Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2018; 6(2): 711-714

Received: 04-01-2018
Accepted: 07-02-2018

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Effect of incorporation of bovine colostrum in broiler chicken diets on body weight, mortality pattern and economics of production

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Abstract
A biological trial was conducted on 192, three days old commercial broiler chicks, distributed randomly into four treatment groups of 4 replicates of 12 birds each, reared for a period of 35 days. The first treatment group (T_1) was taken as control group and offered basal diet without any additive. The other three treatment groups (T_2, T_3 and T_4) were fed diets supplemented with 1, 1.5 and 2 % bovine colostrum/kg feed, respectively. The treatment groups offered diets supplemented with bovine colostrum showed significantly higher body weight with the highest body weight recorded in T_4. The final body weights recorded at the end of the trial period were 1503.04±25.16, 1577.99±35.99, 1675.86±77.21 and 1897.02±37.51 in groups T_1, T_2, T_3 and T_4 respectively. There was a significant reduction in mortality percentage across the treatment groups. An overall mortality of 11.43% was recorded during the trial. The highest overall mortality being recorded in T_1 (19.23%) and lowest in T_4 (2.5%). T_2 and T_3 showed a mortality percentage of 16.92 and 3.77 respectively. There was a positive impact on the economics of production, thus increasing the profit margins. Economic analysis revealed that the cost of feed/kg body weight gain was Rs 78.20, 73.50, 69.58 and 66.60 in T_1, T_2, T_3 and T_4 respectively. T_2, T_3 and T_4 had a relative advantage of Rs 4.70, 8.62 and 11.60 respectively as compared to control T_1. Thus, it was concluded that bovine colostrum could be incorporated in broiler diets @ 2% for better body weight at market age, reduced mortality percentage and improved the overall economics of production.

Keywords: Broilers, Bovine colostrum, body weight, mortality, economics

1. Introduction
The Poultry industry has been recognized as the fastest growing segment of the Indian agricultural sector. Most of this growth could be attributed to commercial broiler and layer enterprises that have come up since early eighties. The broiler industry in particular is growing very fast. The current strength of broilers in India is estimated to be 2300 million with the broiler meat production of 2.6 million tons thus making India the 5th largest poultry meat producer in world (Anonymous, 2014).

Poultry production, particularly broiler production is the quickest way to increase the availability of high quality protein for human consumption. Since the feed cost alone contributes to about 70-75% of the total cost of production, economically poultry production is, therefore, possible only when the feed cost is reduced and efficiency of feed utilization is increased [17]. Several studies have shown that use of feed additives considerably reduces feed cost and economises production in broiler chicken either by improving body weight, FCR or both and decreasing mortality percentage. Additionally, the efforts are on to identify and use various feed additives/ nutraceuticals/ bio-active compounds to optimize nutrient utilization, by favorably altering the intestinal microflora and intestinal micro architecture and by enhancing the immunity of the birds so as to prevent the losses on account of morbidity and mortality.

Colostrum is the "early" milk produced by female mammals and in case of bovines it is the first four days of milk post parturition [7]. In addition to proteins, carbohydrates, fats, vitamins and minerals it contains various growth factors, cytokines and nucleosides. It is rich in oligosaccharides, natural antimicrobials, immune regulation factors [9] and anti-oxidative factors. Bovine colostrum contains immuno-globulins such as IgG, IgM, IgA, IgD, and IgE. IgG and IgM function in systemic infections while IgA functions within internal body surfaces such as the intestine (Muller and Ellinger, 1981).

When taken orally, the immuno-globulins in colostrum may not be absorbed into the blood stream. However, within the gastro-intestinal tract of animals of all ages they are very effective against pathogenic organisms. Colostral immunoglobulins are able to bind and agglutinate invading organisms such as bacteria, viruses, fungi and parasites that enter the intestinal tract, facilitating their removal before they cause infection and diseases (Oyenyi and Hunte, 1978). The immunoglobulins also prevent pathogens from binding to intestinal surfaces (Bitzan *et al.*, 1998) thereby inhibiting an important step in the infection process. Published reports have shown that colostrum and its components are effective against a wide range of common pathogens which include *Rotavirus*, *Cryptosporidium* spp., *Staphylococcus aureus*, *Candida* spp., *Clostridium* spp., *Feline immunodeficiency virus*, *Shigella* spp., *Streptococcus* spp. and *E.coli*.

Keeping in view the versatility of colostrum along with its immense food, nutritional and economic value, the present study was envisaged to study the effect of incorporation of bovine colostrum in broiler rations on body weight, mortality percentage and economics of production.

2. Materials and Methods

Bovine Colostrum from Six Crossbred Jersey Cows secreted immediately after calving was procured and stored in sterile containers in packs of 250 ml or less and frozen immediately till use. A biological trial duly approved by the Institutional Animal Ethics Committee (IAEC) was conducted on one hundred and ninety two, three days old commercial broiler chicks (Rathi cob) procured from a reputed hatchery and reared for a period of 36 days. The birds were reared on deep litter throughout the experimental period. The chicks were distributed randomly into four treatment groups (T_1, T_2, T_3 and T_4) and each treatment comprised of 4 replicates of 12 birds each. Group T_1 was offered basal diet comprising of commercially available broiler pre-starter and starter rations while T_2, T_3 and T_4 were offered basal diets supplemented with 1, 1.5 and 2% of colostrum/kg feed. All chicks were kept under the same managerial, hygienic and environmental conditions and had *adlibitum* access to feed and water throughout and were maintained on a constant 24 hours light schedule. All chicks were vaccinated against Ranikhet disease on the 5th day with F_1 strain vaccine and B_2K vaccine against Infectious Bursal Disease (IBD) on the 16th day.

2.1. Live body weight

The body weight of the experimental birds was recorded on the individual basis at weekly intervals.

2.2. Mortality

The chicks were checked twice daily for mortality, if any and the same was recorded.

2.3. Economics of production

The economics of production at the end of the experimental period were calculated using market prices of feed, colostrum, feed consumed and body weight gain.

Statistical Analysis

The analysis of the data was carried out by using Analysis of Variance (ANOVA). The data generated was classified treatment wise and averages were drawn. After performing statistical analysis the tests were referred by p-values. Any p-value less than 0.05 ($p<0.05$) was taken as statistically significant. The comprehensive statistical package for social sciences (SPSS ver.15.00) Chicago U.S.A. for Windows was used for analysis.

3. Results

3.1. Body Weight

The results of weekly live body weight of broiler chicken under different dietary treatments have been summarised in Table 1. The body weight after 1 week of feeding bovine colostrum (BC) incorporated diets showed an increasing trend from T_1 to T_4 but there was no significant difference between the groups. From 2nd week onwards, there was a gradual increase in body weight of colostrum fed groups compared to control, with significantly higher live body weight in the group fed 2% BC in the diet. At the end of 3rd week also, the group supplemented with 2% BC showed significantly higher body weight as compared to control group and also in comparison to other BC treated groups. Similarly at the end of 4th week, the group fed 2% BC supplemented ration showed significant increase in body weight as compared to the control group but no significant difference in body weight was noticed in comparison with other BC supplemented groups. The final body weight of the birds at the end of five weeks of feeding trial showed an increasing trend from T_1 to T_4 groups. Final body weight was significantly higher in the groups fed BC supplemented feed as compared to control. 2% BC supplemented group had significantly higher body weight than 1% and 1.5% BC supplemented groups as well.

3.2. Mortality

The weekly and overall mortality of the broiler birds subjected to different concentrations of BC in the feed is depicted in Table 2. An overall mortality of 11.43% was recorded during the trial. An increasing trend was seen in mortality in different weeks with a mortality of 1.90% in Ist week, 2.43% in 2nd week, 2.49% in 3rd week, 2.04% in 4th week and 3.13% in 5th week was recorded. The overall mortality across the groups however showed a decreasing trend with the highest overall mortality of 19.23% recorded in group T_1 and lowest of 2.5% in group T_4. Treatment groups T_2 and T_3 showed a mortality percentage of 16.92 and 3.77 respectively. Between the groups higher mortality was recorded in 5th week in group T_2 (5.26%) followed by T_1 (4.55%) and least in T_3 (1.92%). T_4 had 0% mortality during this period. The study revealed that BC supplementation resulted in lower mortality in birds and it was considerably lower in group T_4 supplemented with the highest percentage of BC (2%).

3.3. Economics

The economics of production of broiler chicken fed BC supplemented diet in different concentrations worked out on the basis of feed cost per kg live weight gain is depicted in Table 3. The feed cost/kg body weight gain was Rs 78.20, 73.50, 69.58 and 66.60 in groups T_1, T_2, T_3 and T_4 respectively. There was a relative advantage of Rs 4.70, 8.62, 11.60 per kilogram of live weight in groups T_2, T_3 and T_4 respectively as compared to the control group T_1. The economics worked out at the end of the trial based on feed cost/kg live weight indicated higher feed cost in the group not supplemented with BC (T_1) and least in the group supplemented with 2% BC (T_4). Feed cost/kg live weight thus showed a decreasing trend across the groups.

Table 1: Effect of incorporation of bovine colostrum in broiler chicken diet on Body weight and Body weight gain

Weeks of supplementation	Treatment groups			
	T_1 (0%colostrum)	T_2 (1%colostrum)	T_3 (1.5%colostrum)	T_4 (2% colostrum)
Body weight (g)				
0 day	96.29±1.04	94.03±1.12	96.21±1.00	96.92±0.82
1	274.69±2.90	274.34±1.98	276.16±4.53	280.74±5.13
2	534.37±10.22^{a}	530.89±9.96^{a}	550.96±5.11^{ab}	572.65±13.29^{b}
3	663.28±5.52^{a}	704.34±8.54^{b}	721.68±11.69^{b}	766.73±21.26^{c}
4	992.50±22.46^{a}	1085.47±57.16^{ab}	1140.56±63.68^{ab}	1201.92±100.52^{b}
5	1503.04±25.16^{a}	1577.99±35.99^{ab}	1675.86±77.21^{b}	1897.02±37.51^{c}

Means within the same row with different superscripts are significantly different ($p \leq 0.05$)

Table 2: Effect of incorporation of bovine colostrum in broiler chicken diet on mortality (%)

Age in weeks	Treatment groups				Overall
	T_1 (0%colostrum)	T_2 (1%colostrum)	T_3 (1.5%colostrum)	T_4 (2% colostrum	
0-1	3.85	3.08	0.00	0.00	1.90
1-2	4.00	1.59	1.89	2.55	2.43
2-3	4.17	4.84	0.00	0.00	2.49
3-4	4.35	3.39	0.00	0.00	2.04
4-5	4.55	5.26	1.92	0.00	3.13
0-5	19.23	16.92	3.77	2.5	11.43

Table 3: Effect of incorporation of Bovine Colostrum in broiler chicken diet on Economics of production

	Treatment groups			
	T_1 (0% colostrum)	T_2 (1% colostrum)	T_3 (1.5% colostrum)	T_4 (2% colostrum
FCR	2.30	2.10	1.96	1.85
Cost of Basal Feed (Rs)/Kg	34	34	34	34
Cost of Colostrum (Rs)/Kg of feed	0	1.00	1.50	2.00
Total Cost of Feed (Rs/Kg)	34	35.00	35.50	36.00
Feed Cost/Kg live wt gain (Rs)	78.20	73.50	69.58	66.60
Difference in Feed cost/Kg live wt gain (Rs) as compared to control	-	4.70	8.62	11.60

4. Discussion

In the present study, significant ($p \leq 0.05$) difference in body weight was observed in the group supplemented with 2% BC (T_4). A similar study was conducted which resulted in higher body weight at day 7 and 13 in immunmilk fed birds as compared to the control [18]. Also a patent, that stands filed at US patent office with regards to use of a feed additive containing bovine colostrum claims that incorporation of this feed additive enhances growth in broiler chicken [3]. Some of the growth promoting proteins that have been identified in colostrum include insulin-like growth factors (IGF) 1 and 2[6,22], transforming growth factor (TGF-B) [15], platelet derived growth factor (PDGF) like molecule termed as colostral growth factor [21], and angionin [4]. It is therefore possible that the colostrum improves growth and integrity of the intestinal tract thereby allowing better nutrient absorption and utilization resulting in higher body weight and body weight gain [18]. However, there was no effect of feeding spray-dried colostrum on body weight of chick [10].

The results with respect to mortality revealed that BC supplementation resulted in lower mortality in birds and it was considerably lower in group T_4 supplemented with highest percentage of BC (2%). Our results are in agreement with those of other workers who found similar results in other animals. An increased survival rate in weaned piglets was reported on BC supplementation [23]. A better steady-state of red kids after supplemental intake of colostrum has also been reported by some workers [1, 13]. This may be directly associated with the presence of various nutrients in colostrum. Besides providing energy and protein, the supplementation of colostrum probably helped bringing additional levels of vitamins (A and E) and minerals (zinc, selenium and iodine) which gave animals a way to develop and maintain a stronger immunity [12, 20]. Colostrum is also rich in lactoferrin, which plays an important role in defending the body against pathogens [2, 5, 20]. In addition, colostrum provides at low concentration polypeptidic compounds such as cytokines (IL-1, IL-6, IFN-7 and IL-1) belonging to the family of specific and non-specific antimicrobial factors [8].

The results of economics worked out at the end of the trial based on feed cost/kg live weight indicated higher feed cost in the group not supplemented with BC (T_1) and least in the group supplemented with 2% BC (T_4). This could be a direct consequence of increased weight gain and improved FCR noted in the groups subjected to BC supplementation. Thus, addition of feed additives to the broiler diets economises the production cost as investigated by various workers. The effect of six commonly available commercial feed additives on the performance of the broilers was studied and the ration having no feed additive (control) was found to be the most uneconomical [16]. Similarly, the addition of commercial and natural (skimmed milk and whey) probiotics to broiler diets improved the average values of calculated economical efficiency [14]. Addition of phytogenics (Dandelion leaves and fenugreek seeds) to the broiler diet also resulted in reduction in feed cost/kg live weight as compared to the control [19]. The diet supplemented with whey protein was cheaper than the control and the highest profitability was recorded with the broiler chicks which received the highest percentage of whey protein among the various groups [11].

5. Conclusion

It was concluded that adding 2% bovine colostrum to broiler chicken diets had a positive impact on body weight of broiler chicken and reduced mortality percentage thereby resulting in improved overall economics of production.

6. Acknowledgement
Division of Livestock Production and Management, FVSc and AH, SKUAST-K, Shuhama, Kashmir.

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