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Effect of feeding different levels of distillers dried grains with solubles (DDGS) on the carcass quality of commercial broiler chicken

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Abstract
A study was conducted to investigate the effect of dietary incorporation of distillers dried grains with solubles (DDGS) on carcass quality of commercial broiler chicken. A total of 180 day-old commercial broiler chicks were randomly divided into five groups *viz.* T_0, T_1, T_2, T_3 and T_4 consisting of 36 number of birds in each group. Each group was further sub divided into 3 replicates consisting of 12 birds in each sub group. The experiment was conducted for period of six weeks and followed standard and uniform managemental practice. The birds under T_0 group (control) were offered basal diet without inclusion of DDGS. Rice DDGS was incorporated to the broiler ration at the levels of 5, 10, 15 and 20 percent in the T_1, T_2, T_3 and T_4 groups, respectively. At the end of the experiment metabolic trials was conducted and meat quality of the birds were analyzed. The results indicated that addition of DDGS didn't have negative effect on carcass quality and organoleptic parameters.

Keywords: DDGS, carcass quality, broilers, chickens

Introduction
It has emerged as the essential-growing sector in the global economy since independence. Agriculture is an important sector of the Indian economy growth and about half of the population still relies on agriculture as its principal source of income. It is a source of raw material for a large number of industries. The livestock sector is major allied sector contributing nearly 25.6% total value of output in agriculture which is nearly 4.11% of total GDP (19th livestock census, GOI, 2012). The growth rate is 10-12% in broilers per year against the growth of agriculture as a whole which is around 2.5% (APEDA, 2016) [1]. The productive potential of poultry in India has not been fully exploited in all the places due to deficit feed resources and unutilization of available improved technologies for getting high productivity from the poultry at economical rate. Hence, it is essential to further enhance the feeding value of available feed resources so as to improve the efficiency of feed utilization and minimize the cost of feed per kilogram live weight gain. Distillers dried grains with solubles (DDGS) is a co-product of ethanol production process, is high nutrient feed valued by livestock industry when ethanol plants make ethanol, they use only starch of grain. The remaining nutrients like proteins, fibers and oil are by-products used to create livestock feed called as dried distillers grains with soluble (Chauhan and Dikshit, 2012). Despite some limitations, the use of alternative feed ingredients is increasing due to high cost or shortage of conventional feed ingredients. In this context, DDGS is an ingredient that has received considerable attention recently. Thus, proposed study is aimed to investigate the effects of graded levels of DDGS supplementation as a partial replacement for sources of protein and energy in basal diet on broilers chicken.

Materials and Methods
The present study was conducted in the experimental poultry shed of Instructional Poultry Farm, College of Veterinary Science, Assam Agricultural University, Guwahati. For this experimental trial, 180 numbers day-old commercial broiler chicks (Hubbard) having similar body weight were weighed and randomly divided into five groups *viz.* T_0, T_1, T_2, T_3 and T_4 containing 36 chicks in each group. Each group was further subdivided into 3 replicates of 12 chicks. The chicks were wing banded, provided standard feeding and managemental practices were done under deep litter system. All the biosecurity measures were adopted during the

experimental period. The diets were formulated as per specification mentioned in Bureau of Indian Standard (BIS), 2007 [3]. The feeding trial was conducted for a period of 6 weeks using broiler pre-starter (0-7 days), broiler starter (8-21 days) and broiler finisher (22-42 days) ration (Table 1).

At the end of the experiment, five (5) birds from each treatment groups were randomly selected to determine carcass characteristics *viz*. dressing percentage, giblets weight, and organoleptic evaluation.

Processing (slaughtering, bleeding, scalding, defeathering) of birds was done following standard procedures. The dressed weight of the carcass was recorded after bleeding, defeathering, evisceration and giblets removal on the basis of pre-slaughtered live weight.

$$\text{Dressing percentage} = \frac{\text{Dressed weight (weight after bleeding, defeathering, evisceration and giblets removal)}}{\text{Pre-slaughter live weight}} \times 100$$

Giblets weight

The liver was made free from gall bladder, heart was freed from the pericardium and gizzard was cleaned by removing internal lining and faecal material. The weight of heart, liver and gizzard was recorded as giblets weight.

Organoleptic Evaluation

Test panel of meat sample

The chicken breast meat samples from the five groups were taken as small cubes. The meat cubes were pressure cooked at 15 lb pressure for 5 minutes and then subjected to taste panel evaluation. Codified samples were served immediately to a 12-member semi- trained panelist. The panelist were provided with a 7 point hedonic score card to assess the colour, flavor, tenderness, juiciness and overall acceptability of the meat samples as described by Bratzler (1971) [6].

Metabolic Trial

A metabolism trial of 3 (three) days was conducted taking 5 (five) birds from each group. Feed offered and residues left were recorded daily during the metabolic trial. Fresh water was made available to all the birds throughout the day. A two days adaptation period was given prior to sampling and collection.

Representative samples of feed offered and residues left during the metabolism trial was collected daily for estimation of dry matter and samples were used for further chemical analysis. Excreta voided daily by each bird were weighed separately in previously weighed containers. The amount of excreta collected at 24 hours was quantified and representative samples was taken daily for aliquoting in the laboratory. A suitable aliquot of excreta was taken for Dry Matter estimation and was kept for 5 days and stored in a labelled container for further analysis. A separate aliquot of excreta mixed with Sulphuric acid (5%) was preserved for 5 days in previously weighed wide-mouthed stopper glass bottle for Nitrogen estimation.

Statistical Analysis

Statistical analysis was done with the help of software SAS system (9.3).

Results and Discussion

Carcass Quality

The carcass traits and their mean (±SE) values of broilers under different treatment groups are presented in Table 2.

Dressing percentage

The per cent dressing yield under different treatment groups were recorded as 69.44±0.38, 69.19±0.38, 69.08±0.45, 68.74±0.55 and 67.96±0.36g for T_0, T_1, T_2, $T_3$and T_4 groups, respectively. The mean (±SE) dressing percentage of broiler chicken did not differ significantly (P>0.05) among different treatment groups at various levels of inclusion of DDGS in the experimental diets. However, the dressing percentages were decreased gradually as the inclusion levels of DDGS increased in the diets, which were non-significant. These findings were also in agreement with the results of Tang *et al*. (2011) who reported that there was no difference in dressing percentage among different dietary DDGS treatment groups, fed DDGS upto 20%. Accordingly, Wang *et al.* (2007) [12] also indicated that there was no significant difference in dressing percentage among different DDGS treatment groups, fed DDGS upto 25%. Accordingly, Swiatkiewicz and Koreleski (2006) [10] reported that, the dressing yield was not affected by inclusion of DDGS in the diet.

Giblets weight

The mean giblets weight under different treatment groups were recorded as 94.21± 4.73, 95.36± 5.16, 89.28± 2.14, 88.51± 4.11 and 82.31± 3.19 g for T_0, T_1, T_2, T_3 and T_4 groups, respectively (Table 2). The average weights of liver under different treatment groups were recorded as 49.33 ± 2.73, 50.78± 4.16, 47.28 ± 2.83, 46.82 ± 3.33 and 43.02 ± 1.97 g whereas for heart mean weights were recorded as 9.62 ± 0.40, 9.78± 0.35, 9.30 ± 0.46, 9.15 ± 0.64 and 8.32 ± 0.47 g for T_0, T_1, T_2, T_3 and T_4 groups, respectively. The average weights of gizzard under different treatment groups were recorded as 35.07 ± 1.02, 34.76 ± 2.62, 33.35 ± 3.12, 32.57 ± 2.29 and 30.74 ± 2.26 g for T_0, T_1, T_2, T_3 and T_4 groups, respectively. In the present study, Giblets weights, weight of heart, weight of liver and weight of gizzard of various slaughtered birds of different experimental groups were not affected by various levels of inclusion of DDGS in the diets. These results were in corroborating with Kaya and Tarkan (2013) [7] who stated that supplementing broiler rations with different amounts (5, 10, 15%) of DDGS had no effect (P>0.05) on the weight of the liver or heart. Similarly, Barekatain *et al.* (2013) [2] reported that, there was no significant effect of sorghum DDGS up to 20% inclusion on the weight of the gizzard and Liver. Similarly, Kowalczyk *et al*. (2012) [8] stated that giblet weight was not affected by dietary DDGS levels upto 30%. Youssef *et al*. (2013) [14] also observed that the levels of DDGS upto 15% in the broiler ration did not show any significant effect on heart, liver and gizzard weights of the birds slaughtered.

Organoleptic evaluation

The mean (±SE) scores for organoleptic evaluation comprising of colour, flavor, texture, juiciness and overall acceptance of broiler meat were studied at the end of the experimental period of 42 days and mean values have been presented in Table 3.The mean scores for colour of broiler meat of T_0, T_1, T_2, T_3 and T_4 groups were recorded as 5.42±0.15, 5.50±0.15, 5.58±0.19, 5.67±0.19 and 5.33±0.22, respectively. The mean scores for flavour and texture of broiler meat for different treatment groups (T_0, T_1, T_2, T_3 and T_4) were recorded as 5.67±0.22, 5.42±0.19, 5.58±0.15, 5.50±0.19, 5.50±0 and 5.42 ± 0.19, 5.42 ± 0.19, 5.50 ± 0.19,

5.75 ± 0.22, 5.33 ± 0.19 respectively. The mean scores for juiciness of broiler meat of T_0, T_1, T_2, T_3 and T_4 groups were recorded as 5.58 ± 0.19, 5.83 ± 0.21, 5.75 ± 0.22, 5.75 ± 0.18 and 5.58 ± 0.19 respectively. The mean scores for overall acceptance of broiler meat for different treatment groups were recorded as 6.00 ± 0.17, 5.50 ± 0.15, 5.42 ± 0.15, 5.67 ± 0.19 and 5.50± 0.19 of T_0, T_1, T_2, T_3 and T_4 groups, respectively. The mean (±SE) scores for organoleptic evaluation of meat of broiler chicken under different treatment groups did not differ significantly (P>0.05). Thus, the various organoleptic parameters of broiler meat like colour, flavour, texture, juiciness and overall acceptability were not affected due to incorporation of DDGS in feed. The overall acceptance was found highest in the control group. The mean overall acceptance of various groups of meat ranged from 5.50 to 6.00 and hence, according to the hedonic scale, the meat can be said as of good to very good quality. Similar trend of finding was also observed by Corzo *et al*. (2009) [5] who stated that acceptability of flavor and overall acceptability were highest in the control group when broilers were fed 8% DDGS. Likewise, Kowalczyk *et al.* (2012) [8] found that inclusion of DDGS at the levels of 15-30% in duck diets did not significantly affect the colour of the breast muscles.

Metabolic Trial

Nutrient digestibility of Dry Matter, Crude Fibre, Ether Extract, Crude Protein and Nitrogen Free Extract are presented on the Table 4. Average values of Crude protein digestibility for experimental birds were 78.23 ± 0.09, 78.13 ± 0.06, 78.20 ± 0.06, 78.04 ± 0.09 and 77.98 ± 0.11 for T_0, T_1, T_2, T_3, and T_4, respectively. Average values of CF digestibility for experimental birds were 52.30 ± 0.09, 52.32 ±0.06, 52.21 ± 0.04 52.27 ± 0.07 and52.24 ± 0.03 for T_0, T_1, T_2, T_3, andT_4, respectively. Average values of EE digestibility for experimental birds were 73.59 ± 0.04, 73.45 ± 0.04, 73.58 ± 0.09, 73.53 ±0.04 and 73.55 ± 0.02 for T_0, T_1, T_2, T_3, andT_4, respectively. Average values of NFE digestibility for experimental birds were 72.17 ± 0.01, 72.19 ± 0.01, 72.15 ± 0.04, 72.12 ±0.06 and 72.18 ± 0.04 for T_0, T_1, T_2, T_3, and T_4, respectively.

Statistical analysis indicates that there was no significant difference (P>0.05) in nutrient digestibility parameters of crude protein, crude fibre, ether extract and nitrogen free extract among the various experimental groups. Similar trends of finding were also reported by Youssef *et al*. (2008) [13]. Likewise, Kumar *et al.* (2017) [9] reported that nitrogen retention was non-significant among different groups which were incorporated with DDGS at the levels of 15, 30 and 45% in the broiler rations.

Conclusion

Based on the obtained results, it can be concluded that dietary inclusion of distillers dried grains with solubles (DDGS) didn't have negative effects on carcass quality and organoleptic parameters. The metabolic trial was also unaffected on supplementation of DDGS among different treatment groups.

Table 1: Composition of Broiler Pre- starter, Starter and Finisher rations

Ingredients	Treatment groups														
	Pre-starter					Starter					Finisher				
	T_0 (Control)	T_1 (DDGS 5%)	T_2 (DDGS 10%)	T_3 (DDGS 15%)	T_4 (DDGS 20%)	T_0 (Control)	T_1 (DDGS 5%)	T_2 (DDGS 10%)	T_3 (DDGS 15%)	T_4 (DDGS 20%)	T_0 (Control)	T_1 (DDGS 5%)	T_2 (DDGS 10%)	T_3 (DDGS 15%)	T_4 (DDGS 20%)
Maize (%)	54.00	53.00	52.00	49.00	48.00	58.00	56.00	54.00	52.00	50.00	60.00	59.00	58.00	55.00	54.00
Soybean meal (%)	38.00	34.00	30.00	28.00	25.00	33.00	30.00	27.00	24.00	21.00	30.00	26.00	22.00	20.00	16.00
DDGS (%)	0	5.00	10.00	15.00	20.00	0	5.00	10.00	15.00	20.00	0	5.00	10.00	15.00	20.00
Di-calcium phosphate (%)	1.26	1.58	1.66	1.48	0.53	1.38	1.27	1.25	1.16	1.08	1.32	1.39	1.10	1.04	0.98
Limestone powder (%)	1.50	1.40	1.40	1.50	1.50	1.30	1.40	1.40	1.50	1.50	1.30	1.30	1.50	1.50	1.60
Veg. oils (%)	2.50	2.20	2.10	2.10	2.00	3.60	3.61	3.50	3.50	3.50	4.70	4.60	4.60	4.60	4.50
Methionine (%)	0.13	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.12	0.12	0.16	0.16	0.18	0.18	0.18
Lysine (%)	0.09	0.15	0.17	0.25	0.30	0.05	0.05	0.17	0.20	0.28	0	0.03	0.10	0.16	0.22
Salt (%)	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vita pmx (%)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Mineral mixture*(%)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
CP (%)	23.06	23.25	23.10	23.12	22.98	22.08	22.13	21.96	21.93	22.03	19.95	20.24	20.18	20.12	20.26
ME (Kcal. Kg)	3003	3005	3002	2997	3002	3102	3100	3104	3101	3098	3204	3205	3202	3203	3201

*Mineral mixture contains (per 1.2 kg): Calcium- 255 g, Phosphorous- 127.5 g, Magnesium- 6 g, Manganese- 1.5 g, Iron- 1.5 g, Iodine- 325 mg, Copper- 4.2 g, zinc-9.6 g, Cobalt- 150 mg, Sulphur- 7.2 g, Potassium- 100 mg, Sodium- 6mg, Selenium- 10 mg, Vitamin A- 700000 IU, Vitamin D3- 70000 IU, Vitamin E- 250 mg, Nicotinamide- 1000 mg & Chromium- 78 mg.

** Calculated value

Table 2: Mean ± SE of Carcass quality of Broilers under different treatment groups

Parameters \ Groups	T0 (Control)	T1 (DDGS 5%)	T2 (DDGS 10%)	T3 (DDGS 15%)	T4 (DDGS 20%)
Dressing percentage	69.44^a±0.38	69.19^a±0.38	69.08^a±0.45	68.74^a±0.55	67.96^a±0.36
Giblet weight (g)	94.21^a±4.73	95.36^a±5.16	89.28^a±2.14	88.51^a±4.11	82.31^a±3.19
Liver weight (g)	49.33^a±2.73	50.78^a±4.16	47.28^a±2.83	46.82^a±3.33	43.02^a±1.97
Heart weight (g)	9.62^a±0.40	9.78^a±0.35	9.30^a±0.46	9.15^a±0.64	8.32^a±0.47
Gizzard weight (g)	35.07^a±1.02	34.76^a±2.62	33.35^a±3.12	32.57^a±2.29	30.74^a±2.26

Means bearing same superscripts in a row did not differ significantly.

Table 3: Mean ± SE scores for Organoleptic Evaluation of Broilers under different treatment groups

Groups / Parameters	T_0 (Control)	T_1 (DDGS- 5%)	T_2 (DDGS- 10%)	T_3 (DDGS- 15%)	T_4 (DDGS- 20%)
Colour	5.42^a±0.15	5.50^a±0.15	5.58^a±0.19	5.67^a±0.19	5.33^a±0.22
Flavour	5.67^a±0.22	5.42^a±0.19	5.58^a±0.15	5.50^a±0.19	5.50^a±0.19
Texture	5.42^a±0.19	5.42^a±0.19	5.50^a±0.19	5.75^a±0.22	5.33^a±0.19
Juiciness	5.58^a±0.19	5.83^a±0.21	5.75^a±0.22	5.75^a±0.18	5.58^a±0.19
Overall acceptance	6.00^a±0.17	5.50^a±0.15	5.42^a±0.15	5.67^a±0.19	5.50^a±0.19

Means bearing same superscripts in a row did not differ significantly.

Table 4: Mean ± SE of Nutrient Digestibility in different treatment groups

Nutrients	T_0 (Control)	T_1 (DDGS-5%)	T_2 (DDGS-10%)	T_3 (DDGS-15%)	T_4 (DDGS-20%)
CP	78.23^a±0.09	78.13 ^{a}±0.06	78.20 ^{a}±0.06	78.04 ^{a}±0.09	77.98 ^{a}±0.11
CF	52.30 ^{a}±0.09	52.32 ^{a}±0.06	52.21 ^{a}±0.04	52.27 ^{a}±0.07	52.24 ^{a}±0.03
EE	73.59 ^{a}±0.04	73.45 ^{a}±0.04	73.58 ^{a}±0.09	73.53 ^{a}±0.04	73.55 ^{a}±0.02
NFE	72.17 ^{a}±0.01	72.19 ^{a}±0.01	72.15 ^{a}±0.04	72.12 ^{a}±0.06	72.18 ^{a}±0.04

Means bearing same superscripts in a row did not differ significantly.

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