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EFFECT OF FEEDING CORN DISTILLERS DRIED GRAINS WITH SOLUBLES AND ENZYME SUPPLEMENTATION ON IMMUNE RESPONSE AND NUTRIENT UTILIZATION

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Abstract: The present experiment was conducted on 420 straight run Vencobb-400 commercial day-old broiler chickens from 0-42 days. The chicks were randomly distributed into seven dietary treatments groups with three replicates of 20 birds each. The birds in control group (A) offered basal diet adequate in all nutrients as per BIS, (2007). The birds in dietary treatment groups B, C and D were offered diet containing corn distillers dried grains with soluble (cDDGS) at 5, 10 and 15% level and birds in groups E, F and G were offered diet cDDGS at 5, 10 and 15% level with enzyme @ 400g/ton of feed (DSM, Mumbai), respectively. The antibody titers against ND (log2 values) at 3rd and 6th week of age in broilers fed different levels of cDDGS with or without enzyme were non-significant in all treatment groups. At 3rd week of age antibody titer values were numerically higher in treatment groups receiving diet at 5 and 10% cDDGS with or without enzyme as compared to control group. The statistical difference was non-significant for IBD titers at 3rd week of age in all treatment groups, whereas diet containing 5 and 10% cDDGS with enzyme showed higher IBD titers as compared to control group A. However, the IBD titers at 6th week of age in treatment group D receiving diet with 15% cDDGS was reduced significantly as compared to control group and groups B, E and F. There was non-significant difference for nutrient utilization in all treatment groups. The nutrient utilization was numerically improved in enzyme supplemented groups as compared to non-enzyme supplemented groups. The inclusion of 5 and 10% cDDGS with or without enzyme showed improved nitrogen retention as compared to control group but the difference was non-significant. It may be concluded that the inclusion of cDDGS up to 10% levels in broiler diets with or without enzyme was found to be beneficial in terms of immune response and nutrient utilization in broiler chickens.
Keywords: Corn DDGS, enzyme, immune response, nutrient utilization, broilers.

INTRODUCTION

Ethanol in India, is manufactured from the starch content of cereal grains (bajra, barely, corn, rice, sorghum, triticale and wheat), by wet processing or dry processing. Several cereals grains are used in India to produce ethanol. Although corn is the major grain used in alcohol production, wheat, barley, rice and sorghum (milo) may also be used. The DDGS type

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available in India are DDGS barely, DDGS bajra, DDGS corn, DDGS rice, DDGS sorghum and DDGS wheat. Among all these the DDGS rice is predominant one and available in more quantity than other type of DDGS. The DDGS from corn, rice and sorghum has 29-30%, 38-53% and 26-27% protein, respectively (Nutrinomics, Advanced Bio-Agro Tech Limited, Pune, 2013). Investigations have been conducted on the possibility of using DDGS in feed for various animal species, including broiler chickens (Swiatkiewicz and Koreleski, 2007; Thacker and Widyaratne, 2007; Swiatkiewicz and Koreleski, 2008). These studies indicated that soybean meal in a feed may be replaced partially by DDGS without affecting production level. However, concern has been raised towards balancing of the diet in respect of amino acids and energy and in respect of ensuring quantities of minerals and vitamins. An increase in ethanol production during the last 5 to 10 years has led to an increased supply of DDGS that is available for livestock feed (Noll *et al*., 2007). Researchers have reported that broilers can be fed 6% DDGS during the starter period (Lumpkins *et al*., 2004) and 12 to 15% DDGS during the finishing stage without affecting carcass composition or growth (Lumpkins *et al*., 2004; Wang *et al*., 2007). Furthermore, the DDGS are richer in fibre, protein and fat than the cereal source (Swiatkiewicz and Koreleski, 2008) and also contain significant amounts of non-starch polysaccharides (NSPs). The use of appropriate enzymes to hydrolyze these compounds can increase the nutritional value of DDGS and promote greater inclusion in poultry diets (Juanpere *et al.,* 2005). In view of the above facts the present investigation was planned to study the effect of feeding corn distillers dried grains with solubles and enzyme supplementation on immune response and nutrient utilization in broiler chickens.

MATERIALS AND METHODS

Experimental Design and Management of the birds

The experiment was conducted on 420 commercial day-old Vencobb-400 straight broiler chicks for 42 days. The birds were randomly distributed into seven dietary treatments groups with three replicates of 20 birds each. The birds in control group (A) offered basal diet adequate in all nutrients as per BIS, (2007). The birds in dietary treatment groups B, C and D were offered diets containing cDDGS at 5, 10 and 15% level and birds in groups E, F and G were offered diets cDDGS at 5, 10, and 15% level with enzyme (Ronozyme Max Act (GT), DSM, Mumbai) at recommended dose 400 g/ton of feed, respectively. The experimental design used for housing the broilers is presented in Table 1.

Table-1: The details of different dietary treatments using Corn DDGS with or without enzyme.

Treatment groups	Treatment group details	No. of birds/ replicate	No. of replicates	No. of birds
A	Control diet	20	3	60
B	Ration containing 5% Corn DDGS	20	3	60
C	Ration containing 10% Corn DDGS	20	3	60
D	Ration containing 15% Corn DDGS	20	3	60
E	Ration containing 5% Corn DDGS + enzyme	20	3	60
F	Ration containing 10% Corn DDGS + enzyme	20	3	60
G	Ration containing 15% Corn DDGS + enzyme	20	3	60
Total number of birds				**420**

*Enzyme @ 400g/ton of feed

The standard and uniform managemental practices were followed for all treatment groups throughout the experimental period. The birds were offered *ad-lib* fresh and clean drinking water throughout the experiment. The immunization against Ranikhet Disease (B1 strain) and Infectious Bursal Disease (IBD Intermediate strain) vaccination was carried out on 7^{th} and 14^{th} day, respectively, followed by booster doses on 21^{st} day and 28^{th} day through drinking water.

Procurement of Ingredients

The good quality feed ingredients were procured from local market for preparation of experimental diets. The corn DDGS was procured from Grainotch Industries Ltd., Aurangabad, Maharashtra, India. The chemical analysis of cDDGS was carried out as per AOAC, (1995) and presented in Table 2.

Table-2: Chemical analysis of corn DDGS (cDDGS)

Sr. No.	Nutrient	Percent (%)
1	Moisture	9.68
2	Crude protein	28.03
3	Crude fat	10.15
4	Total ash	4.55
5	Acid insoluble ash	0.39
6	Crude fibre	6.30
7	Salt	0.12
8	Total phosphorus	0.59
9	Calcium	0.40

Batal and Dale (2006) reported metabolizable energy in corn DDGS was 2906 kcal/kg and same was considered for the feed formulation. The enzyme (Ronozyme Max Act (GT)) was supplied by DSM, Nutritional Products India Pvt. Ltd., Mumbai, Maharashtra, India. The rations were formulated as per BIS (2007) for pre-starter, starter and finisher phases. All the diets were isocaloriec and iso-nitrogenous. The inclusion of various levels of cDDGS with partial replacement of soyabean meal and energy sources in different dietary treatments.

Data Collection

The birds under the experimental trials were assessed for the antibody titer against the New Castle Disease Virus (NCDV) and Infectious Bursal Disease (IBD). Two birds from each replicate and a total of six birds from each treatment group were randomly selected for the blood collection at the end of 3rd and 6th week of age. The blood samples were collected from wing vein from each bird. The serum was separated by centrifugation at 3000 RPM for 20 minutes and decanted into clean, sterile plastic vials and stored under deep freeze at –18º to –20ºC. These serum samples were used for Haemagglutination Inhibition (HI) test to detect the antibody titer against New Castle Disease Virus by Beta procedure (Allan et al., 1978). This was performed to evaluate, the humoral immune response of bird to viral antigen (NCDV Lasota strain) by beta procedure (constant virus diluted serum), utilizing 8HA unit of Lasota virus. The HA unit of NCDV (Lasota strain) were determined by the standard procedure by using micro HA- HI plate (Allan *et al.,* 1978). The serum was also used to specific antibody titers against Infectious Bursal Disease Virus (IBDV) as quantified by enzyme-linked immunosorbent assay (ELISA) kit at the end of 3^{rd} and 6^{th} week of age.

A metabolic trial was conducted for three consecutive days at the end of 6^{th} week of experiment. For metabolic trial two birds from each replicate and thus, six birds from each treatment group were taken randomly and caged individually giving pre-experimental period of two days. During metabolic trial, record of feed offered, leftover was maintained on daily basis. A representative sample of feed offered, leftover on everyday were collected for dry matter determination. All the excreta from each group will collected on polythene sheet over a period of 24 hours. A representative sample (1/10) of excreta was taken for nitrogen estimation in 10% H_2SO_4 solution to avoid the nitrogen loss. The excreta collected from each groups was oven dried at 80^0C for 72 hours till the constant weight for dry matter determination. The dried samples of three consecutive days were pulled and then thoroughly mixed, powdered and used for nitrogen analysis as per AOAC, (1995).

Statistical Analysis

All the generated data was subjected to statistical analysis by using Complete Randomized Design by Snedecor and Cochran, (1994). The treatment means were compared by Critical Differences (CD) and Analysis of Variance.

RESULTS AND DISCUSSION

Immune Response

The antibody titers against ND (log2 values) at 3rd and 6th week of age in broilers fed different levels of cDDGS with or without enzyme were non-significant in all treatment groups (Table 3). At 3rd week of age antibody titer values were numerically higher in treatment groups receiving diet at 5 and 10% cDDGS with or without enzyme as compared to control group. The finding are in accordance with Dora *et al.* (2013) reported that the specific immunity against avian influenza disease virus (AIDV) titer was significantly increased when using 10 % CDDGS with Galzym supplementation in the diets after vaccination as compared to other experimental samples. Also, there were insignificant differences in the Newcastle disease virus (NDV) titer after vaccination among all the experimental treatments. Nguyen *et al.* (2004) also reported that the inclusion of 10% beer by-product in the diet increased the antibody titre against Newcastle disease when the birds were aged 9 weeks, but not when they were aged either 4 or 12 weeks.

The statistical difference was non-significant for IBD titers at 3rd week of age in all treatment groups, whereas diet containing 5 and 10% cDDGS with enzyme showed higher IBD titers as compared to control group A. However, the IBD titers at 6th week of age in treatment group D receiving diet with 15% cDDGS was reduced significantly as compared to control group and groups B, E and F. The inclusion of 5% cDDGS with or without enzyme were improved the IBD antibody titers as compared to control group at 3rd and 6th week of age.

Similarly, Min *et al.* (2015) reported that dietary DDGS inclusion has the beneficial effects on immune functions for broilers to some degree.

Table 3. Antibody titers against ND (log2 values) and IBD at 3rd and 6th week of age in broilers fed different levels of cDDGS with or without enzyme.

Treatment groups	3rd week		6th week	
	ND titers	IBD titers	ND titers	IBD titers
A	5.00±0.37	1164.17±489.93	3.83±0.60	1780.17±172.55^{ab}
B	5.33±0.42	1071.50±183.40	4.00±0.82	1819.67 ±176.58^{ab}
C	5.17±0.48	967.83±211.03	3.33±0.56	1467.00±168.99^{bc}

D	4.33±0.42	659.67±69.93	2.83±0.65	1184.83±154.68c
E	5.67±0.49	1273.33±161.43	3.67±0.88	2260.17±149.46^{a}
F	5.33±0.49	1103.50±110.92	3.17±0.70	1774.00±117.60^{ab}
G	4.50±0.43	839.50±220.53	3.33±0.84	1489.50±298.67^{bc}
CD	NS	NS	NS	711.540**
CV%	21.616	41.561	51.931	26.895

Means bearing different superscripts differ significantly within a column. *P<0.05, **P<0.01

Nutrient Utilization

There was non-significant difference for nutrient utilization in all treatment groups (Table 4). The nutrient utilization was numerically improved in enzyme supplemented groups as compared to non-enzyme supplemented groups. The inclusion of 5 and 10% cDDGS with or without enzyme showed improved nitrogen retention as compared to control group but the difference was non-significant. Similarly, Swiatkiewicz *et al.* (2014) reported that DDGS can be included at a level of 120 (starter) or 180 g (finisher)/kg in the diet of broiler chickens without any detrimental effect on performance, and feed additives such as enzymes (xylanase+phytase), probiotic, and chitosan can increase the nutritional efficacy of the diets with a high level of DDGS. Min *et al.* (2011) also reported that supplementation of either basal diet with different levels of enzyme had no significant effects on excreta N content or AME, GE digestibility, or NR values. Moreover, the interaction between different levels of DDGS and enzyme levels on performance or nutrient utilization parameters were not significant. Bolu *et al.* (2015) also reported that the nutrients had highest retentions for broilers fed 10% dietary level of DDGS. Pirgozliev *et al.* (2016) Feeding DDGS did not influence (P>0.05) N-corrected metabolisable energy (AMEn), total tract dry matter (DMR) and nitrogen (NR) retention. However, enzyme supplementation improved (P<0.05) AMEn, AMEn intake, DMR and NR. Leytem *et al*. (2008) indicated that high levels of wheat DDGS in the diet increased the amount of nitrogen and phosphorus in the excreta which should be accounted for in manure management plans.

Table 4. Nutrient utilization in broilers fed different levels of cDDGS with or without enzyme

Particulars	**Treatment groups**							**CD**	**CV%**
	A	**B**	**C**	**D**	**E**	**F**	**G**		
Dry matter Intake	80.46	83.16	87.46	82.50	84.95	80.07	89.68	NS	16.844

(g/bird/day)	±3.99	±5.82	±5.20	±6.65	±5.87	±4.14	±7.82		
Faecal dry matter Excreted (g/bird/day	24.14 ±1.98	24.17 ±1.99	29.95 ±4.74	23.12 ±0.93	24.95 ±1.20	22.09 ±1.67	26.69 ±2.42	NS	23.798
Nitrogen Intake (g/bird/day)	2.74 ±0.14	2.80 ±0.20	2.98 ±0.18	2.68 ±0.22	2.76 ±0.19	2.69 ±0.14	2.94 ±0.26	NS	16.724
Nitrogen excreted (g/bird/day)	1.02 ±0.06	1.02 ±0.09	1.10 ±0.09	0.99 ±0.05	0.96 ±0.06	0.94 ±0.05	1.09 ±0.08	NS	16.856
Nitrogen retention (%)	62.86 ±0.65	63.59 ±1.06	63.09 ±1.17	62.32 ±1.80	65.03 ±0.86	64.85 ±0.99	62.64 ±1.30	NS	4.509
DMM (%)	70.15 ±1.39	70.94 ±1.38	66.38 ±3.33	70.80 ±3.11	70.39 ±1.11	72.27 ±1.94	69.97 ±1.68	NS	7.527

NS -Non-significant.

CONCLUSION

The results of the present experiment suggested that the inclusion of cDDGS up to 10% levels in broiler diets with or without enzyme was found to be beneficial in terms of immune response and nutrient utilization in broiler chickens.

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