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Wheat Distillers Dried Grains with Soluble Improved the Immunity and Cost Economics of Broiler Chicken

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ABSTRACT

A non-conventional feed ingredient that has got impressive consideration is Distillers Dried Grains with Soluble (DDGS), obtained by dry and wet processing of grains after fermentation in ethanol industry. This can be used as an economical source of protein in animals and chicken. In order to asses the effect of wheat DDGS supplementation in broiler chicken, ninety numbers of day-old Red Cornish broiler chicks randomly divided into three groups consisting thirty birds in each. Each group consisted of three replicates having ten birds in each. Group T1 served as control (without any DDGS supplementation), whereas birds in groups T2 and T3 were supplemented with 15% and 30% DDGS in the basal diet. The isonitrogenous and isocalorific feeds were supplemented for 5 weeks. Weekly body weight changes, feed intake, feed conversion ratio were measured. At the end of the experiment, the immunity and cost of production was evaluated. The cellular immune response of broiler chickens to PHA-P and antibody titre to Ranikhet disease vaccine was significantly ($P<0.05$) higher in treated group than unsupplemented control birds. The total feed cost per bird was significantly reduced in the wheat DDGS supplemented birds than control. The present results confirmed that 30% wheat DDGS in the basal diet improved the immunity and reduced the cost of production in broiler chicken.

Key words: Body weight, Chicken, DDGS, Economics, Immunity

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INTRODUCTION

Feed cost constitutes nearly about 65-70% of total cost of production in broiler chicken. Therefore, any fluctuation in the price of feed will directly affect the price of poultry production. Among the feed sources, soybean is most commonly used protein source in poultry ration. A large gap has been noticed in the requirement and production of soybean since few years. Shortage of this major feed ingredients causes inflation of the feed cost due to imbalance in the demand and supply equation which leads to direct surge in the cost of production and hence the cost of the poultry products. Investigation and assessment of new elective feed ingredients and their proficient use ought to be a continuous process to conquer the issue of feed shortage. Attributable to this, look for under or unutilized unconventional feeds like Distillers Dried Grains with Soluble (DDGS) that can be used as a source of protein in chicken (Swain et al., 2014). DDGS supplementation up to 15% in the broiler ration had no significant effect on the performance of birds (Swiatkiewicz and Korelski, 2008; Choi et al., 2008). But supplementation at higher level may be economical to the broiler industry. Keeping this in view with paucity of work done, an attempt has been made to assess the effect of graded levels of wheat DDGS supplementation on the performance of broiler chicken.

MATERIALS AND METHODS

The present research was conducted in ninety numbers of day-old Red Cornish broiler chicks, randomly divided into three groups consisting thirty birds in each group. Each group consisted of three replicates having ten birds in each. Group T1 served as control (without any DDGS supplementation), whereas birds in groups T2 and T3 were supplemented with 15% and 30% wheat DDGS in the basal diet respectively. Birds were reared in deep litter system and were given feed and water ad lib. Broiler birds were fed iso-nitrogenous and iso-calorific pre-starter feed (1-14 days), starter feed (15-21 days) and finisher feed (22-35 days). Wheat DDGS procured from the local beverages of Khordha district of Odisha were sun dried and incorporated at 15 and 30% level in the basal diet. calculated at weekly interval by subtracting the leftover feed from the total feed supplied during that week. Feed intake from the first week to the fifth week is the cumulative feed intake. FCR was calculated using standard formula.

At 5^{th} weeks of age, ten birds from each dietary treatment were injected intra-dermally in the right foot web with 100 micro gram of Phytohaemagglutinin-P (PHA-P) in 0.1 ml of normal saline (Edelman et al., 1986). The thickness of foot web was measured using digital calliper before injection and 24h post injection and cutaneous basophilic hypersensitive (CBH) response was calculated using the formula:

Table 1. Ingredient composition (%) of basal diet

Ingredients (%)	Pre-starter (%) (1-14 day)			Starter (%) (15-21 day)			Finisher (%) (22-35 day)		
DDGS	0.00	15.00	30.00	0.00	15.00	30.00	0.00	15.00	30.00
Maize	51.50	43.72	35.70	53.50	44.80	36.60	56.50	48.70	40.89
Soyabean meal	43.00	35.38	28.00	39.00	32.40	25.30	35.00	27.50	19.91
Vegetable oil	2.00	2.40	2.80	4.00	4.30	4.60	5.00	5.30	5.70
Dicalcium phosphate	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Limestone	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
DL-Methionine	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
L-Lysine	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Vitamin and trace mineral mixture*	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Common salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50

* Ca: 32%, P: 6%, Mn: 0.27 %, Zn: 0.26 %, I: 0.01 %, Cu: 0.01 %, Fe: 0.01 %, Vitamin A (retinyl acetate): 82500 IU, Vitamin B2 (Riboflavin): 50 mg, Vitamin D3 (cholecarciferol): 16500 IU, Vitamin K3 (menadione dimethyl pyrimidinol): 10, mg, Folic acid: 10 mg, Vitamin E (dl-á-tocopheryl acetate): 200 mg, Se: 400 ìg, Vitamin B1 (thiamin mononitrate): 4 mg, Vitamin B6 (pyridoxine): 8 mg, Vitamin B12, (cyanocobalamin): 40 ìg, Calcium pantothenate: 40 mg, Niacin (niacinamide): 60 mg

The experimental feed was analysed for proximate principles and phosphorus content as per AOAC (1995). Calcium was measured according to the method of Talapatra et al. (1940). Individual body weights of the Red Cornish birds were measured by using electric balance at different weeks of the experiments. The initial body weight was subtracted from final to get the BW gain. Feed intake was

$$\text{CBH response} = \frac{\text{Post injection skin thickness}}{\text{Pre-injection thickness}} \times 100$$

The humoral immunity was assessed from the antibody production against Ranikhet disease vaccine by using micro titration hemagglutination (HA) technique. Data obtained were subjected to one-way analysis of variance using Software

Package for Social Sciences (SPSS) version 17.0 (2008) and comparison among treatment means was made by Duncan's multiple range test (Duncan, 1955) with significance level of P<0.05.

RESULTS AND DISCUSSION

The ingredients and chemical composition of the experimental diets were presented in Table 1 and Table 2 respectively. The diets were made isonitrogenous and isocalorific by incorporating feed ingredients at different ratios. The crude protein content (%) of the broiler pre-starter, starter and finisher ration were as per the ICAR (2013) requirement. The weekly body weight (g) of broiler birds were similar (P<0.05) among all the treated groups indicated that supplementation of DDGS @ 30% in the diet of broiler chicken had no significant (P>0.05) effect on the body weight gain of the birds (Table 3). Wang et al. (2007) observed that supplementation of 0, 5, 10, 15, 20, or 25% DDGS had no negative impact on body weight gain. Experiment conducted by Youssef et al. (2008) concluded that diet containing 0,5,10, 15% DDGS had no significant effect on body weight gain. Damasceno et al. (2020) concluded that 160g DDGS/kg in ration had no significant effect on body weight gain in birds. Dry matter metabolizability, nitrogen retention, gross energy metabolizability were not affected in birds supplemented with DDGS may be the attributing factor for non significant change in the body weight gain of birds (Kumar et al., 2017).

As regard to cumulative feed intake and FCR, no significant effect was observed among the treatments (Table 4 and 5). Similarly, Choi et al. (2008) and Hassan et al. (2015) observed non-significant difference in feed intake and FCR in broiler birds supplemented with 0, 5, 10 and 15% DDGS. Damasceno et al. (2020) provided 0, 10, 40, 70, 100, 130 and 160g DDGS/kg to broiler up to 21 days and concluded that there was no significant difference in feed intake and FCR across all treatment groups.

Table 2. Proximate composition of the basal diet (% DM basis)

Nutrients (%)	Pre-starter (%)			Starter (%)			Finisher (%)		
	0% DDGS	15% DDGS	30% DDGS	0% DDGS	15% DDGS	30% DDGS	0% DDGS	15% DDGS	30% DDGS
Crude protein	24.9	24.8	22.4	22.4	22.7	22.8	20.3	20.7	20.8
Ether extract	2.86	2.97	3.24	3.52	3.62	4.37	3.56	3.87	3.96
Crude fibre	5.24	5.43	5.68	6.21	6.36	6.48	6.24	6.45	6.61
Total Ash	9.30	9.69	9.97	9.75	9.43	9.88	9.36	9.39	9.42
Nitrogen free extract	57.6	57.0	58.6	58.0	57.8	56.4	60.5	59.5	59.1
Ca	1.18	1.17	1.18	1.32	1.32	1.36	1.25	1.24	1.26
P	0.46	0.48	0.45	0.42	0.44	0.42	0.47	0.47	0.46
ME(Calculated, Kcal/Kg)	2902	2921	2917	2986	2979	2995	3048	3037	3042

Table 3. Body weight changes (g) in experimental birds

Age (week)	Treatment			P Value
	T1	T2	T3	
Initial	41.8±0.66	42.1±0.90	41.6±0.94	0.930
1st week	121±2.81	120±3.30	125±3.77	0.480
2nd week	278±5.53	280±5.32	278±5.30	0.920
3rd week	545±6.31	541±5.06	547±7.13	0.800
4th week	855±15.34	849±13.89	860±12.14	0.860
5th week	1355±19.67	1360±12.13	1360±10.18	0.907

Table 4. Cumulative feed intake (g) in Red Cornish birds

Age (week)	Treatment			P Value
	T1	T2	T3	
1st week	118±0.71	114±1.96	124±2.55	0.090
2nd week	378±5.33	388±4.43	384±3.12	0.260
3rd week	862±9.64	877±7.48	862±9.97	0.410
4th week	1451±23.76	1442±9.98	1479±15.47	0.315
5th week	2446±25.57	2445±12.05	2417±26.10	0.580

Table 5. Cumulative FCR in Red Cornish birds

Age (week)	Treatment			P Value
	T1	T2	T3	
1st week	1.51±0.05	1.49±0.07	1.52±0.08	0.953
2nd week	1.61±0.05	1.64±0.04	1.64±0.04	0.880
3rd week	1.71±0.03	1.76±0.02	1.71±0.03	0.337
4th week	1.79±0.05	1.80±0.04	1.81±0.03	0.937
5th week	1.87±0.03	1.86±0.02	1.83±0.02	0.633

Table 6. Immunity status of broiler chicken (5th week)

Age (week)	Treatment			P Value
	T1	T2	T3	
Cutaneous Basophilic Hypersensitive response (%)	161±19.33[a]	183±14.87[a]	216±16.48[b]	0.02
Hemagglutination (Log 2)	5.73±0.21[a]	6.89±0.19[b]	6.79±0.18[b]	<0.01

*Mean values bearing different superscripts within row and column different significantly (P<0.05)

The cellular immune response of broiler birds in terms of cutaneous basophilic hypersensitive (CBH) against PHA-P was significantly higher in 30% wheat DDGS supplemented birds than other two groups. Similarly, the influence on the HA titers (log_2) against Ranikhet vaccine inoculation was significantly (P<0.05) higher in wheat DDGS supplemented birds than control birds (Table 6). Barekatain et al. (2013) noticed increased level in IgA and IgG titer in birds after inclusion of DDGS in diet @ 20% under a necrotic enteritis disease condition. Min et al. (2015) concluded that 15% DDGS in diet enhanced IgA, IgG levels in blood. Alizadeh et al. (2016) suggested that DDGS @ 10% in diet had immunomodulatory action. Gupta et al. (2017) stated that supplementation rice DDGS @ 7.5 and 10% in layer diet significantly enhanced the hemagglutinins antigen titre (HA) but Cell mediated immune response to PHA-P remained unaffected. Increased immunity may be a result of increased small intestinal goblet cells, enhanced secretion of mucus and reducing pH of the intestinal cells leading to increased production of antibodies and lymphocytes in DDGS supplemented birds (Lamsal et al., 2012).

The economics of chicken production in the present experiment was calculated by taking the cost of chick, feed and miscellaneous (litter, vaccine, medicine etc.) cost into consideration (Table 7). It has been found that the net profit/bird and net profit/kg was better in wheat DDGS supplemented birds (T2 and T3) as compared to control group of birds. These findings were in agreement with Choi et al. (2008), who reported that use of DDGS in diet @ 10% could decrease feed cost without any adverse effect. Lukaszewicz and Kowalczyk (2014) found that incorporation of DDGS up to 15% in broiler diet led to reduce the feed cost. Similarly, Borah et al. (2019) observed that the cost of production was lower in DDGS supplemented bird @ 10% than control group of birds. Similarly, Ghazalah et al. (2011) had observed that inclusion of DDGS (25% or 50% or 75%) as a replacement for soybean meal linearly reduced feed cost in hens.

Table 7. Cost of production of experimental chickens

Sl. No.	Parameters	Treatments		
		T1	T2	T3
1.	Cost of day old chick (Rs)	30.0	30.0	30.0
2.	Feed consumption (g)			
i)	Pre-starter	118	114	124
ii)	Starter	743	762	737
iii)	Finisher	1584	1568	1555
	Total	2446	2445	2417
3.	Rate of feed (Rs. /Kg)			
i)	Pre-starter	35.1	33.8	32.1
ii)	Starter	36.9	35.8	34.6
iii)	Finisher	37.2	35.8	34.5
4.	Cost of feed consumed (per bird Rs.)			
i)	Pre-starter	4.16	3.87	4.01
ii)	Starter	27.4	27.3	25.5
iii)	Finisher	58.9	56.1	53.7
	Total cost of feed consumed per bird (Rs.)	90.5	87.4	83.3

Sl. No.	Parameters	Treatments		
		T1	T2	T3
5	Miscellaneous cost	30.0	30.0	30.0
6	Total cost of production (1+4+5)	150.5	147.4	143.3
7	Average live weight (g)1355.2	1360.2	1360.4	
	Sale price @ Rs. 120 per kg live weight	162.6	163.2	163.2
8	Net Profit/Bird (Rs.)	12.0	15.8	19.9
9	Net profit/ Kg (Rs.)	8.92	11.63	14.65

CONCLUSION

It may be concluded that wheat DDGS can be incorporated upto 30% in the ration of chicken with increased immunity and reduced cost of production in birds.

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