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Sanganagoud B Biradar
M.V.Sc Scholar, Department of Poultry Science, Veterinary College Hebbal, Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka, India

Krishnamurthy TN
Professor and Head, Department of Poultry Science, Veterinary College Hebbal, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka, India

HC Indresh
Assistant Professor, Department of Poultry Science, Veterinary College Hebbal, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka, India

Suma N
Assistant Professor, Department of Animal Nutrition, Veterinary College Hebbal, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka, India

Corresponding Author:
Sanganagoud B Biradar
M.V.Sc Scholar, Department of Poultry Science, Veterinary College Hebbal, Veterinary, Animal and Fisheries Sciences University, Bidar, Karnataka, India

Effect of feeding rice distillers dried grains solubles on immune status in broilers

Sanganagoud B Biradar, Krishnamurthy TN, HC Indresh and Suma N

Abstract
The present study aimed to evaluate the effect of feeding rice distillers dried grains solubles on the immune status of broilers. A total of 128 day-old broiler chicks were divided into four treatments consisting of four replicates in each group and eight chicks in each replicate. The basal diet (T_1), formulated according to Bureau of Indian Standards guidelines (2007) standards and the experimental diets were prepared by incorporating rice DDGS at 5%, 10% and 15% (T_2, T_3 and T_4, respectively) to the basal diet. The result revealed that there was no significant enhancement in the immunological response against Newcastle disease and Infectious bursal disease and weight of immune organs among all groups and the control group on the 42nd day of the experiment.

Keywords: Rice DDGS, broiler, immunological response, immune organ

1. Introduction
The growth of the poultry industry is vital for addressing global nutrition needs, providing essential protein, vitamins, and minerals to billions of people worldwide. The accessibility of nutrient-rich foods like poultry becomes imperative in reducing malnutrition. Poultry meat and eggs offer a cost-effective and efficient means of delivering essential nutrients to diverse populations, particularly in regions where access to other protein sources is limited. Poultry farming, characterized by its shorter production cycles and efficient feed conversion rates, offers a buffer against food security risks. The contribution of livestock in total agriculture and allied sector GVA (Gross Value Added) has increased from 24.32% (2014-15) to 30.13% (2020-21). The livestock sector contributed 4.90% of the total Grass value added in 2020-21 (Ministry of Fisheries, Animal Husbandry and Dairying, 2023) [8]. India ranks third in egg and fifth in poultry meat production in the world (BAHS, 2023) [2].

The primary aim of poultry feeding is to transform low-quality feed resources, such as cereal grains, oil cakes, and agricultural and industrial byproducts, into high-quality meat and eggs. Corn and soybean meal are typically the main ingredients, constituting 70-80% of poultry feed. Despite the prevalence of these ingredients, there's a limited variety of feed components used in poultry diets. Hence, there's potential in partially substituting these ingredients with alternative options like millets, cottonseed meal, canola meal, guar meal, distiller's dried grains with soluble (DDGS), sunflower meal, etc., which offer low phytate levels and highly digestible nutrient profiles.

Distiller's Dried Grains with Solubles (DDGS) are derived from the spirit industry and the production of bioethanol. In India, ethanol is produced from the starch content of cereal grains such as bajra, barley, corn, rice, sorghum, triticale and wheat through either wet or dry processing methods. Wet processing yields starch, oil and gluten feed, while dry processing results in ethanol along with various co-products of the ethanol industry, including wet distiller's grain and DDGS. The rDDGs contain 45% and 40.17% crude protein, as reported by Talasani *et al.* (2021) [13] and Kaninde *et al.* (2023) [6], respectively. Dorra *et al.* (2013) [5] found that adding 10% corn distillers dried grains with soluble (C-DDGS) with enzyme improved specific immunity against avian influenza in broilers chick after vaccination, with no significant differences in Newcastle disease virus titres. The inclusion of rDDGS with enzyme supplementation up to a 15% level was found to be beneficial, without affecting immune response Khose *et al.* (2021) [7]. Singh *et al.* (2020) [10] observed experimental diets were

prepared through the incorporation of Rice-DDGS at an inclusion level of (0, 5, 10, 15 and 20%), respectively. The results showed that the weights of immunological organs such as the bursa, spleen, and thymus did not alter significantly due to the presence of rDDGS.

2. Materials and Methods

This experiment was conducted at the Department of Poultry Science, Veterinary College, Hebbal, Bengaluru. The study was approved in the Institutional Animal Ethics Committee of KVAFSU, Bidar, Karnataka. A total of 128 day old broiler chicks were procured from Venkateshwara Hatcheries Pvt. Ltd., Palamaner, Chittoor, Andhra Pradesh. The chicks were weighed, wing banded and allocated randomly to four experimental groups consisting of four replicates with eight chicks each. The control group T1 was fed soya bean meal as protein in the basal diet as per BIS (2007) [3]. The treatment groups T_2, T_3 and T_4 were fed with 5%, 10% and 15% rDDGS inclusion to basal diet respectively. T_2, T_3 and T_4 diets were formulated to meet isocaloric and isonitrogenous by manipulating the test diet inclusion level in the basal diet. Chicks were reared under a deep litter system up to six weeks of age, with the supply of *ad libitum* feed and water. The standard managemental practice was followed during the experiment. A standard vaccination schedule was followed for immunizing the birds.

2.1 Antibody titres against Newcastle and Infectious bursal disease

At the end of the experiment, blood samples were obtained from two birds in each replicate. Serum was extracted from the blood collected from the wing vein of the birds. Antibody titers against Newcastle disease virus and Infectious bursal disease virus were assessed using Hemagglutination followed by Hemagglutination Inhibition (Allan and Gough, 1974) [1] and an indirect ELISA kit, respectively, in the treatment groups.

2.2 Lymphoid organ weight

At the conclusion of the experiment, two birds from each replicate in every treatment group were euthanized and the weights of lymphoid organs such as the spleen, thymus and bursa of Fabricius were measured. These weights were then expressed as a percentage of the pre-slaughter weight (% of live weight).

The formula used for the calculation of percent relative weight of lymphoid organ is as follows

$$\text{Lymphoid organ weight (\%)} = \frac{\text{Lymphoid organ weight (g)}}{\text{Pre slaughter live weight (g)}} \times 100$$

The experiment was designed as a complete randomized design (CRD) with one-way analysis. All data related to various parameters of the biological trial were analyzed following the standard procedures outlined by Snedecor and Cochran (1994) [11], utilizing SPSS 20 statistical software. Differences between means were evaluated using Tukey's Range Test at a significance level of ($p \leq 0.05$).

3. Results

The results of the effect of feeding Rice distillers dried grains solubles (DDGS) on antibody titres against Newcastle disease, Infectious bursal disease and relative immune organ weight (% live weight) during 42nd day in broilers is presented in Table 1 and 2, respectively. The results revealed that there were no significant there were no statistically significant variation ($p>0.05$) observed in the antibody titers against Newcastle disease, Infectious bursal disease and relative immune organ weight (% live weight) among the rice DDGS incorporated diet groups in comparison to the control group.

At the end of 42nd day, the antibody titres against Newcastle disease (log_{10} HI titre) in groups T_1, T_2, T_3 and T_4 were 1.279, 1.242, 1.317 and 1.355, respectively. ANOVA indicated no significant ($p>0.05$) difference in antibody titres against Newcastle disease between various treatment groups compared to control. At the end of 42nd day, the antibody titres against Infectious bursal disease (ELISA titre) in groups T_1, T_2, T_3 and T_4 were 2318.63, 2256.50, 2269.63 and 2210.25, respectively. The statistical analysis indicated no significant ($p>0.05$) difference in antibody titres against Infectious bursal disease between various treatment groups compared to control.

The weight of spleen (% live weight) on 42nd day of the experiment in groups T_1, T_2, T_3 and T_4 were 0.139, 0.131, 0.135 and 0.131, respectively. ANOVA revealed no significant ($p>0.05$) difference in weight of spleen between the treatments compared to control.

The weight of thymus (% live weight) on 42nd day of the experiment in groups T_1, T_2, T_3 and T_4 were 0.355, 0.321, 0.342 and 0.332, respectively. ANOVA revealed no significant ($p>0.05$) difference in weight of spleen between the treatments compared to control.

The weight of bursa of Fabricius (% live weight) on 42nd day of the experiment in groups T_1, T_2, T_3 and T_4 were 0.117, 0.123, 0.121 and 0.117, respectively. The statistical analysis revealed no significant ($p>0.05$) difference in weight of bursa of Fabricius between the treatments compared to control.

4. Discussion

The results of the present study were in agreement with Dorra *et al.* (2013) [5] found that adding 10% corn distillers dried grains with soluble (C-DDGS) with enzyme improved specific immunity against avian influenza in broilers chick after vaccination, with no significant differences in Newcastle disease virus titres. Similar findings were observed by Khose *et al.* (2021) [7], Dinani *et al.* (2018) [4] and Singh *et al.* (2020) [10] who incorporated rDDGS in replacement of soyabean and maize at different inclusion level.

Where as results of Pradhan *et al.* (2022) [9] are in contrary with the present study who supplemented DDGS at 15% and 30% level in the basal diet and found that cellular immune response of broiler chickens to PHA-P and antibody titre to Ranikhet disease was significantly ($p<0.05$) higher in treated group than control birds. Similarly Swain *et al.* (2012) [12] also observed that thymus weight increased ($p<0.05$) due to incorporation of brewers dried grains at both levels in the diet of chicks.

Table 1: Effect of feeding Rice distillers dried grains solubles (Rice-DDGS) on antibody titres against Newcastle disease (log_{10} HI titre) and Infectious bursal disease (ELISA) at the 42nd day in commercial broilers

Experimental group	Description of the treatment	ND (log_{10})	IBD (ELISA)
T_1	Control diet	1.279±0.148	2318.63±132.19
T_2	5% Rice DDGS incorporated in diet	1.242±0.089	2256.50±132.03
T_3	10% Rice DDGS incorporated in diet	1.317±0.150	2269.63±209.19
T_4	15% Rice DDGS incorporated in diet	1.355±0.189	2210.25±122.77

Table 2: Effect of feeding Rice distillers dried grains solubles (Rice-DDGS) on immune organ weights (% of live weight) (Mean±SE) in broilers at the end of experiment.

Experimental group	Description of the treatment	Spleen	Bursa	Thymus
T_1	Control diet	0. 139±0.006	0.117±0.006	0.355±0.008
T_2	5% Rice DDGS incorporated in diet	0.131±0.011	0.123±0.013	0.321±0.014
T_3	10% Rice DDGS incorporated in diet	0.135±0.007	0.121±0.006	0.342±0.020
T_4	15% Rice DDGS incorporated in diet	0.131±0.012	0.117±0.006	0.332±0.015

5. Conclusion

The incorporation of rice DDGS at 5, 10 and 15 percent in diet will led to no significant improvement in the antibody titers against Newcastle disease and Infectious bursal disease among different treatment groups. Similarly, there was no significant difference in immune organ weights among different treatment groups compared to control at the end of the experiment. Therefore, it was concluded that feeding rice DDGS up to 15% in broiler diet can be recommended without any adverse effect.

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