On 15th day of study, numerically higher average value was observed in 15% group followed by 10%, 5% and control group. But the differences were non-significant. On 30th and 45th day of study, it followed the same trend as first day of study. On 60th, to 90th day of study, significantly different (P<0.01) average value was observed in treatment groups than control but the treatment groups didn't differ significantly among themselves. The lowest value for Haugh unit was found in Control and highest value was observed in 10% among all treatment groups up to 30th day of experiment. After that up to 90th day highest value was observed in 15% and lowest in control. All treated samples differed significantly (P<0.01) from control but didn't differ significantly among themselves. Higher the value of Haugh unit better is the egg albumen quality. In this experiment, egg quality improved upon supplementation of whey up to a level of 15 per cent up to 90 days of experiment.

Yolk quality of egg

The average value for yolk index was found to be varied from 0.29 to 0.44 in different treatment groups from first to 90th day of study period (Table 2). On 1st day of experiment, highest value was observed at 5% level and rest other treatment groups showed same value. On 15th day highest value was observed at 10% level but after that highest value was observed in 15% group and lowest in control group. On 90th day, 5% level gr showed similarity with other

Table 1: Effect of different levels of whey supplementation on egg production percentage and egg weight (g) of layer chicken.

Parameters	Egg production %			
Days	Treatments			
	0%	5%	10%	15%
1st-15th Day	57.66^{c}±0.33	60.50^{d}±0.28	53.22^{b}±0.11	51. 23^{a}±0.08
16th-30thDay	56.22^{b}±0.12	61.17^{c}±0.09	56.46^{b}±0.10	49.39^{a}±0.23
31st-45thDay	59.35^{b}±0.17	63.25^{c}±0.08	59.21^{b}±0.06	55.45^{a}±0.19
46th-60th day	55.27^{c}±±0.10	61.65^{d}±0.07	52.89^{b}±0.003	51.58^{a}±0.05
61st-75th day	62.60^{c}±0.07	64.58^{d}±0.16	54.78^{b}±0.06	54.14^{a}±0.03
76th-90th day	61.43^{c}±0.06	61.83^{d}±0.04	54.39^{b}±0.05	51.49^{a}±0.04
Egg weight (g)				
1st-15th Day	49.93^{a}±0.31	49.08^{a}±0.10	52.08^{b}±0.38	53.10^{b}±0.26
16th-30thDay	52.50^{a}±0.25	52.80^{a}±0.10	53.65^{b}±0.32	54.16^{b}±0.08
31st-45thDay	54.00^{a}±0.11	54.53^{a}±0.14	55.70^{b}±0.05	56.46^{c}±0.26
46th-60th day	54.76^{a}±0.14	56.09^{a}±0.32	57.85^{b}±0.10	58.05^{b}±0.02
61st-75th day	55.36^{a}±0.28	57.73^{b}±0.17	58.20^{b}±0.15	59.92^{c}±0.11
76th-90th day	56.90^{a}±0.45	58.30^{b}±0.05	59.66^{c}±0.20	61.10^{d}±0.20

Means with different superscripts in a row differ significantly (P<0.01).

Table 2: Effect of different levels of whey supplementation on egg quality of layer chicken.

Parameters	Egg quality parameters			
Days	Treatments			
	0%	5%	10%	15%
Shape index				
1st day	84.40±0.64	84.97±1.82	84.47±2.19	85.60±1.51
15th day	85.80±0.64	87.23±0.04	87.13±1.6	87.97±1.34
30th day	86.33±0.63	88.17±0.59	88.83±2.3	89.10±0.90
45th day	87.60±0.74	87.73±1.5	88.07±2.6	90.30±1.6
60th day	89.53±0.46	89.93±1.2	90.37±1.2	90.93±0.63
75th day	89.13±0.48	91.30±0.60	92.50±1.1	93.03±1.69
90th day	90.47±0.69	92.47±1.2	92.87±1.3	93.07±0.46
Albumen quality (Haugh unit)				
1st day	75.0^{a}±1.101	85.10^{b}±1.83	85.06^{b}±1.69	85.23^{b}±0.54
15th day	77.36 ±0.54	86.30±0.21	86.53 ±1.04	87.26±1.24
30th day	77.76^{a}±0.73	87.20^{b}±1.21	88.26^{b}±2.10	87.70^{b}±0.92
45th day	79.23^{a}±0.17	87.80^{b}±1.66	88.80^{b}±0.41	89.13^{b}±0.54
60th day	80.06^{a}±0.29	89.26^{b}±1.09	90.43^{b}±1.16	92.40^{b}±1.21
75th day	80.43^{a}±0.08	89.10^{b}±0.60	91.70^{b}±0.70	92.36^{b}±1.33
90th day	81.10^{a}±0.45	93.13^{b}±0.06	93.20^{b}±0.72	93.66^{b}±0.29
Yolk index				
1st day	0.29±0.005	0.30±0.008	0.29±0.005	0.29±0.005
15th day	0.30^{a}±0.005	0.29^{a}±0.008	0.33^{b}±0.005	0.29^{a}±0.005
30th day	0.30±0.006	0.31±0.008	0.32±0.005	0.33±0.005
45th day	0.32±0.006	0.34±0.011	0.35±0.008	0.36±0.005
60th day	0.35^{a}±0.005	0.37^{b}±0.006	0.38^{b}±0.006	0.38^{b}±0.00
75th day	0.39±0.006	0.39±0.011	0.41±0.003	0.42±0.008
90th day	0.39^{a}±0.003	0.41^{ab}±0.008	0.42^{b}±0.003	0.44^{b}±0.005

Means with different superscripts in a row differ significantly (P<0.01).

treatment groups, but 10% and 15% level group didn't differ significantly from each other. Although yolk index was numerically higher in 15% supplemented group and lowest in control group, however on first, 30th, 45th and 75th day, the differences were non-significant among all treatment groups. This present study shows similarity with the findings of Youssef *et al.* (2013), who reported improvement in egg quality by prebiotics and organic acids treatment.

CONCLUSIONS AND APPLICATION

Liquid whey can be supplemented to layer poultry with drinking water for better egg production at 5% level and for quality egg production at 15% level. Further study may be carried out to improve egg production by dietary supplementation of whey in different forms.

Ethical issues

Yes, the approval of Institute's Animal Ethics committee's was obtained.

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Data availability statement

Data is contained within the article.

Institutional review board statement

NA

Informed consent statement

NA

Conflict of interest

The authors declare that there is no conflict of interest any regarding the publication of paper.

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