



## Effects of Feeding Distillers Dried Grains with Solubles (DDGS) with or without Enzymes on Carcass Characteristics of Indigenous Chicken

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### Authors' contributions

This work was carried out in collaboration among all authors. Authors AKS RB and BNS designed the study, wrote the protocol and wrote the first draft of the manuscript. Author AKS performed the statistical analysis, performed the feeding trial managed the analyses of the study and the literature searches. Authors AKS, JDM, SB and RI performed processing and analysis of carcass characteristics and proximate principles of meat samples. All authors read and approved the final manuscript.

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### ABSTRACT

**Aims:** The present investigation aimed at assessing the effects of feeding graded levels of DDGS with or without enzymes on the carcass characteristics of indigenous chicken.

**Study Design:** The experiment was conducted in a Completely Randomized Design (CRD).

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**Place and Duration of Study:** Department of Animal Nutrition, College of Veterinary Science, Guwahati-22, Assam for a period of 182 d (13 fortnights) between January 2018 and June 2018.

**Methodology:** A total of 180 21 d old indigenous chicks were divided into six groups: T1, T2, T3, T4, T5 and T6 each with 30 chicks. The birds of T1, T3 and T5 were fed a basal diet containing 0, 10 and 20 per cent DDGS while the birds in T2, T4 and T6 were fed the same basal diet as that of T1, T3 and T5, respectively, but were additionally supplemented with a commercial exogenous multi-enzyme preparation. The feeding trial was conducted for a period of 182 d (13 fortnights) excluding a metabolic trial for a period of 8 days. At the end of the experiment, four birds from each treatment group were randomly selected, slaughtered and processed and different carcass traits viz. live weight, dressing percentage, relative weights of breast, thigh, drumsticks, liver, heart, gizzard, giblets, head and shank in relation to pre-slaughtered live weights were recorded. The chemical composition and organoleptic evaluation of meat samples from different treatment groups were also conducted.

**Results:** The percent dressing and eviscerated yields of experimental birds under different treatment groups were ranged from  $66.81 \pm 0.37$  to  $67.68 \pm 0.41$  and  $71.74 \pm 0.54$  to  $73.35 \pm 0.34$ , respectively. No significant ( $P \geq .05$ ) differences were observed in respect of relative weights of various carcass traits in relation to the live body weights, the chemical compositions of breast meat comprising of moisture, crude protein, ether extract and total ash and the mean scores for organoleptic evaluation comprising of colour, tenderness, flavor, juiciness and overall acceptance of the breast meat of experimental birds from different treatment groups.

**Conclusion:** It is concluded that DDGS can be incorporated at 20% level in the rations of indigenous chicken for the economic gain without any adverse effect on dressing percentage as well as various carcass traits and organoleptic qualities.

*Keywords: Carcass characteristic; chemical composition; DDGS; enzyme; indigenous chicken.*

## 1. INTRODUCTION

The maize and soybean meal are the major conventional sources of energy and protein, respectively, in poultry feeds, which are not only becoming scarce but also costly. It seems that maize will not be completely available in the next few years for using as energy source in poultry diets due to its use to produce biofuel ethanol in the most produced countries. The shortage of high quality conventional poultry feed ingredients is considered as one of the major concern facing poultry producers worldwide especially in the developing countries like India in near future. So, in the present status of feed resource availability, utilization of non-conventional feed resources in poultry rations seems indispensable to keep pace with the deficiency of nutrients, to make ration economic and to have more profit from poultry. The replacement of costlier traditional ingredients with cheaper non-conventional ingredients without adversely affecting the feed quality, bird performance and meat quality is probably the most viable proposition to address this situation.

Among others, distillers dried grains with solubles (DDGS), a co-product of ethanol production process, has been identified as a promising feed resource for its use in the ration

of poultry as a source of energy, protein, water soluble vitamins and minerals [1,2,3]. It contains a substantial amount of total phosphorus (0.72%), out of which 54% is available for poultry [4]. It was noted that arabinoxylans and cellulose were the predominant non-starch polysaccharides (NSP) in DDGS, which restricts its extensive use in poultry feeds [5]. Exogenous enzymes are able to offer nutritional benefits in a variety of ways by hydrolyzing NSP that could not be used by poultry [6]. Enzyme supplementation helps in removing of deleterious incriminating factors, improves the digestibility of existing nutrients, increases the utilization of non-starch polysaccharides and supplements most of the endogenous enzymes [7,8]. On the other hand, there is an ever-increasing demand for meats and eggs of indigenous chicken all over our country. Both the meats and eggs of indigenous chicken fetch higher prices which are more than double of the prices of broiler meats as well as commercial table eggs. In numbers of markets these are marketed as organic meats and organic eggs, resulting their increased demand among the consumers. So, it may be considered as the need of the hour to rear indigenous chicken for meat as well as egg purpose by feeding balanced poultry feeds like other commercial birds with proper nutrient concentrations. Rearing such chickens with

somewhat cheaper feeds by using unconventional and low-costly ingredients like DDGS to reduce the cost of production may be considered as remunerative one for the village poors. Therefore, the present study was undertaken to investigate the effect of dietary incorporation of DDGS at different levels with or without multi-enzyme supplementation on the carcass characteristics including the proximate composition and organoleptic parameters of indigenous chicken.

## 2. MATERIALS AND METHODS

A total of one hundred and eighty. 21 d-old indigenous chicks found in Assam, reared for both meat and egg purposes, were taken and divided into six groups: T1, T2, T3, T4, T5 and T6 containing 30 chicks with 3 replicates of 10 chicks in each group. The feeding trial was conducted in the experimental poultry shed of the Department of Animal Nutrition, College of Veterinary Science, Guwahati-22, Assam. The chicks were wing banded and reared under deep litter system of management throughout the experimental period following uniform managerial practices. The birds of T1 group (control) were offered the standard chick, grower & layer feeds as per [9] (Table 1). The birds of T2 group were fed with the same standard chick, grower and layer feeds as per [9] with supplementation of multi-enzyme. Maize DDGS was incorporated at 10% level in all the rations for T3 and T4 groups, while the rations for T4 group were supplemented with multi-enzymes. In the same way, the birds of T5 and T6 groups were fed with rations containing 20% DDGS without and with enzymes, respectively. The composition of chick, grower and layer rations for birds of different treatment groups along with the estimated crude protein (CP) and calculated metabolizable Energy (ME) values were presented in Table 1. The feeding trial was conducted for a period of 182 d (13 fortnights) using chick feeds for first 42 d, grower feeds for next 43-140 d and layer feeds for last 141-182 d.

### 2.1 Statistical Analysis

The experiment was conducted in a Completely Randomized Design (CRD). The statistical analyses of the experimental data were carried out according to the method described by [10] following One way ANOVA and the means were compared for Duncan's Multiple Range Test (DMRT) for significance.

At the end of the experiment, four birds from each treatment group were randomly selected, slaughtered and processed as per [11] and different carcass traits viz. live weight, dressing percentage, relative weights of breast, thigh, drumsticks, liver, heart, gizzard, giblets, head and shank in relation to pre-slaughtered live weights were recorded as per standard procedure.

### 2.2 Dressing Percentage (%)

Dressed weight (wt. after bleeding, de-feathering, evisceration and giblet removal) (g) / Pre-slaughter live wt. (g) X 100.

### 2.3 Eviscerated Yield

After dressing of the birds, the giblet was retained along with the carcass and the weight of the carcass with giblet was expressed as eviscerated weight, which was expressed in percentage of pre-slaughtered live weight. Thoroughly cleaned gizzard, liver and heart, which constitute giblet, were weighed. The eviscerated carcass along with giblet formed the total meat yield of the birds. The weights of breast, thigh and drumsticks of all the slaughtered birds were recorded by using a standard electronic balance.

Giblet yield (%)= Weight of giblet (g)/ Pre-slaughter live weight (g) X 100

Weights of head and shank of all the slaughtered birds were also recorded by using a standard electronic balance and expressed in terms of percentage on the basis of pre-slaughter live weight.

### 2.4 Chemical Analysis

The representative amounts from each of the breast meat samples of the carcasses of different treatment groups were analyzed in the laboratory for proximate principles as per the method described by [12] to find their composition in respect of moisture content or dry matter (DM), crude protein (CP), ether extract (EE) and total ash (TA).

### 2.5 Organoleptic Evaluation

The mean ( $\pm$ SE) scores for organoleptic evaluation comprising of colour, tenderness, flavor, juiciness and overall acceptance of the breast meat of experimental birds were studied at the end of the study period of 182 days.

**Table 1. Ingredient and nutrient composition of experimental diets**

| Ingredients (%)                   | Ration stages |               |               |               |               |               |               |               |               |
|-----------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
|                                   | Chick mash    |               |               | Grower mash   |               |               | Layer mash    |               |               |
|                                   | T1/T2*        | T3/T4*        | T5/T6*        | T1/T2*        | T3/T4*        | T5/T6*        | T1/T2*        | T3/T4*        | T5/T6*        |
| Maize                             | 48.00         | 42.93         | 39.00         | 40.40         | 32.26         | 29.32         | 43.18         | 34.21         | 32.27         |
| Soybean meal                      | 30.50         | 25.00         | 19.00         | 15.50         | 10.00         | 5.00          | 25.00         | 19.85         | 14.30         |
| Rice Polish                       | 5.00          | 5.00          | 5.00          | 5.00          | 5.00          | 5.00          | 5.00          | 7.00          | 8.00          |
| DDGS                              | 00            | 10.00         | 20.00         | 00            | 10.00         | 20.00         | 00            | 10.00         | 20.00         |
| Di-calcium phosphate              | 1.30          | 1.20          | 1.00          | 1.30          | 1.20          | 1.00          | 1.30          | 1.20          | 1.00          |
| Limestone powder                  | 1.70          | 2.00          | 2.00          | 1.70          | 2.00          | 2.00          | 7.00          | 7.20          | 7.30          |
| Methionine                        | 0.10          | 0.07          | 0.08          | 0.10          | 0.07          | 0.08          | 0.10          | 0.07          | 0.08          |
| Lysine                            | 0.00          | 0.05          | 0.18          | 0.00          | 0.05          | 0.18          | 0.00          | 0.05          | 0.18          |
| Salt                              | 0.27          | 0.27          | 0.27          | 0.27          | 0.27          | 0.27          | 0.27          | 0.27          | 0.27          |
| Mineral-vit. Premix**             | 0.10          | 0.10          | 0.10          | 0.10          | 0.10          | 0.10          | 0.10          | 0.10          | 0.10          |
| Toxin binder                      | 0.05          | 0.05          | 0.05          | 0.05          | 0.05          | 0.05          | 0.05          | 0.05          | 0.05          |
| Broken Rice                       | 6.00          | 6.50          | 6.20          | 7.05          | 10.00         | 10.00         | 6.00          | 10.0          | 6.00          |
| De-oiled rice bran                | 6.98          | 6.78          | 7.12          | 28.53         | 29.00         | 27.00         | 12.00         | 10.00         | 10.45         |
| <b>TOTAL</b>                      | <b>100.00</b> | <b>100.00</b> | <b>100.00</b> | <b>100.00</b> | <b>100.00</b> | <b>100.00</b> | <b>100.00</b> | <b>100.00</b> | <b>100.00</b> |
| <b>Nutrient composition</b>       |               |               |               |               |               |               |               |               |               |
| Crude protein (%)                 | 19.25         | 19.33         | 19.22         | 15.49         | 15.54         | 15.45         | 17.55         | 17.51         | 17.47         |
| Ether extract (%)                 | 2.97          | 3.74          | 4.53          | 2.75          | 3.44          | 4.27          | 2.77          | 3.73          | 4.69          |
| Crude fibre (%)                   | 4.92          | 5.13          | 5.12          | 6.88          | 7.01          | 7.16          | 5.43          | 5.58          | 6.02          |
| Nitrogen free extract (%)         | 65.82         | 64.37         | 62.95         | 66.47         | 65.23         | 64.14         | 66.61         | 65.01         | 63.61         |
| Calcium (%)                       | 1.08          | 1.14          | 1.04          | 1.01          | 1.08          | 1.05          | 2.93          | 2.98          | 2.95          |
| Total phosphorus (%)              | 0.88          | 0.86          | 0.87          | 1.01          | 1.00          | 0.99          | 0.83          | 0.83          | 0.84          |
| Metabolizable energy*** (Kcal/kg) | 2798          | 2793          | 2800          | 2527          | 2503          | 2539          | 2580          | 2600          | 2604          |

\*Diets of T2, T4 and T6 groups were additionally supplemented with multi-enzyme preparations (Xzyme) at 0.05 per cent level

\*\*Mineral-vitamin premix contained (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 and Chromium- 78 mg.

\*\*\* Calculated value

### 2.5.1 Test panel of meat sample

The chicken breast meat samples from the six 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 panelists 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 [13].

## 3. RESULTS AND DISCUSSION

The average live body weights and different carcass traits viz. dressing and eviscerated yields, relative weights of breast, thigh, drumsticks, liver, heart, gizzard, giblets, head and shank in relation to pre-slaughtered live weights were presented in Table 2.

**Chart 1. Score Card under Hedonic Scale for evaluation of chicken meat**

| Score under Hedonic Scale |   |
|---------------------------|---|
| Excellent                 | 7 |
| Very good                 | 6 |
| Good                      | 5 |
| Fair                      | 4 |
| Poor                      | 3 |
| Very poor                 | 2 |
| Extremely poor            | 1 |

### 3.1 Live Body Weights

The average live body weights of the birds just before slaughtering were  $1620 \pm 63.77$ ,  $1665 \pm 74.89$ ,  $1605 \pm 30.69$ ,  $1618 \pm 53.13$ ,  $1603 \pm 54.06$  and  $1618 \pm 43.08$  g for T1, T2, T3, T4, T5 and T6 groups, respectively. There was no significant ( $P > .05$ ) difference in the body weights of birds of different treatment groups.

### 3.2 Dressing Percentage

The percent dressing yields of experimental birds under different treatment groups were recorded between  $66.81 \pm 0.37$  and  $67.68 \pm 0.41$ . The dressing percentage of different experimental groups of indigenous chicken did not differ significantly ( $P > .05$ ) though the numerically highest and lowest dressing yields being recorded in T2 group, the birds of which received basal diets supplemented with multi-enzymes and T5 group, the birds of which were given diets containing 20% DDGS without supplementation of enzymes, respectively.

### 3.3 Eviscerated Yield (%)

The per cent eviscerated yields of experimental birds under different treatment groups were ranged from  $71.74 \pm 0.54$  to  $73.35 \pm 0.34$ . There was no significant ( $P > .05$ ) difference in the average eviscerated yields of birds in different experimental groups. The highest and lowest eviscerated yield being recorded in T2 and T5 groups, respectively.

### 3.4 Relative Organ Weights

#### 3.4.1 Breast

The relative weights of breast from experimental birds of different treatment groups in relation to their live body weights were varied from  $21.96 \pm 0.19$  to  $22.41 \pm 0.37\%$ . The data recorded were comparable among the groups. No significant ( $P > .05$ ) difference was observed in respect of

relative breast weights of the birds under investigation.

#### 3.4.2 Thigh

The average relative weights of thigh in relation to the live body weights of the birds under different treatment groups were recorded between  $10.85 \pm 0.24$  and  $11.29 \pm 0.38$ . The highest and lowest mean relative thigh weights were recorded in the birds of T2 and T4 groups, respectively and the values are comparable with the control group (T1).

#### 3.4.3 Drumsticks

The average relative weights of drumsticks as percentage of live body weights of the birds under different treatment groups were presented in Table 2. The weights of drumsticks in relation to live body weight were ranged from  $9.80 \pm 0.15$  to  $10.23 \pm 0.29\%$ . No significant ( $P > .05$ ) difference was observed with respect to relative drumsticks weights of the birds of different treatment groups.

#### 3.4.4 Liver weight

The average relative weights of livers in relation to live body weights of the birds under different treatment groups were found to be between  $1.59 \pm 0.034$  and  $1.72 \pm 0.022\%$  and the highest and lowest values being recorded in the birds of T2 and T5 groups, respectively. No significant ( $P > .05$ ) difference was observed with respect to relative liver weights of the birds of different treatment groups.

#### 3.4.5 Heart weight

The average relative weights of hearts in relation to the live body weights of the birds under different treatment groups were ranged between  $0.54 \pm 0.022$  and  $0.59 \pm 0.020\%$  and the highest and lowest mean values being recorded in T2 and T5 groups, respectively. No significant ( $P > .05$ ) difference was observed in case of relative heart weights among the birds of different treatment groups.

#### 3.4.6 Gizzard weight

The mean relative weights of gizzard of the slaughtered birds in terms of the live body weights of the birds under different treatment groups were found to be varied between  $1.57 \pm 0.020$  and  $1.64 \pm 0.017\%$ . No significant ( $P > .05$ ) difference was observed in relative gizzard weights of experimental birds among different treatment groups.

### 3.4.7 Giblet weights

The mean relative weights of giblet in terms of live body weights of experimental birds under different treatment groups were presented in Table 2 and recorded between  $3.70 \pm 0.080$  and  $3.93 \pm 0.054\%$ . The mean relative giblets weights in terms of live body weights of experimental birds were comparable under different treatment groups, with the highest relative giblet weights being recorded in T2 group, receiving basal diets containing supplemental multi-enzymes and the lowest relative giblets weights being observed in T5 group, receiving diets containing 20% DDGS without any enzymes supplementation. The relative weights of giblets of birds did not differ significantly ( $P > .05$ ) among the treatment groups.

### 3.4.8 Head weight

The average relative weights of heads in relation to the live body weights of birds under different treatment groups were ranged between  $3.84 \pm 0.020$  and  $4.01 \pm 0.073\%$ . No significant ( $P > .05$ ) difference was noticed in the relative weights of the heads of the experimental birds among different treatment groups.

### 3.4.9 Shank weight

The average relative weights of shank in terms of live body weights of the birds in different treatment groups were varied between  $3.78 \pm 0.031$  and  $3.95 \pm 0.012\%$  (Table 2). No significant ( $P > .05$ ) difference was observed in respect of the relative shank weights of the experimental birds among the treatment groups.

The data recorded in the present study in terms of dressing percentage of the birds of different treatment groups were in agreement with the results of experiment reported by [14], who observed no significant ( $P > .05$ ) difference in dressing percentages in broiler chicken when different levels of DDGS were included in the diets. Reports are there that the broiler birds fed diets with 15% DDGS did not differ significantly ( $P > .05$ ) in dressing percentage with control diet [15]. Researcher also observed similar dressing percentage in Ross broiler birds with different inclusion rates of DDGS at 10, 15, 20, 25 and 30% levels in their diets [16].

The eviscerated yields recorded in the present study were comparable among different treatment groups. Similar types of eviscerated

yield (%) of indigenous chicken under deep-litter system of rearing were recorded by Gonmei [17]. Higher eviscerated yield was observed in T2 group could be due to higher pre-slaughter body weights in that group.

In respect of various relative organ weights recorded in this study, no significant ( $P > .05$ ) differences were observed among the groups and similar results were also reported by Tang et al. [14] in broiler chicken when different levels of DDGS were included in the diets. Workers also opined that the carcass yield and relative weight of liver and gizzard were not affected by inclusion of DDGS in the diet, or by addition of additives (xylanase  $\pm$  phytase) to the diet with the high level of DDGS [18]. Similar types of observations among the carcass traits in different experimental groups were reported by Yoon et al. [19] in pigs and by Kowalczyk et al. [20] in Pekin ducks by feeding different levels of DDGS in their respective diets. Some experts reported no significant ( $P > .05$ ) difference in breast, wing and drumstick yields as percentage of live or carcass weight in the birds of different treatment groups by feeding the iso-caloric and iso-nitrogenous diets with different inclusion rates of DDGS at 10, 15, 20, 25 and 30% [16]. Another group of workers [21] reported that there was no significant ( $P > .05$ ) effect of sorghum DDGS inclusion up to 200 g/kg on the relative weights of gizzard and liver. They were not affected by either sorghum DDGS level or enzyme supplementation. Scientists also observed no effect on the weight of the liver or heart from a feeding trial in broiler by supplementing rations with different amounts of DDGS at 5, 10 and 15 % levels [22]. Researchers also reported from an experiment on broiler birds, using different levels of DDGS at 0, 5, 10 and 15% in the diets, that the levels of DDGS used did not show any significant effect on heart, liver, gizzard weight [23]. Few other workers observed non-significant ( $P > .05$ ) difference in weight of edible giblets among different treatment groups of broilers chicken by feeding different experimental diets containing DDGS at the levels of 0, 5, 10 and 15% [24,25]. The giblets weights of the slaughtered birds of different experimental groups were also not affected by various inclusion levels of DDGS in the diets of broiler chicken as reported by [26]. An experiment was conducted on Ross 308 broiler by feeding different inclusion levels of DDGS (0, 10, 15 and 20%) and reported that there was no significant ( $P > .05$ ) difference in grill, breast and thigh weight among the groups [27].

### 3.5 Chemical Composition of Meat

The average chemical composition of meat collected from breast portions of the birds of the six experimental groups have been evaluated and presented in Table 3. From the table it could be observed that the moisture, crude protein, ether extract and total ash contents of meat were ranged between  $73.67 \pm 0.33$  and  $74.09 \pm 0.09$ ;  $19.33 \pm 0.12$  and  $19.66 \pm 0.16$ ;  $3.66 \pm 0.14$  and  $3.84 \pm 0.11$  and  $1.10 \pm 0.03$  and  $1.22 \pm 0.05\%$ , respectively. There was no significant ( $P > .05$ ) difference among the treatment groups in respect of all the above mentioned parameters.

The data pertaining to the proximate principles of meat of chicken or other animals as affected by feeding various levels of DDGS is very meagre. The findings of the study (Table 3) in respect of proximate principles of breast meat were in agreement with the reports of Miklos (2015) [27], who reported from a feeding trial by adding DDGS at 0, 15, 20 and 25% levels in the diets of ROSS 380 broiler birds that protein, total ash, crude fibre and NFE content in breast meat of

different treatment groups did not differ significantly ( $P > .05$ ).

### 3.6 Organoleptic Evaluation

The mean ( $\pm$ SE) scores for organoleptic evaluation comprising of colour, tenderness, flavor, juiciness and overall acceptance of the breast meat of experimental birds have been presented in Table 4. The mean scores for colour of the breast meat were found to be  $6.36 \pm 0.029$ ,  $6.42 \pm 0.023$ ,  $6.35 \pm 0.019$ ,  $6.39 \pm 0.022$ ,  $6.35 \pm 0.014$  and  $6.34 \pm 0.018$  for T1, T2, T3, T4, T5 and T6 groups, respectively. The highest scores for colour were being recorded in T2 group, where birds were fed basal diet with multi-enzymes and lowest scores were recorded in T3 and T5 groups fed with the diets containing 10 and 20% DDGS without multi-enzyme supplementation, respectively. No significant ( $P > .05$ ) difference was observed in respect of score for the colour. The mean scores for tenderness, juiciness, flavor and overall acceptances were ranged between  $5.96 \pm 0.019$  and  $6.03 \pm 0.028$ ;  $5.27 \pm 0.031$  and  $5.37 \pm 0.091$ ;

**Table 2. Mean ( $\pm$ SE) carcass quality of experimental birds of different treatment groups**

| Particulars           | Treatment groups |                  |                  |                  |                  |                  |
|-----------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                       | T1               | T2               | T3               | T4               | T5               | T6               |
| Live weights (g)      | 1620 $\pm$ 63.77 | 1665 $\pm$ 74.89 | 1605 $\pm$ 30.69 | 1618 $\pm$ 53.13 | 1603 $\pm$ 54.06 | 1618 $\pm$ 43.08 |
| Dressing yield (%)    | 67.40 $\pm$ 0.36 | 67.68 $\pm$ 0.41 | 66.96 $\pm$ 0.75 | 67.35 $\pm$ 0.45 | 66.81 $\pm$ 0.37 | 67.27 $\pm$ 0.37 |
| Eviscerated yield (%) | 72.47 $\pm$ 0.40 | 73.35 $\pm$ 0.34 | 72.21 $\pm$ 0.69 | 72.67 $\pm$ 0.13 | 71.74 $\pm$ 0.54 | 71.94 $\pm$ 0.73 |
| Breast (%)            | 22.33 $\pm$ 0.29 | 22.41 $\pm$ 0.37 | 22.16 $\pm$ 0.22 | 22.23 $\pm$ 0.17 | 21.96 $\pm$ 0.19 | 22.14 $\pm$ 0.28 |
| Thigh (%)             | 11.28 $\pm$ 0.36 | 11.29 $\pm$ 0.38 | 11.06 $\pm$ 0.28 | 10.85 $\pm$ 0.24 | 11.03 $\pm$ 0.43 | 10.99 $\pm$ 0.24 |
| Drumsticks (%)        | 10.11 $\pm$ 0.25 | 10.23 $\pm$ 0.29 | 9.94 $\pm$ 0.28  | 9.96 $\pm$ 0.18  | 9.80 $\pm$ 0.15  | 10.05 $\pm$ 0.29 |
| Liver (%)             | 1.69 $\pm$ 0.037 | 1.72 $\pm$ 0.022 | 1.65 $\pm$ 0.042 | 1.68 $\pm$ 0.031 | 1.59 $\pm$ 0.034 | 1.60 $\pm$ 0.035 |
| Heart (%)             | 0.58 $\pm$ 0.015 | 0.59 $\pm$ 0.020 | 0.57 $\pm$ 0.022 | 0.58 $\pm$ 0.024 | 0.54 $\pm$ 0.022 | 0.56 $\pm$ 0.015 |
| Gizzard (%)           | 1.60 $\pm$ 0.021 | 1.62 $\pm$ 0.021 | 1.61 $\pm$ 0.009 | 1.64 $\pm$ 0.017 | 1.57 $\pm$ 0.020 | 1.59 $\pm$ 0.013 |
| Giblet (%)            | 3.87 $\pm$ 0.072 | 3.93 $\pm$ 0.054 | 3.83 $\pm$ 0.055 | 3.90 $\pm$ 0.072 | 3.70 $\pm$ 0.080 | 3.75 $\pm$ 0.062 |
| Head (%)              | 3.91 $\pm$ 0.106 | 4.01 $\pm$ 0.073 | 3.85 $\pm$ 0.102 | 3.90 $\pm$ 0.028 | 3.84 $\pm$ 0.020 | 3.89 $\pm$ 0.041 |
| Shank (%)             | 3.91 $\pm$ 0.056 | 3.95 $\pm$ 0.012 | 3.86 $\pm$ 0.051 | 3.89 $\pm$ 0.040 | 3.78 $\pm$ 0.031 | 3.85 $\pm$ 0.055 |

Means with different super script in the same row differed significantly ( $P > .05$ )

**Table 3. Average ( $\pm$ SE) proximate principles of breast meat of experimental birds of different treatment groups**

| Proximate principles | Treatment groups |                  |                  |                  |                  |                  |
|----------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                      | T1               | T2               | T3               | T4               | T5               | T6               |
| Moisture (%)         | 74.02 $\pm$ 0.58 | 73.81 $\pm$ 0.80 | 74.09 $\pm$ 0.09 | 73.80 $\pm$ 0.56 | 73.98 $\pm$ 0.57 | 73.67 $\pm$ 0.33 |
| Protein (%)          | 19.61 $\pm$ 0.16 | 19.53 $\pm$ 0.23 | 19.40 $\pm$ 0.19 | 19.33 $\pm$ 0.12 | 19.57 $\pm$ 0.18 | 19.66 $\pm$ 0.16 |
| Fat (%)              | 3.77 $\pm$ 0.22  | 3.69 $\pm$ 0.20  | 3.67 $\pm$ 0.26  | 3.66 $\pm$ 0.14  | 3.84 $\pm$ 0.11  | 3.71 $\pm$ 0.12  |
| Total ash (%)        | 1.16 $\pm$ 0.05  | 1.22 $\pm$ 0.05  | 1.20 $\pm$ 0.06  | 1.10 $\pm$ 0.03  | 1.16 $\pm$ 0.04  | 1.11 $\pm$ 0.07  |

Means bearing the same superscripts within the row do not differ significantly ( $P > .05$ )

**Table 4. Mean ( $\pm$ SE) scores for organoleptic evaluation of breast meat of experimental birds under different treatment groups**

| Particulars        | Treatment groups |                  |                  |                  |                  |                  |
|--------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                    | T1               | T2               | T3               | T4               | T5               | T6               |
| Colour             | 6.36 $\pm$ 0.029 | 6.42 $\pm$ 0.023 | 6.35 $\pm$ 0.019 | 6.39 $\pm$ 0.022 | 6.35 $\pm$ 0.014 | 6.34 $\pm$ 0.018 |
| Tenderness         | 5.98 $\pm$ 0.018 | 5.96 $\pm$ 0.019 | 6.01 $\pm$ 0.018 | 6.02 $\pm$ 0.011 | 6.02 $\pm$ 0.024 | 6.03 $\pm$ 0.028 |
| Flavour            | 5.27 $\pm$ 0.031 | 5.37 $\pm$ 0.091 | 5.32 $\pm$ 0.037 | 5.34 $\pm$ 0.053 | 5.28 $\pm$ 0.035 | 5.31 $\pm$ 0.042 |
| Juiciness          | 5.24 $\pm$ 0.027 | 5.30 $\pm$ 0.030 | 5.25 $\pm$ 0.030 | 5.26 $\pm$ 0.023 | 5.24 $\pm$ 0.042 | 5.27 $\pm$ 0.036 |
| Overall acceptance | 5.95 $\pm$ 0.035 | 6.01 $\pm$ 0.034 | 5.93 $\pm$ 0.039 | 5.95 $\pm$ 0.029 | 5.92 $\pm$ 0.030 | 5.94 $\pm$ 0.031 |

Means bearing same superscripts within the row do not differ significantly ( $P > .05$ )

5.24  $\pm$  0.027 and 5.30  $\pm$  0.030 and 5.92  $\pm$  0.030 and 6.01  $\pm$  0.034, respectively. The highest score for overall acceptance of the said meat was observed in T2 group and the lowest scores being observed in T5 group. The mean scores ( $\pm$  SE) for organoleptic evaluation of meat of indigenous chicken under different treatment groups was comparable among the birds of different treatment groups and did not differ significantly ( $P > .05$ ). Thus, the various organoleptic parameters of meat of the birds of different treatment groups like colour, tenderness, juiciness, flavor and overall acceptability were not affected due to incorporation of DDGS in feeds at different levels.

The recorded findings in the present study corroborated the results of Lyon and Lyon [28] and Schilling et al. [29], who reported that all broiler breast meat from the birds of DDGS incorporated group and control treatment were very tender and they would be highly acceptable to the consumers. The colour of breast meat of the birds from different groups were found to be very good, which is in agreement with results of the experiment conducted by Corzo et al. [30], who observed that there was no effect of DDGS inclusion on meat color of chicken broilers fed 8 % DDGS. Likewise, Kowalczyk et al. [20] reported that inclusion of DDGS at the levels of 15, 25 and 30% in Pekin duck diets did not significantly affect the colour of the breast muscles.


The mean overall acceptance of breast meat from various groups ranged from 5.92 to 6.01 and hence, according to the hedonic scale, the meat can be said to have good to very good acceptance quality. Similar types of findings about overall acceptance of meat from an experiment where DDGS was added in the diets of broiler birds at the levels of 0, 5, 10, 15 and 20% was reported [26].

#### 4. CONCLUSION

Based upon the results of this experiment, it was found that the incorporation of DDGS up to 20% level in the diets of indigenous chicken did not have any adverse effect on dressing and eviscerated yields as well as other carcass traits of experimental birds of different treatment groups. The chemical compositions of the meat of the experimental birds were found to be within the normal ranges among the groups. In terms of organoleptic parameters also the meat from different groups were observed to be good to very good. It is concluded that DDGS can be incorporated at 20% level in the rations of indigenous chicken for the economic gain without any adverse affect on dressing percentage as well as various carcass traits and organoleptic qualities.



#### ETHICAL APPROVAL

Animal Ethic committee approval has been collected and preserved by the authors.



ASSAM AGRICULTURAL UNIVERSITY: KHANAPARA: GUWAHATI – 781022  
INSTITUTIONAL ANIMAL ETHICS COMMITTEE

Approval No. 770/ac/CPCEA/FVSc/AAU/IAEC/17-18/479dated 09.08.2017  
Communication of Decision of the Institutional Animal Ethics Committee (IAEC)

|  |   |
|--|---|
| Topic of the PG Research :   |   |
| EFFECT OF FEEDING DISTILLERS DRIED GRAIN WITH SOLUBLESA (DDGS) WITH OR WITHOUT MULTI-ENZYMES ON THE GROWTH PERFORMANCE OF INDIGENOUS CHICKEN   |   |
| Name of the Student: DR. ASHIM KUAMAR SAIKIA, 2016-VDK-05  |   |
| Department : Department of ANIMAL NUTRITION,<br>College of Veterinary Science, AAU, Khanapara  |   |
| <input checked="" type="checkbox"/> - New review <input type="checkbox"/> - Revised review <input type="checkbox"/> - Expedited review   |   |
| Date of review (DMNY): 09.08.2017<br>Date of previous review, if revised application :   |   |
| Decision of the IAEC   |   |
| <input checked="" type="checkbox"/> - Recommended <input type="checkbox"/> - Recommended with suggestions<br><input type="checkbox"/> - Suggested Revision <input type="checkbox"/> - Rejected                                     |   |
| Suggestions / Reasons/ Remarks :   |   |
| Please note*   |   |
| - Inform IAEC immediately in case of any adverse events.<br>- Inform IAEC in case of any change of study procedure, site and investigator<br>- Members of IAEC have right to monitor the trial / experiment with prior intimation. |   |
|    | <br>(Apurba Chakraborty)<br>Chairman, IAEC |



## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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