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Effect of rice distiller dried grains with solubles (RDDGS) in commercial broiler chicken ration on carcass traits, chemical composition, and fatty acid profile of meat

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ABSTRACT

A six-week experimental trial was conducted to evaluate the effect of feeding different levels of RDDGS in commercial broiler chicken on carcass traits, chemical composition, and fatty acid profile of meat. A total of 144 birds were divided into four treatments and three replicates each with 12 birds and were fed with RDDGS at inclusion levels of 0% (T1), 5% (T2), 10% (T3) and 15% (T4). All the rations were nearly isocaloric and isonitrogenous. One male and one female were selected from each replicate to determine the carcass traits and cut up parts. The meat samples were analyzed for its chemical composition and fatty acid profile. Statistical analysis of the data revealed that there was highly significant difference in the live body weight before slaughtering between T3 (10%) and T4 (15%) group when compared to control group, and there was no significant difference between the T1 (control) and T2 (5%) group in carcass characters and cut up parts. Intestinal length in males was significantly higher than females irrespective of the treatment. The fatty acid profile and chemical composition of meat were non-significant. So, it can be concluded that RDDGS could be included up to 5% without adverse effects on carcass traits and meat quality.

Keywords: Carcass traits, Chemical composition, Commercial broiler chicken, Fatty acid profile, Rice DDGS

Poultry feeds are largely comprised of grains and oilseed meals, and as such, the environmental sustainability of poultry production is directly related to the efficiency by which poultry utilize nutrients within these feedstuffs. Therefore, increasing the capacity of poultry to convert agricultural co-products that are not suited for human consumption into edible protein will be essential in sustainably meeting growing global animal protein demand (Rochell *et al*. 2018).

Since, Soyabean meal (SBM) price has increased manifold, feed manufacturers have favourably used different viable alternate sources like mustard de-oiled cake (DOC), groundnut DOC, and cotton DOC among the oilseed cakes (oil extracted variety), rice DDGS, corn DDGS among fermentation by-products, gluten meals (maize and rice), fish meal, meat, and bone meal and poultry meal among the alternate animal protein sources. Key factors that govern the best utility of these alternate ingredients in both commercial broilers and layers, depends on the availability of raw materials, nutrient composition, digestibility, and viability of unit cost of protein from these ingredients. Another risk factor lies in the anti-nutritional factors and adulterants associated with the alternate raw materials that limits its usage in feed (Das *et al.* 2021).

DDGS are an excellent low-cost alternative protein feed ingredient that continue to be produced in large quantities by the dry-grind fuel ethanol industry. An increase in ethanol production over the last 5 to10 years, due to increasing prices of petroleum products, limited underground reserves, and an addition of ethanol in fuels, has led to an increased supply of DDGS, available as livestock feed (Noll *et al.* 2007). Rice distillers dried grains with solubles (RDDGS) can be potential feed ingredients for poultry ration. The rising cost of production due to rise in feed cost can be decreased by use of RDDGS protein rich alternative feed ingredient to replace costly soybean meal in broiler chicken ration. Hence, a research work was carried out with an aim to study the effect of different inclusion levels of RDDGS on carcass traits, chemical composition, and fatty acid profile of meat.

MATERIALS AND METHODS

Experimental design and birds: A six-week duration biological experiment was conducted to evaluate the effect of rice-based distiller's dried grains with solubles (RDDGS) on the carcass traits, chemical composition, and fatty acid profile of meat in commercial broilers. The experimental trial was carried out as per guidelines and approval of the Institutional Animal Ethical Committee (IAEC) with IAEC number 17/SA/IAEC/2022. A total of

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144-day old straight run commercial broilers were obtained from Venkateshwara Hatcheries Private Limited and were allotted randomly to four treatment groups viz., T1, T2, T3 and T4 with three replicates in each treatment and twelve chicks in each replicate.

Experimental diets: The experimental period of 42 days was divided into three phases, namely: pre-starter (0–7 days), starter (8-21 days), and finisher (22-42 days). Four treatment rations containing RDDGS at levels of 0 % (T1), 5 % (T2), 10 % (T3) and 15 % (T4) of the total ration at the expense of soya bean meal were formulated to be nearly isocaloric and isonitrogenous as per BIS (2007) standards. Standard managemental practices were followed and the birds were provided with *ad lib.* feed with the respective rations and potable drinking water was given during entire period of biological experiment. The chemical composition of RDDGS was analysed according to AOAC (2012).

Carcass yield characteristics: After the end of the 42nd day of biological experiment, one male and one female from each replicate were starved for 12 h and weighed individually, stunned, and slaughtered by severing jugular vein and allowed to bleed completely and weighed for blood loss percentage. The slaughtered birds were defeathered by hand plucking and weighed. The head, feet and viscera were removed and weighed for carcass weight and expressed as percent live weight. Abdominal fat pad was removed and measured. The collected intestines were flushed with Phosphate buffer saline to remove all the feed contents. The total intestinal length was measured using a measuring tape.

$$\text{New York dressed yield (\%)} = \frac{\text{Live weight (g) – Weight of blood and feather}}{\text{Live weight (g)}} \times 100$$

$$\text{Ready-to-cook yield (\%)} = \frac{\text{Eviscerated weight with giblet (g)}}{\text{Live weight (g)}} \times 100$$

From eviscerated carcass weight, drumstick, thigh, neck, back, and breast meat were separated and weighed for yield of cut up parts as percentage.

Fatty acid profile and chemical composition of meat: Approximately 200 g of muscles from the breast were sampled and stored at 4°C for its chemical composition and fatty acid profile. The fatty acid profile of meat samples were analyzed at Animal Feed Analytical and Quality Assurance Laboratory, (AFAQAL) Namakkal, as per Palmquist and Jenkins (2003). The proximate composition of meat samples namely crude protein, ether extract, moisture, total ash were analyzed by following the standard procedure of AOAC (2012).

Statistical analysis: All the data were subjected to analysis through the procedure one way Analysis of Variance (ANOVA) using statistical analysis software (IBM SPSS version 22.0 for windows) as per Snedecor and Cochran (1989). The differences among treatment means were estimated by Duncan's multiple range test.

RESULTS AND DISCUSSION

Chemical composition of RDDGS: The sample of RDDGS use for ration formulation had moisture 16.71%, crude protein 40.17%, crude fibre 5.33%, ether extract 7.67%, total ash 5.06%, acid insoluble ash 0.69%, calcium 0.35%, phosphorus 0.71%, salt 0.44%, gross energy 4227 kcal/kg and no mycotoxins were detected.

Carcass traits: The results of the present study showed that feeding RDDGS had a negative impact on the preslaughter live weight in 10% (T3) and 15% (T4) inclusion levels, and other parameters were non-significant (p>0.05) (Table 1). Absolute intestinal length was different in males and was higher when compared to females (Supplementary Table1). The cut-up parts yield was non-significant (p>0.05) (Table 2). The decrease in the preslaughter live weight was not in agreement with Gacche *et al.* (2016), who reported that there was improvement in preslaughter body weight when the commercial broiler chickens were fed with corn DDGS (cDDGS) up to 20% inclusion levels. The results were in line with the annual report submitted by ICAR-CARI (2014–15), which shows that there was no significant difference in carcass traits up to 10% inclusion levels. Dinani et al. (2018),

Table 1. Effect of feeding different levels of RDDGS in commercial broiler chickens on carcass characteristics (Mean±SE)

Parameter	Carcass characteristics				F value
	T1 (control)	T2 (5%)	T3 (10%)	T4 (15%)	
Live weight (g)	2483.00^a±73.70	2542.00^a±91.75	2273.67^b±94.15	2019.29^c±52.25	11.35**
Blood loss (%)	0.83±0.16	1.00±0.16	0.83±0.16	0.69±0.16	0.64^{NS}
New York dressing weight (%)	91.33±0.54	89.67±0.59	89.00±0.72	90.57±0.48	2.82^{NS}
Ready to cook (%)	82.00±1.38	78.50±0.80	78.33±0.85	78.41±0.93	3.24^{NS}
Giblets (%)	3.33±0.07	3.50±0.18	3.67±0.17	3.64±0.40	0.24^{NS}
Carcass weight (%)	78.33±1.43	75.17±0.78	74.67±0.91	74.73±0.71	2.96^{NS}
Abdominal fat pad (%)	1.50±0.24	1.50±0.24	1.83±0.24	0.93±0.25	2.34^{NS}
Meat: bone ratio	2.00±0.06	1.83±0.13	1.83±0.12	1.69±0.12	0.64^{NS}
Intestinal length (cm)	166.58±5.02	175.17±7.72	169.00±5.37	163.79±2.27	1.15^{NS}
Intestinal weight (g/kg)	58.85±1.67	57.59±2.19	64.573±2.80	73.20±2.05	10.34^{NS}

Means bearing different superscripts within a row differ significantly (P<0.05). **, Significant (P<0.01); *, Significant (P<0.05); NS, Not significant; No. of observations (N), 6.

Table 2. Effect of feeding different levels of RDDGS in commercial broiler chickens on cut up parts yield (% live weight) (Mean±SE)

Parameter	Cut up parts				F value
	T1 (control)	T2 (5%)	T3 (10%)	T4 (15%)	
Breast (%)	27.33±0.75	27.00±1.74	26.17±1.24	24.80±0.86	0.91^{NS}
Back (%)	13.67±0.60	12.00±0.90	11.17±0.53	11.79±1.04	1.54^{NS}
Thigh (%)	10.33±0.65	10.33±0.88	11.17±0.24	11.31±0.47	0.75^{NS}
Drumstick (%)	10.50±0.23	10.67±0.84	9.83±0.21	11.09±0.34	1.17^{NS}
Wing (%)	7.33±0.33	7.17±0.44	7.50±0.24	7.37±0.20	0.25^{NS}
Neck (%)	5.45±0.36	5.50±0.60	6.50±0.29	6.40±0.17	2.21^{NS}

Means bearing different superscripts within a row differ significantly (P<0.05). **, Significant (P<0.01); *, Significant (P<0.05); NS, Not significant; No. of observations (N), 6.

Table 3. Effect of feeding different levels of RDDGS in commercial broiler chickens on fatty acid profile of meat (Mean±SE)

Fatty acid	T1 (control)	T2 (5%)	T3 (10%)	T4 (15%)	F value
Myristic acid (%)	1.98±0.41	1.03±0.16	1.11±0.39	1.17±0.38	1.18
Palmitic acid (%)	32.73±4.59	25.25±0.54	26.50±0.08	25.20±0.67	2.32
Stearic acid (%)	6.90±0.42	5.41±0.01	5.74±1.07	5.75±0.44	0.92
Oleic acid (%)	36.52±1.69	42.40±2.00	41.54±1.55	42.33±1.18	2.29
Linoleic acid (%)	13.19±0.38	15.26±2.21	15.32±0.98	14.93±1.45	0.38
Linolenic acid (%)	0.51±0.07	0.40±0.18	0.40±0.07	0.36±0.05	3.06
Arachidic acid (%)	0.19±0.04	0.28±0.07	0.17±0.08	0.23±0.01	0.67
Behenic acid (%)	4.11±1.21	2.89±0.65	2.02±1.29	0.59±0.52	1.524
Eicosapentaenoic acid (%)	1.44±0.27	0.50±0.55	0.43±0.29	0.42±0.22	3.307
Docosahexaenoic acid (%)	0.81±0.14	0.20±0.14	0.21±0.14	0.24±0.16	4.541
Palmitoleic acid (%)	4.61±0.24	2.60±2.44	6.38±1.42	4.94±0.05	2.983
Others (%)	1.57±0.35	0.68±0.35	0.07±0.35	0.16±0.41	3.625
MUFA: PUFA	2.51±0.08	2.82±0.43	2.96±0.41	2.93±0.11	0.44^{NS}
MUFA: SFA	0.91±0.14	1.29±0.01	1.35±0.15	1.39±0.07	3.81^{NS}
PUFA: SFA	0.36±0.04	0.47±0.07	0.46±0.01	0.47±0.04	1.19^{NS}

Means bearing different superscripts within a row differ significantly (P<0.05).**, Significant (P<0.01); *, Significant (P<0.05); NS, Not significant; No. of observations (N), 3.

Raju *et al.* (2022) fed RDDGS in Vanaraja chicken also reported similar results. Kowalczyk *et al.* (2012) included four levels of cDDGS in ducks, Damasceno *et al.* (2020), also concluded that there was no significant difference in carcass traits. Both Mir *et al.* (2017) and Saikia *et al.* (2020) included broken rice and cDDGS at different levels along with commercial exogenous multienzyme in indigenous birds and concluded that there was no negative effect on cut up parts yield. Loar *et al.* (2010) included up to 30% cDDGS and showed a decline in the cut-up parts yield, which were not in line with current experiment. The decrease in the live weight before slaughter might be due to decreased growth performance during experimental period as the level of inclusion of RDDGS increased.

Chemical composition of the meat: The results of chemical composition of meat of commercial broiler chickens were non-significant (p>0.05) (Supplementary Table 2). The results of the current study are in accordance with earlier reports by Kucheriya *et al.* (2019) who included RDDGS up to 10% in commercial broiler chicken diet and showed non-significant effect on the chemical composition of the muscle. Schilling *et al.* (2010) also reported non-significant difference in protein, fat and moisture content of broiler meat fed with cDDGS up to 24%. Similarly, Miklos (2015) reported that there was no change in the chemical composition of ROSS 380 broilers fed with cDDGS up to 25%. Kumar *et al.* (2017) also concluded the same when birds were fed with cDDGS up to 45% along with lysine included up to 1%. Corn DDGS up to 20% along with exogenous multi enzyme preparation included in indigenous birds had non-significant impact on the chemical composition of meat (Saikia *et al.* 2020).

Fatty acid profile of the meat: Statistical analysis of fatty acid profile of meat revealed that the poly unsaturated fatty acids (PUFA), Mono unsaturated fatty acids (MUFA) and Saturated fatty acids (SFA) were non-significant (p>0.05) differences (Table 3). The results of the present experiment are in line with Min *et al.* (2012) who also observed non-significant difference in the SFA, MUFA, PUFA by feeding corn DDGS at 0, 10, 15, 20% inclusion levels in commercial broiler meat. Yang *et al.* (2019) also found no negative impact of fermented cDDGS on the fatty acid profile of commercial broiler meat. Alternatively, Schilling *et al.* (2010) observed that linoleic acid and PUFA levels increased when cDDGS levels at the rate of 0, 6, 12, 18, 24% were fed to commercial broilers which showed a significant difference when compared to control. Corzo *et al.* (2009) also concluded that there was increase in the linolenic acid and PUFA in cDDGS when fed to commercial broilers. Mir *et al.* (2018) fed commercial broiler with cDDGS along with flax seeds and observed that 10% flax seeds along with 5 and 10% cDDGS showed increase in MUFA, PUFA and decrease in SFA in the meat. Jiang *et al.* (2014) reported that 15% inclusion level increased linoleic acid and PUFA.

Overall, it may be concluded that RDDGS can be included up to 5% in commercial broiler chicken ration without any adverse effect on carcass traits, chemical composition, and fatty acid profile of meat. RDDGS can be a potential alternative for soyabean meal.

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