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ORIGINAL ARTICLE

Effects of Feeding Diets Containing Distillers Dried Grains with Solubles (DDGS) with or without Enzyme Supplementation on Egg Quality Characteristics of Indigenous Chicken

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ABSTRACT
An investigation was conducted using distillers dried grains with soluble (DDGS) at 0, 10 and 20% levels with or without enzymes supplementation in the diets of indigenous chicken to study its effect on different egg quality characteristics. A total of one hundred and eighty 21 days-old indigenous chicks were divided into six groups viz. T1, T2, T3, T4, T5 and T6 containing 30 chicks in each group. The birds of T1 (control) and T2 groups were offered the standard chick, grower & layer feeds as per BIS, 2007 without and with multi-enzymes (Xzyme), respectively. The birds of T3, T4, T5 and T6 groups were fed the rations containing 10% DDGS without and with enzymes and 20% DDGS without and with enzymes, respectively. The feeding trial was conducted for a period of 13 fortnights. No significant ($P \geq 0.05$) differences were observed in respect of the average values of different egg quality parameters viz. egg weight, shape index, specific gravity, surface area, albumen index, Haugh unit, yolk index, shell weight, shell percentage and shell thickness among the treatment groups. It can be concluded that the incorporation of DDGS up to 20% level in the diets of indigenous chicken did not have any adverse effect on the egg quality characteristics of experimental birds.
Key words: *Distillers dried grains with soluble (DDGS), Enzymes, Egg quality characteristics, Haugh unit, Indigenous chicken, Shape index, Yolk index*

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INTRODUCTION

The maize and soybean meal are the major conventional sources of energy and protein, respectively, in poultry feeds. These ingredients are becoming scarce day by day due to their increased requirement in livestock and poultry feed preparation for ever-increasing population leading to their higher cost. Again, due to its use for production of biofuel ethanol in the most produced countries, it seems, maize may not be completely available in the next few years for using as energy source in poultry diets. Hence, 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, utilization of non-conventional feed resources in the poultry feeding is indispensable to keep pace with the deficiency and 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 and bird performance is probably the most viable proposition to address this situation.

Distillers dried grains with solubles (DDGS), a co-product of ethanol production process, has been identified as one of the promising non-conventional feed resource for its use in the ration of poultry as an energy and protein source. Recently, a renaissance in the use of DDGS has been observed worldwide due to rapid escalation in DDGS production and improvement in its quality when derived from new generation ethanol plants [1]. It is a source of energy, protein, exogenous amino acids, B-group vitamins and mineral compounds including phosphorus [2]. The DDGS are richer in fibre, protein and fat than the cereal source and contain a significant amount of non-starch polysaccharides (NSP) [3], which restrict in the extensive use of it in poultry feeds. Exogenous enzymes are able to offer nutritional benefits in a variety of ways by hydrolyzing NSP that could not be used by poultry [4]. The use of appropriate enzymes to hydrolyze these compounds can increase the nutritional value of DDGS and promote greater inclusion in poultry diets [5].
In view of the above facts, the present study was undertaken to investigate the effect of dietary incorporation of distillers dried grains with solubles (DDGS) at different levels with or without multi-enzyme supplementation on egg quality characteristics of indigenous chicken.

MATERIAL AND METHODS

A total of one hundred and eighty 21 days-old indigenous chicks were taken and divided them into six groups, viz. T1, T2, T3, T4, T5 and T6 containing 30 chicks with 3 replicates of 10 chicks in each group. The chicks were wing banded and reared under deep litter system of management throughout the experimental period following uniform managemental practices. The birds of T1 group (control) were offered the standard chick, grower & layer feeds as per [6] (Table 1). The birds of T2 group were fed with the same standard chick, grower and layer feeds as per BIS, 2007 with supplementation of multi-enzyme (Xzyme). 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 feeding trial was conducted for a period of 13 fortnights using chick feeds for first 3 fortnights (0-42 days), grower feeds for next 7 fortnights (43-140 days) and layer feeds for last 3 fortnights (141-182 days). Eggs were laid by birds of all the treatment groups during last month of the experiment. The eggs were collected immediately after laying and cleaned and preserved for evaluation of their quality. Six numbers of eggs from each of the experimental groups were taken and measured the egg quality parameters under two sub-heads viz. external and internal egg quality characteristics as per the procedure narrated below in the departmental laboratory of the Department of Livestock Products and Technology, CVSc, Khanapara.

External egg quality characteristics:

Egg weight: Individual egg weight (g) was recorded with accuracy of 0.0001 g using electronic balance and from that, the mean egg weight was calculated.

Shape index: The length and width of the eggs were measured by a dial caliper with 0.05 mm accuracy. The shape index was calculated as follows.

$$\text{Shape index} = \frac{\text{Greatest width of the egg}}{\text{Greatest length of the egg}} \times 100$$

Specific gravity: By measuring the egg weight (g) and egg volume (ml), the specific gravity was calculated as follows.

$$\text{Specific gravity} = \frac{\text{Egg weight (g)}}{\text{Egg volume (ml)}} \times 100$$

Surface area: Surface area of egg was calculated by using the standard formula for poultry egg-
Surface area= $12.6 \times (\text{Length} + \text{width}/4)^2$
Where, 12.6 is a constant.

Cleanliness of shell: The eggs collected from different rooms having birds of different groups were observed for their cleanliness and was recorded accordingly.

Shell colour: The shell colour of the collected eggs was also recorded.

Internal egg quality characteristics

The quality of egg were ascertained by breaking open the egg and studying the various parameters of the shell, albumen, yolk and also by objective evaluation.

Albumen index: The eggs were broken on a glass plate, laid evenly on the table and the width of the thick albumen was measured in two places using the dial caliper with 0.05 mm accuracy and their mean width

was arrived at. The height of the thick albumen was measured to 0.01 mm accuracy using “Ames tripod micrometer”.
Albumen index was calculated by using the following formula:

$$\text{Albumen index} = \frac{\text{Maximum height of thick albumen (mm)}}{\text{Mean width of the thick albumen (mm)}}$$

Haugh unit: It is the modified version of albumen index and the most widely used measure of albumen quality
Haugh unit for chicken egg = 100 log (H+7.57- 1.7 $W^{0.37}$)
Where,
H- Height of albumen in mm
W- Weight of albumen in gram

Yolk index: The width of yolk at two different places was measured by using the dial caliper with 0.05 mm accuracy and the mean width was arrived at. The height of yolk was measured to 0.01 mm accuracy using “Ames tripod micrometer”. The yolk index was calculated by using following formula:

$$\text{Yolk index} = \frac{\text{Maximum height the yolk (mm)}}{\text{Mean width of the yolk (mm)}}$$

Shell weight (g): The shell of each egg after removing shell membrane was dried in hot air oven and weighed in electronic balance.
Shell percentage: The shell percentage of egg was calculated by using the following formula:

$$\text{Shell percentage} = \frac{\text{Shell weight (g)}}{\text{Egg weight (g)}} \times 100$$

Shell thickness (mm): After removing the shell membranes from the shell, shell thickness (mm) is measured at three places viz. equatorial region, narrow and broad ends by using a shell thickness gauge with 0.01 mm accuracy and from that, mean thickness was calculated.
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 [7].

RESULTS AND DISCUSSION
External egg quality
The external quality characteristics of the eggs from the birds of different treatment groups were studied and recorded the values under different parameters like egg weight, shape index, volume of egg, specific gravity, surface area, cleanliness and egg colour and are shown in Table 2. The average weights of eggs laid by the birds of different treatment groups were 40.04±0.40, 40.51±0.46, 40.18±0.36, 40.27±0.50, 39.90±0.49 and 40.58±0.39 g in T1, T2, T3, T4, T5 and T6 groups, respectively. The mean egg weights from the birds of different experimental groups were found to be comparable. The average shape indexes and specific gravities of eggs from the experimental birds of different treatment groups were ranged from 74.55±0.80 to 75.19±0.71 and 1.15±0.02 to 1.19±0.01, respectively. The average surface area of the eggs laid by the birds of different experimental groups was ranged between 451±6.20 and 455±5.18 sq. mm. All the eggs from the birds of different treatment groups were found clean. Ninety percent of the eggs laid during the study period were found to be dark brown in colour and rest of the eggs had light brown colour. The recorded data on various external egg quality parameters did not differ significantly ($P \geq 0.05$) though numerical differences were observed in respect of particular parameter. The findings of this study were in agreement with the results of [8], who studied the productive performance of Hisex laying hens by adding DDGS at the levels of 0, 5, 10 or 20% in their rations and reported that there were no significant effect of adding DDGS on egg weight, egg mass and egg specific gravity.
The DDGS could be used up to 20% into laying hen diets without negative effect on egg production and egg weight [9]. Likewise, [10] and [11] reported that there was no significant ($P \geq 0.05$) difference in egg production and egg weights between hens were fed diets containing 0 or 15% DDGS. Similarly, [12] also reported that the inclusion of 15% DDGS had no negative effect on productive performance as well as the Haugh unit values of the produced eggs in Hy-Line W-36 laying hens.
Like the findings of present study, [13] reported from an experiment in commercial layer diets, using DDGS at the levels of 0 and 15% and Avizyme at four levels (0, 100, 150 and 200 grams/ ton) that DDGS, Avizyme and their interaction did not significantly affect egg production, egg weight and egg mass. [14] conducted an experiment in Hisex laying hens by inclusion of DDGS as substitution for soybean meal at 0,

25, 50, 75 and 100% levels with or without enzyme or vitamin E supplementation and reported that satisfactory results were observed when hens fed 25 or 50% DDGS substituted for soybean meal.

Table 1: Ingredient and nutrient composition of experimental diets

Ingredients	Rations (Parts per quintal)																	
	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	48.00	42.93	42.93	39.00	39.00	40.40	40.40	32.26	32.26	29.32	29.32	43.18	43.01	34.21	34.21	32.27	32.27
SBM	30.50	30.50	25.00	25.00	19.00	19.00	15.50	15.50	10.00	10.00	5.00	5.00	25.00	25.10	19.85	19.85	14.30	14.20
Rice Polish	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	7.00	7.00	8.00	8.00
DDGS	00	00	10.00	10.00	20.00	20.00	00	00	10.00	10.00	20.00	20.00	00	00	10.00	10.00	20.00	20.00
DCP	1.30	1.30	1.20	1.20	1.00	1.00	1.30	1.30	1.20	1.20	1.00	1.00	1.30	1.30	1.20	1.20	1.00	1.00
LSP	1.70	1.70	2.00	2.00	2.00	2.00	1.70	1.70	2.00	2.00	2.00	2.00	7.00	7.00	7.20	7.20	7.30	7.30
Methionine	0.10	0.10	0.07	0.07	0.08	0.08	0.10	0.10	0.07	0.07	0.08	0.08	0.10	0.10	0.07	0.07	0.08	0.08
Lysine	0.00	0.00	0.05	0.05	0.18	0.18	0.00	0.00	0.05	0.05	0.18	0.18	0.00	0.00	0.05	0.05	0.18	0.18
Salt	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Mineral premix*	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Toxin bind	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Broken Rice	6.00	6.00	6.50	6.50	6.20	6.20	7.05	7.05	10.00	10.00	10.00	10.00	6.00	6.50	10.0	10.0	6.00	6.00
DORB	6.98	6.93	6.78	6.78	7.12	7.07	28.53	28.53	29.00	29.00	27.00	27.00	12.00	11.50	10.00	10.00	10.45	10.50
Enzymes	00	0.05	00	0.05	00	0.05	00	0.05	00	0.05	00	0.05	00	0.05	00	0.05	0.00	0.05

TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Nutrient composition																		
C P(%)	19.25	19.37	19.33	19.41	19.22	19.33	15.49	15.53	15.54	15.61	15.45	15.53	17.55	17.65	17.51	17.53	17.47	17.48
EE(%)	2.97	2.91	3.74	3.81	4.53	4.67	2.75	2.71	3.44	3.38	4.27	4.33	2.77	3.01	3.73	3.83	4.69	4.62
CF(%)	4.92	4.80	5.13	5.00	5.12	5.42	6.88	6.98	7.01	7.12	7.16	7.25	5.43	5.53	5.58	5.65	6.02	6.11
NFE(%)	65.82	65.75	64.37	64.39	62.95	62.13	66.47	66.23	65.23	65.32	64.14	63.78	66.61	65.94	65.01	65.03	63.61	63.41
Calcium(%)	1.08	1.10	1.14	1.17	1.04	1.07	1.01	0.99	1.08	1.10	1.05	1.09	2.93	2.96	2.98	3.01	2.95	3.00
T-P(%)	0.88	0.90	0.86	0.87	0.87	0.90	1.01	1.01	1.00	1.03	0.99	1.02	0.83	0.84	0.83	0.85	0.84	0.86
ME (Kcal/kg)**	2798	2798	2793	2793	2800	2800	2527	2527	2503	2503	2539	2539	2580	2580	2600	2600	2604	2604

SBM- Soybean meal, DDGS- Distillers dried grains with soluble, DCP- Di-calcium phosphate, LSP-Limestone powder, DORB- De-oiled rice bran, CP-Crude protein, EE-Ether extract, CF-Crude fibre, NFE-Nitrogen free extract, T-P-Total phosphorus, ME-Metabolizable energy

*__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.

Composition of multi-enzyme (Xzyme): Each kg of Xzyme premix contains: Lactic Acid Bacillus-30,000 million spores, Saccharomyces Cervisiae- 100 billion CFU, Amylase- 29,000 IU, Betaglucanase-4,05,000 IU, Phytase-44,500 IU, Lipase- 31,000 IU, Protease- 7,40,000 IU, Cellulase- 5,500 IU, Pectinase -1,01,000 IU and Hemicellulase- 25,000 IU

**** Calculated value**

TABLE 2: Average (±SE) quality characteristics of eggs from experimental birds of different groups

Parameters	Treatment groups						SEM	P-VALUE
	T1	**T2**	**T3**	**T4**	**T5**	**T6**		
External characteristics								
Egg wt. (g)	40.04	40.51	40.18	40.27	39.90	40.58	0.170	0.865941748
Shape index	74.65	74.55	74.73	75.19	74.60	74.55	0.340	0.995677278
Specific gravity	1.15	1.19	1.18	1.17	1.16	1.18	0.008	0.846222938
Surface area (sq. mm)	453	451	455	452	453	452	2.267	0.99764152
Internal characteristics								
Albumin index	0.104	0.105	0.103	0.106	0.105	0.104	0.002	0.999611549
Haugh Unit	102.83	101.33	101.67	102.17	103.09	104.00	0.817	0.954867887
Yolk index	0.40	0.40	0.39	0.40	0.40	0.39	0.004	0.962756236
Shell weight (g)	3.70	3.74	3.82	3.85	3.80	3.83	0.033	0.813413136
Shell percentage (%)	9.25	9.25	9.52	9.54	9.53	9.42	0.084	0.839364401
Shell thickness (mm)	0.33	0.33	0.33	0.33	0.33	0.33	0.001	0.785476372

Means with same superscripts within the row do not differ significantly (P≥0.05)

The eggs laid by birds of different groups were clean which signified the cleanliness of shed and the swift removal of eggs from the shed. Dark brown colour of the eggs might be due to genetic makeup of the indigenous birds that naturally lay brown coloured eggs and it normally leads to higher demand for the eggs in market and fetching more prices compared to white coloured egg.

Internal egg quality:

The average internal quality characteristics of the eggs laid by the birds of different treatment groups were studied and recorded in Table 2. The average albumin index, Haugh unit values and yolk indexes of the eggs laid by the birds of different treatment groups were ranged between 0.103±0.005 and 0.106±0.005, 101.33±2.42 and 104.00±1.65 and 0.39±0.01 and 0.40±0.01, respectively. The data recorded on albumin index, Haugh unit values and yolk indexes were almost similar and there were no significant (P≥0.05) differences in respect to these parameters among the treatment groups. The average shell weights of eggs, egg shell percentage in comparison to egg weights and shell thickness were ranged between 3.70±0.07 and 3.85±0.10 g, 9.25±0.21 and 9.54±0.16% and 0.33±0.002 to 0.33±0.003 mm, respectively, among the groups. No significant (P≥0.05) differences were observed in average shell weights, shell percentage and shell thickness of the eggs among different treatment groups.

The productive performance of Hisex laying hens by adding DDGS at the levels of 0, 5, 10 or 20% in their rations had no significant (P≥0.05) effect of adding DDGS on Haught unit values of the eggs [8]. [10] reported that there was no significant (P≥0.05) difference in egg shell thickness and Haugh unit values between hens fed diets containing 0 or 15% DDGS. Likewise, [12] and [11] also reported that the inclusion of 15% DDGS had no negative effects on the Haugh unit values of the produced eggs. The laying hens could be fed diets high in corn DDGS, up to 69%, without adverse effects on egg quality [15]. The supplementation of DDGS up to 20% in the diets did not affect the productive performance of laying hens [16]. There was no negative effect on the performance parameters with increasing levels of DDGS from 0 to 32% in Bovans White laying hens [17]. The experiment in Bovans Single Comb White Leghorn laying hens by feeding diets containing 0, 5, 10, 15, 20 and 25% DDGS had no negative effect on Haugh unit [18]. It was also found that up to 16% addition, DDGS did not affect egg production, egg weight and egg mass [19].

It is revealed that the addition of DDGS up to 20% in the feeds of indigenous chicken by replacing maize and soybean meal led to reduction in cost of feed and thereby production cost and increases in profit margin (data are not presented here) without showing any harmful effect on egg quality parameters.

CONCLUSION

Based upon the results of this experiment, it is observed that the incorporation of DDGS up to 20% level in the diets of indigenous chicken did not have any adverse effect on different egg quality parameters of experimental birds. Therefore, it can be concluded that DDGS can be used as a cheap source of protein and energy in the rations of indigenous chicken with multi-enzymes for economical and profitable poultry production.

COMPETITING INTEREST

The authors have declared that no competing interest exists.

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