



## Effect of dietary inclusion of rice distillers dried grains with solubles (rDDGS) on growth performance and production efficiency of Kuroiler chicken

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### ABSTRACT

Rice Distillers Dried Grains with Solubles (rDDGS) is a by-product of ethanol production which is used as alternative protein source in the poultry diet. Present investigation was conducted to assess the growth performance and production efficiency in Kuroiler chickens. Feeding trial was designed into four dietary groups, viz. T<sub>0</sub> (Control, without rDDGS), T<sub>1</sub> (7.5% rDDGS), T<sub>2</sub> (15% rDDGS) and T<sub>3</sub> (22.5% rDDGS) in different treatment groups along with basal corn soybean diet. Significant variations from 2<sup>nd</sup> to 8<sup>th</sup> weeks of age for body weight were found in all the dietary groups. Body weight gain differed significantly from 1<sup>st</sup> to 5<sup>th</sup> weeks among all the groups, however, overall (1-56d) body weight gain was found highest in T<sub>2</sub> group (1640.29 g) followed by T<sub>1</sub> (1572.52 g), T<sub>0</sub> (1534.01 g) and T<sub>3</sub> (1466.75 g). Feed intake showed significant variation from 2<sup>nd</sup> to 6<sup>th</sup> weeks of age. Maximum feed intake during entire length of trial was observed in the dietary group T<sub>2</sub> and lowest in T<sub>3</sub>. Feed conversion ratio, feed conversion efficiency and protein efficiency ratio were not influenced significantly by feeding rDDGS. Hence, inclusion of rDDGS may be suggested as an alternate protein source and can replace soybean meal up to 15% without any detrimental effect on health and productivity.

**Keywords:** Chicken, Dietary groups, Feed, Kuroiler, rDDGS

Indian poultry industry has made a remarkable growth ever since its emergence and is arising as a glorious sector with a growth rate of 8.51 and 7.52% in egg and broiler production, respectively. Feed, alone accounts nearly 2/3<sup>rd</sup> of total recurring cost of a poultry enterprise. Soybean is the major source of protein in poultry diet and due to its inadequacy at reasonable price, there is need to utilize locally available alternate protein sources to make a cost-effective feed. Many food processing, beverages, slaughter and pharmaceuticals industries leave few by-products with appreciable nutritive value that are being utilized by the poultry feed manufacturers. Rice Distillers Dried Grains with Soluble (rDDGS) contains 65% distillers grain and 35% soluble having approximately 48% protein level. 'Kuroiler' is a dual purpose low input-hardy chicken with high productivity developed by Kegg Farm Pvt Ltd, Haryana. Hence, keeping in view the above, rDDGS may be suggested to include up to 15% as replacer of soybean meal in poultry feed.

### MATERIALS AND METHODS

Study was conducted at Poultry Research and Training Centre, Sardar Vallabhbhai Patel University of Agriculture

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and Technology, Meerut (UP) from January 24<sup>th</sup>, 2021 to March 22<sup>nd</sup>, 2021 for a period of 8 weeks. Feeding trial was designed into four dietary groups, viz. T<sub>0</sub> (Control, without rDDGS), T<sub>1</sub> (7.5% rDDGS), T<sub>2</sub> (15% rDDGS) and T<sub>3</sub> (22.5% rDDGS) along with basal corn soybean diet. One day old 160 chicks were randomly divided into four equal groups (n=40, with four replicate of 10 chicks per group) which were reared in deep litter system with identical housing and managerial conditions for each group. The general topography of the area is plain with a humid sub-tropical climate. Weekly body weight, body weight gain, feed intake on weekly basis, feed conversion ratio, feed conversion efficiency and protein efficiency ratio were evaluated for each dietary group. An ethical approval for the trial was taken by the Institutional Animal Ethics Committee of the university (reference no. as IAEC/SVPUAT/2020/39). Experimental diets were formulated as per ICAR recommendations (2013) for coloured starter and finisher broiler with inclusion of rDDGS at 0, 7.5, 15.0 and 22.5% of diet as control T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively. Ingredient and nutritional composition for starter and finisher diet with different inclusion levels of rDDGS in Kuroiler chicken is given in Table 1. The moisture, CF, CP, NFE, EE, ash content and metabolizable energy (ME, kcal/kg) of rDDGS as on feed basis were 10.08%, 4.89%, 45.0%, 27.12%, 4.49%, 10.20% and 2880 Kcal/kg, respectively. The feed conversion ratio

Table 1. Ingredient and nutritional composition for starter and finisher diet with different inclusion levels of rDDGS in Kuroiler chicken

Ingredient Feed Ingredient	Starter				Finisher			
	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>
Maize	57.135	55.825	55.735	54.345	61.125	60.395	60.625	58.935
Rice bran oil	2.000	1.800	1.300	1.200	2.900	2.500	2.000	1.900
Soyabean meal	34.700	26.600	18.600	10.600	30.300	22.300	14.400	6.300
rDDGS	0.000	7.500	15.000	22.500	0.000	7.500	15.000	22.500
DORB	1.500	3.500	4.500	6.400	1.500	3.000	3.600	5.900
L-Lysine	0.130	0.280	0.420	0.560	0.140	0.310	0.430	0.570
DL-Methionine	0.300	0.260	0.210	0.160	0.240	0.200	0.150	0.100
Salt	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Soda NaHCO <sub>3</sub>	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Choline chloride 60%	0.120	0.120	0.120	0.120	0.080	0.080	0.080	0.080
Dicalcium phosphate (DCP)	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Limestone powder (LSP)	1.500	1.500	1.500	1.500	1.100	1.100	1.100	1.100
Feed additives premix*	0.265	0.265	0.265	0.265	0.265	0.265	0.265	0.265
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
<i>Nutritional composition of diets</i>								
ME (Kcal/kg)	2956	2956	2956	2960	3056	3053	3058	3057
Crude protein (CP), %	21.61	21.60	21.61	21.62	20.01	20.05	20.06	20.05
Ether extract (EE), %	4.24	4.22	3.95	4.03	5.17	4.98	4.71	4.78
Crude fibre (CF), %	3.39	3.57	3.65	3.83	3.25	3.39	3.43	3.65
Calcium, %	1.17	1.20	1.23	1.26	1.01	1.04	1.07	1.10
Available phosphorus, %	0.46	0.44	0.42	0.41	0.45	0.44	0.42	0.40
Lysine, %	1.21	1.20	1.19	1.19	1.10	1.12	1.09	1.08
Methionine, %	0.60	0.60	0.60	0.60	0.52	0.53	0.52	0.52
Cost/Quintal, ₹	3022	2896	2739	2622	2992	2852	2696	2574

\* Include trace minerals, vitamins, toxin binder, coccidiostat, phytase.

(FCR), feed conversion efficiency (FCE) and protein efficiency ratio (PER) of Kuroiler chicken under different treatment groups were recorded from 1<sup>st</sup> to 8<sup>th</sup> weeks of age and calculated as per standard formula.

*Statistical analysis:* Data were statistically analyzed as per the standard statistical procedure (Snedecor and Cochran 1994) using IBM Statistical Package for the Social Sciences (IBM SPSS, version 20). Significant differences ( $P < 0.05$ ) among treatment means and separation of homogenous subset was determined as per Duncan's multiple range test (Duncan 1955). The analyzed data were considered to be significant at  $P < 0.05$  and declared as trend at  $0.05 < P \leq 0.10$ .

## RESULTS AND DISCUSSION

*Growth performance:* Effect of feeding different levels of rDDGS on growth performance in Kuroiler chicken are given in Table 2. Body weight, body weight gain and feed intake were influenced by different levels of rDDGS in Kuroilers. Significant increase in body weight was observed during 1<sup>st</sup> week in 22.5% rDDGS dietary group whereas during 2<sup>nd</sup> week of age, trait was increased significantly ( $P < 0.05$ ) in the diets having 7.5 and 15% levels of rDDGS while in T<sub>4</sub> (22.5% rDDGS) decreasing trend was observed for the similar age. Non-significant ( $P > 0.05$ ) variations in body weight was observed between T<sub>1</sub> (7.5% rDDGS)

and T<sub>2</sub> (15% rDDGS) while dietary group with 22.5% rDDGS showed significantly lower body weight during the age of 3<sup>rd</sup> to 7<sup>th</sup> weeks. However, body weight decreased significantly ( $P < 0.05$ ) in the treatment having 22.5% rDDGS during 8<sup>th</sup> week while it was recorded significantly highest in 15% rDDGS group as compared to control and treatment with 7.5% rDDGS levels. Non-significant ( $P > 0.05$ ) differences were estimated between control (without rDDGS) and the dietary group supplemented with 22.5% rDDGS for 8<sup>th</sup> weeks of age, although, T<sub>0</sub> and T<sub>1</sub> were found to have insignificant variations in body weight. However, significant ( $P < 0.05$ ) differences were recorded in body weight among T<sub>1</sub> and T<sub>2</sub> at similar age. Present results were fairly comparable with the reports of Khose *et al.* (2017), Kumar *et al.* (2017), Sonu *et al.* (2018), Pal *et al.* (2020), Singh *et al.* (2021) and Palanivel and Rao (2021) observing positive effect of feeding DDGS on body weights in various categories of chicken. However, results were contrary to the observations of Borah *et al.* (2020), Dinani *et al.* (2021a) and Dinani *et al.* (2021b) which may be attributed to differences in nutritional composition of DDGS, genotypic variation of poultry birds and managerial reasons. Significant ( $P < 0.05$ ) differences of rDDGS feeding on body weight gain were observed during 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> weeks of age while contrary to this, non-significant ( $P > 0.05$ ) variation in the same trait

Table 2. Effect of feeding different levels of rDDGS on growth performance in Kuroiler chicken

Age (Day/Week)	Weekly body weight						Weekly feed intake					
	Dietary groups*			SEM	P value	P value	Dietary groups*			SEM	P value	
	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>				T <sub>3</sub>	T <sub>0</sub>	T <sub>1</sub>			T <sub>2</sub>
1 <sup>st</sup> week (8 <sup>th</sup> d)	85.96 <sup>a</sup> (43.96 <sup>a</sup> )	89.66 <sup>a</sup> (47.41 <sup>ab</sup> )	90.67 <sup>a</sup> (48.92 <sup>b</sup> )	97.52 <sup>b</sup> (55.27 <sup>c</sup> )	1.33 (1.18)	0.004 (<0.001)	55.83	59.33	60.56	58.87	1.05	0.472
2 <sup>nd</sup> week (15 <sup>th</sup> d)	180.32 <sup>a</sup> (94.35 <sup>a</sup> )	198.90 <sup>b</sup> (109.25 <sup>b</sup> )	202.95 <sup>b</sup> (112.28 <sup>b</sup> )	178.62 <sup>a</sup> (81.10 <sup>a</sup> )	3.75 (3.82)	0.018 (0.002)	197.56 <sup>b</sup>	206.21 <sup>b</sup>	214.31 <sup>b</sup>	157.75 <sup>a</sup>	6.57	0.001
3 <sup>rd</sup> week (22 <sup>nd</sup> d)	353.73 <sup>b</sup> (173.41 <sup>b</sup> )	378.47 <sup>b</sup> (179.56 <sup>b</sup> )	379.32 <sup>b</sup> (176.36 <sup>b</sup> )	309.00 <sup>a</sup> (130.37 <sup>a</sup> )	8.93 (6.30)	0.003 (0.003)	410.78 <sup>b</sup>	411.20 <sup>b</sup>	393.97 <sup>b</sup>	267.00 <sup>a</sup>	16.79	<0.001
4 <sup>th</sup> week (29 <sup>th</sup> d)	582.05 <sup>b</sup> (228.31 <sup>b</sup> )	586.34 <sup>b</sup> (207.87 <sup>ab</sup> )	563.59 <sup>b</sup> (184.27 <sup>a</sup> )	490.00 <sup>a</sup> (181.00 <sup>a</sup> )	10.91 (6.83)	<0.001 (0.026)	485.76 <sup>b</sup>	514.99 <sup>b</sup>	526.48 <sup>b</sup>	432.00 <sup>a</sup>	12.18	0.010
5 <sup>th</sup> week (36 <sup>th</sup> d)	841.09 <sup>b</sup> (259.04 <sup>ab</sup> )	871.97 <sup>b</sup> (285.63 <sup>b</sup> )	861.36 <sup>b</sup> (297.77 <sup>b</sup> )	724.00 <sup>a</sup> (234.00 <sup>a</sup> )	17.26 (8.61)	<0.001 (0.020)	678.32 <sup>b</sup>	693.87 <sup>b</sup>	715.38 <sup>b</sup>	493.50 <sup>a</sup>	26.08	<0.001
6 <sup>th</sup> week (43 <sup>rd</sup> d)	1149.47 <sup>b</sup> (308.37)	1147.37 <sup>b</sup> (275.40)	1145.22 <sup>b</sup> (283.86)	969.50 <sup>a</sup> (245.50)	22.89 (10.75)	0.001 (0.232)	866.99 <sup>ab</sup>	895.77 <sup>b</sup>	925.29 <sup>b</sup>	780.50 <sup>a</sup>	19.48	0.030
7 <sup>th</sup> week (50 <sup>th</sup> d)	1355.19 <sup>b</sup> (205.72)	1389.12 <sup>b</sup> (241.75)	1395.50 <sup>b</sup> (250.27)	1224.50 <sup>a</sup> (255.00)	23.10 (12.08)	0.010 (0.506)	964.78	968.80	1004.43	1040.85	19.98	0.542
8 <sup>th</sup> week (57 <sup>th</sup> d) Final	1576.01 <sup>ab</sup> (220.81)	1614.77 <sup>bc</sup> (225.64)	1682.04 <sup>c</sup> (286.54)	1509.00 <sup>a</sup> (284.50)	21.68 (15.51)	0.017 (0.271)	1015.98	1078.50	1080.63	1152.50	19.94	0.103

<sup>abc</sup>Means with different superscripts in a row differ significantly (P<0.05); \* T<sub>0</sub>: Control; T<sub>1</sub>, rDDGS-7.5%; T<sub>2</sub>, rDDGS-15%; T<sub>3</sub>, rDDGS-22.5% (Values in parenthesis represents the body weight gain).

Table 3. Effect of feeding different levels of rDDGS on production efficiency in Kuroiler chicken

Age (Week)	FCR						PER					
	Dietary groups*			SEM	P value	P value	Dietary groups*			SEM	P value	
	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>				T <sub>3</sub>	T <sub>0</sub>	T <sub>1</sub>			T <sub>2</sub>
1 <sup>st</sup> week (1d-7d)	1.26 <sup>b</sup> (0.79 <sup>ab</sup> )	1.25 <sup>b</sup> (0.80 <sup>a</sup> )	1.24 <sup>b</sup> (0.80 <sup>a</sup> )	1.06 <sup>a</sup> (0.94 <sup>b</sup> )	0.02 (0.01)	0.002 (0.001)	3.66 <sup>a</sup>	3.70 <sup>a</sup>	3.74 <sup>a</sup>	4.35 <sup>b</sup>	0.08	0.001
2 <sup>nd</sup> week (8d-14d)	2.10 (0.47)	1.88 (0.53)	1.91 (0.52)	1.96 (0.51)	0.04 (0.01)	0.337 (0.288)	2.20	2.45	2.43	2.39	0.05	0.322
3 <sup>rd</sup> week (15d-21d)	2.40 (0.42)	2.29 (0.43)	2.23 (0.45)	2.05 (0.49)	0.05 (0.01)	0.156 (0.116)	1.95	2.02	2.07	2.26	0.04	0.142
4 <sup>th</sup> week (22d-28d)	2.17 (0.48)	2.49 (0.40)	2.87 (0.35)	2.40 (0.42)	0.09 (0.01)	0.067 (0.072)	2.39	2.02	2.02	1.75	0.09	0.76
5 <sup>th</sup> week (29d-35d)	2.65 (0.39)	2.45 (0.41)	2.40 (0.41)	2.11 (0.47)	0.09 (0.01)	0.205 (0.156)	1.95	2.06	2.07	2.37	0.06	0.150
6 <sup>th</sup> week (36d-42d)	2.81 (0.35)	3.32 (0.31)	3.34 (0.31)	3.23 (0.31)	0.13 (0.01)	0.495 (0.655)	1.78	1.55	1.55	1.57	0.06	0.612
7 <sup>th</sup> week (43d-49d)	4.88 (0.21)	4.13 (0.24)	4.24 (0.25)	4.09 (0.24)	0.22 (0.01)	0.633 (0.567)	1.05	1.24	1.26	1.23	0.05	0.560
8 <sup>th</sup> week (50d-56d)	5.48 (0.22)	4.84 (0.20)	3.80 (0.26)	4.09 (0.24)	0.37 (0.01)	0.418 (0.512)	1.10	1.04	1.32	1.23	0.07	0.541
Overall	3.05 (0.33)	3.07 (0.32)	3.00 (0.33)	2.99(0.33)	0.46 (0.00)	0.940 (0.932)	1.63	1.61	1.65	1.65	0.02	0.936

<sup>abc</sup>Means with different superscripts in a row differ significantly (P<0.05); \* T<sub>0</sub>: Control; T<sub>1</sub>, rDDGS-7.5%; T<sub>2</sub>, rDDGS-15%; T<sub>3</sub>, rDDGS-22.5% (Values in parenthesis represents the feed conversion efficiency).

was seen for 6<sup>th</sup> to 8<sup>th</sup> weeks of age. Present findings were in conformity with the reports of Sonu *et al.* (2018) and Singh *et al.* (2021) who observed the increasing body weight gain with the increased inclusion levels of DDGS at various levels in broiler diet. Weekly feed intake was observed to be significantly influenced by feeding rDDGS during 2<sup>nd</sup> to 6<sup>th</sup> weeks whereas, non-significant ( $P>0.05$ ) effect of rDDGS supplementation on feed intake was found for 1<sup>st</sup>, 7<sup>th</sup> and 8<sup>th</sup> week of age. Average feed intake was highest for 1<sup>st</sup> week in T<sub>2</sub> (60.56 g) and lowest in T<sub>0</sub> (55.83 g) whereas, for 2<sup>nd</sup> week, it was maximum in T<sub>2</sub> (214.31 g) and lowest in T<sub>3</sub> (157.75 g). Average weekly feed consumption in the 4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> weeks of age was significantly highest in T<sub>2</sub> group with the estimates as 526.48, 715.38 and 925.29 g while it was computed lowest in T<sub>3</sub> with the approximation of 432.00, 493.50 and 780.50 g, respectively. These results are fairly comparable with the finding of Sonu *et al.* (2018), Singh *et al.* (2020) and Thein *et al.* (2020). The increase in feed intake may be due to very high level of non-starch polysaccharides (NSP) in DDGS, which were not digested by the endogenous enzymes of birds, so, birds consumed more feed to overcome the dilution effect of the NSP in order to satisfy their energy and nutrient needs (Barekatin *et al.* 2013). However, corroborated reports for the same trait have been given by Borah *et al.* (2020) and Dinani *et al.* (2019) who stated that DDGS inclusion level in diet decrease feed intake in the broilers.

**Production efficiency:** Results pertaining to production efficiency due to feeding of rDDGS in Kuroiler chicken are given in Table 3. Weekly feed conversion ratio (FCR) was significantly ( $P<0.05$ ) affected by incorporation level of rDDGS as 22.5% (T<sub>3</sub>) during only 1<sup>st</sup> week with the magnitude of 1.06 while least utilization of feed per unit gain in live body weight was in T<sub>0</sub> (without rDDGS). Feeding varying levels of rDDGS have no significant ( $P>0.05$ ) differences on FCR from 2<sup>nd</sup> to 8<sup>th</sup> weeks of age among all the dietary groups. Cumulative feed conversion ratio for various treatments were found to be non-significant which might be due to increase in body weight proportionally with the increase in feed intake. Overall FCRs decreased gradually with the increasing levels of rDDGS at 7.5, 15 and 22.5% in comparison to control group. Present findings are in corroboration with the reports of Sonu *et al.* (2018), Damasceno *et al.* (2020) and Thein *et al.* (2020). However, Borah *et al.* (2020) reported dissimilar findings for this trait. Weekly feed conversion efficiency was significantly ( $P<0.05$ ) influenced by feeding different levels of rDDGS during only 1<sup>st</sup> week and highest FCE was recorded for T<sub>3</sub> (0.94) followed by T<sub>2</sub> (0.80), T<sub>1</sub> (0.80) and T<sub>0</sub> (0.79) which may be due to the highest feed intake during this period. Weekly protein efficiency ratio differed insignificantly ( $P>0.05$ ) for all the age group except for 1<sup>st</sup> week and maximum protein efficiency ratio was found in T<sub>3</sub> (4.35) followed by T<sub>2</sub> (3.74), T<sub>1</sub> (3.70) and T<sub>0</sub> (3.66) dietary groups during the same age group. The present results are in agreement with the findings of Singh *et al.* (2020) whereas, Dinani *et al.* (2019) reported

non-supporting findings to the present results regarding PER in poultry.

Rice Distillers Dried Grains with Soluble (rDDGS) may be used as alternative protein source and can replace soybean meal up to 15% in the diet of Kuroiler chicken without any detrimental effect on their health and productivity.

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