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Effect of inclusion of Rice Dried Distillers Grain Soluble (RDDGS) at varying levels with or without enzyme supplementation on growth performance of Japanese quails

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ABSTRACT

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The study was conducted to assess the effect of dietary incorporation of rice distiller dried grain solubles (RDDGS) with or without enzyme supplementation on growth performance of Japanese quails. Day-old Japanese quails (N=180) were distributed randomly into six dietary groups each with three replicates of 10 birds. Six experimental diets were formulated by inclusion of RDDGS at 0% (Basal diet, T_1), 0% (Basal diet with enzyme, T_2), 20% (T_3), 20% (with enzyme, T_4), 25% (T_5) and 25% (with enzyme, T_6) levels by marginal adjustment of other feed ingredients and fed for a period of five weeks. Results revealed that inclusion of RDDGS up to 20% with enzyme had significant positive influence on body weight and body weight gain ($p<0.01$), lower the feed intake ($p<0.01$) and better FCR ($p<0.01$). The nutrient digestibility wasn't differed significantly. The feed cost per kg live weight gain was significantly lowest in T_4 group (20% with enzyme). Basing on the findings, it can be concluded that RDDGS can be incorporated up to 20 per cent level with enzyme supplementation in diets of quails for economic production.

Keywords: RDDGS, Enzyme, Production parameters, Cost economics, Japanaese quails

INTRODUCTION

Poultry production in India has taken a quantum leap in the last four decades, emerging from conventional farming practices to commercial production systems with state-of-the-art technological interventions (Annual report 2022-2023, DAHD). Among poultry, Japanese quail farming represents a viable option for poultry farmers seeking to fulfil the growing demand for animal protein. Presently, quail stand as the smallest poultry species, distinguished by distinctive traits such as a short life cycle, rapid growth rate, reduced feed consumption, early sexual maturity, a high rate of egg production, great meat taste, and resistance to diseases (El-Katcha *et al.*, 2014; Bansod *et al.*, 2021). Cost of feeding is the decisive factor dictating economic viability of poultry industry. Further, availability of quality feed at reasonable price is also a key for successful poultry production (Basak *et al*., 2002). So, there is a need to look for suitable unconventional feed stuffs which increases the possibility of reducing the cost of production. One such ingredient which gained importance in recent days is RDDGS. India, one of the major producers of rice, is the world's second-largest producer after China; the rice production was 118.43 MT in 2019-20 (Directorate of Economics and Statistics, 2020). RDDGS is the by-product of the dry millling processing of rice alcohol industry. It contains a valuable source of supplemental protein to the tune of 47% similar to 45% in soybean meal (National Research Council, 1989; Chiou *et al*., 1995) and metabolisable energy around 3500 kcal/ kg (Chiou *et al*., 1995). Non-conventional feed ingredients used in feed contain higher percentage of Non-Starch Polysaccharides (NSP's) and antinutritional factors which reduces the efficiency of nutrient utilization. Poultry has not able to produce enzymes for the hydrolysis of NSP's present in the cell wall of the grains and they remain un-hydrolyzed which will result in lower the feed efficiency. If NSP's are broken down by external enzymes thus reducing intestinal viscosity and ultimately enhanced the digestibility of nutrients by increasing the overall gut performance. One of the potential method to ameliorate the negative effects linked to the high level of NSP's in DDGS, as well as to overcome limitations on DDGS inclusion in the diets of monogastric animals, is by the use of exogenous enzymes (Zijlstra *et al*., 2010). Scientific documentation on feeding different levels of RDDGS with or without enzymes in diets of quails is very limited. Considering the above facts in view, the present study was conducted to evaluate the effect of dietary inclusion of Rice distillers dried grain with soluble (RDDGS) with or without enzyme on growth performance of Japanese quails

MATERIALS AND METHODS

Experimental design

One hundred and eighty day-old Japanese quail chicks were individually weighed, wing banded and divided randomly into six equal groups of three replicates each with 10 chicks/replicate. Each group of quail was

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allotted to one of the dietary treatments at random. The experiment was conducted from 0-5 weeks of age by providing *adlibdum* feed and water. The experiment was done as per the institutional animal ethical committee guidelines vide reference number IAEC number: (No. 7 /IAEC/NTRCVSc/2023).

Housing

The birds were kept in colony cages, each replicate in one cage, and the experiment was conducted from December to January. The system is open sided housing system.

Experimental diet

ENZYMEX (Each kg contains (in Lakhs IU). Amylase, 2.00. Xylanase, 15.00. Betaglucanase, 2.50. Cellulase, 4.00. Protease, 2.00. Lipase 1.5, Pectinase 4.0, Phytase 2.0, Probiotic 10000 million, Yeast 50000 million, Growth promoter Q.S) was procured from local market and added at the rate of 250g per tonne of feed. The proximate composition (AOAC, 2005), calcium and phosphorus (Talapatra *et al.,* 1940) contents were estimated in all major ingredients, before to the formulation of experimental diets. Six experiment diets in the form of mash were formulated with 0, 20 and 25% RDDGS inclusion with or without enzyme supplementation (Table.1). All the feeds were prepared as per NRC (1994) standards and compound feed also analyzed for proximate principles.

Performance parameters

Body weight, Bodyweight gains, FI, FCR: At the beginning (day 0) and on days 7, 14, 21, 28, and 35 body weights and feed residue were recorded, basing on the feed residues the feed intake (FI) levels and feed conversion ratio (FCR) were calculated.

Digestibility

In the final 3 days of the trail, faeces were gathered from all the six treatment groups, each comprising of 3 replicates. These quails had been previously fasted for 12 hours and weighed daily. The collected faeces were subjected to 18-hour oven drying process approximately at 105°C temperature, with daily weight measurements. After the collection period, the faecal samples obtained from each treatment for each day were combined, ground and thoroughly mixed to achieve a uniform mixture. These faecal samples underwent proximate analysis following established methods outlined (AOAC, 2005) and the resulting data was utilised to calculate the apparent digestibility using the formula below.

$$\text{Apparent digestibility coefficient} = \frac{\text{Nutrient in feed} - \text{Nutrient in faeces}}{\text{Nutrient in feed}} \times 100$$

Cost economics

Table 1: Ingredient composition of experimental diets fed to J. quails from day 1 to 5 weeks of age.

Feed ingredients (kg)/ (RDDGS %)	T1 (0%)	T2 (0%with enzyme)	T3 (20.0% without enzyme)	T4 (20.0% with enzyme)	T5 (25.0% without enzyme)	T6 (25.0% with enzyme)
Maize	51.1	51.1	51.1	51.1	51.5	51.5
SBM	41.4	41.4	18.9	18.9	13.5	13.5
DORB	4.9	4.9	7.4	7.4	7.4	7.4
RDDGS	0	0	20	20	25	25
DCP	0.01	0.01	0.01	0.01	0.01	0.01
Stone	1.6	1.6	1.6	1.6	1.6	1.6
Salt	0.3	0.3	0.3	0.3	0.3	0.3
Trace mineral*	0.1	0.1	0.1	0.1	0.1	0.1
DL-Methionine	0.1	0.1	0.1	0.1	0.1	0.1
Vitamins#	0.02	0.02	0.02	0.02	0.02	0.02
Palm oil	0.25	0.25	0	0	0	0
Liver tonic	0.05	0.05	0.05	0.05	0.05	0.05
Lysine	0.08	0.08	0.3	0.3	0.3	0.3
Enzyme	0	0.025	0	0.025	0	0.025
Choline	0.1	0.1	0.1	0.1	0.1	0.1
Coccidiostat	0.02	0.02	0.02	0.02	0.02	0.02
Total	100	100	100	100	100	100
Feed cost/kg (₹)	42.58	42.61	35.93	35.95	34.39	34.41

*Trace minerals contains - Manganese sulphate 55000 mg, Ferrous sulphate 50000 mg, Zinc sulphate 50000 mg, Cobalt sulphate 500 mg, Copper sulphate 3000 mg, Potassium iodide 3000 mg, Sodium selenite 500 mg in 1kg.

#Vitamin A-12.50 MIU, D3-2.50 MIU, E-8G, K-1.50g, B1-1g, B2-5g, B5-1.50g, B12-0.02g, Calcium D Pantothenate-5g, Folic acid-0.25g, Niacin-12g in a 250g pack.

The relative economy of rearing quails up to 5 weeks of age by including RDDGS at varying levels in the diets was calculated by considering the prevailing prices of inputs.

Statistical analysis

Statistical analysis of the data was carried out according to the procedures suggested by Snedecor and Cochran (1989). The data obtained were subjected to one-way ANOVA. Differences between means were tested at the 5% probability level using Duncan (1955) LSD test.

RESULTS AND DISCUSSION

The chemical analysis of RDDGS was carried out as per AOAC (2005). Chemical analysis of RDDGS on DM basis revealed that crude protein 46.00%, ether extract 7.82%, total ash 12.88%, crude fibre 6.67%, total phosphorus 0.70% and calcium 0.07%. Khose *et al*. (2021) and Dingore (2014) reported crude protein levels in rDDGS were 46.04 and 49.75%, respectively. The body weight (Table 2) was significantly higher ($p<0.01$) at 20% RDDGS with enzyme (206.37g) when compared to control (184.27g). In line with the present findings, Ghazalah *et al.* (2012) reported increase in body weights in broilers by incorporation of DDGS at 40% level with enzyme and Dorra *et al.* (2013) reported that highest final live body weight values by 20% corn DDGS level with Galzym in diets of broilers as compared to other dietary treatments. Similarly, Talasani *et al.* (2021) concluded that body weight was significantly ($p<0.05$) increased with increasing levels of rice DDGS (0 to 20%) in quails.

The cumulative body weight gain (Table 2) was significantly higher ($p<0.01$) at 20% RDDGS with enzyme (198.17g) when compared to control (176.07g). In corroboration, Ghazalah *et al.* (2012) in broilers and Mikhail *et al*. (2013) in quails also revealed significant increase in body weight gain at 40 and 20% with enzyme, when fed with DDGS. Similarly, El-Abd (2013) and Talasani *et al.* (2021) reported significant improvement in body weight gain in quails by feeding diets with corn DDGS at 100% and increased level of rice DDGS inclusion(0-20%), respectively. This improved body weight gain in quails fed diets, by inclusion of RDDGS with or without enzyme could be related to more available protein and concentrated nutrients of DDGS because of the processing technic, which have come from grain (Babcock *et al.,* 2008).

Cumulative feed intake (g) as g/bird (Table 2) was significantly lower ($p<0.01$) at 20% RDDGS with enzyme (581.97g) when compared to control (620.30g). Similarly, Talasani *et al*. (2021) reported that numerically lowest cumulative feed intake values were recorded at 20% rice DDGS inclusion and Thein *et al*. (2020) reported non-significant difference ($p>0.05$) in cumulative feed intake at all levels but numerically lower feed intake was reported at 20% level. Even though the diets are isocaloric in nature the decrease in feed intake observed in current study might be due to, availability of nutrients as well as enzyme supplementation improved the absorption of the nutrients and further helps in meeting the nutrient demand easily, might be reasons for lowered feed intake.

In the present study, significantly ($p<0.01$) better FCR was reported at 20% RDDGS with enzyme in comparison to control (Table 2). In support of the present findings, Thein *et al*. (2020) reported numerically better FCR at 20% inclusion of rice DDGS in broilers but it was not significant. Similarly, Mikhail *et al*. (2013) reported significantly better ($p<0.05$) FCR at 20% inclusion level of DDGS in quails and Abudabos *et al.* (2017) reported that the broilers fed with Tomoko enzyme showed significantly ($p<0.05$) better feed conversion ratio and Elshika *et al.* (2018) concluded that the interaction between DDGS levels and enzyme supplementation was significant ($p<0.05$) on FCR.

The improved FCR in current study may be due to decreased feed intake and increased body weight gain with supplementation of enzyme at higher levels of incorporation.

DM digestibility was not significantly ($p>0.05$) different among the treatments (Table 3). Similarly,

Table 2: Mean (± S.E) body weight (g) of Japanese quail fed with different levels of RDDGS with or without enzyme supplementation from day old to 5 weeks.

Treatment/RDDGS%	Body weight (g)	Body weight gain (g)	Feed Intake (g)	FCR
T_1 (Control)	184.27^{d}±1.69	176.07^{d}±1.57	620.30^{a}±2.07	3.50^{a}±0.01
T_2 (Control+ E)	187.60^{cd}±2.01	179.40^{cd}±2.89	613.90^{ab}±2.96	3.38^{ab}±0.06
T_3 (20%)	191.87^{cd}±2.05	183.67^{cd}±1.93	606.23^{abc}±3.68	3.27^{bc}±0.01
T_4 (20%+E)	206.37^{a}±2.41	198.17^{a}±2.28	581.97^{d}±2.81	2.88^{e}±0.02
T_5 (25%)	195.47^{bc}±3.40	187.27^{bc}±2.28	600.40^{bc}±3.11	3.17^{c}±0.06
T_6(25%+E)	200.17^{ab}±2.56	191.27^{ab}±2.44	592.83^{cd}±2.63	3.03^{d}±0.05
SEM	1.26	1.22	3.60	0.0523
n	30	30	3	3
p	0.001	0.001	0.003	0.001
SS	**	**	**	**

^{abc}Values in column bearing different super scripts differ significantly ** ($p<0.01$), * ($p<0.05$), NS ($p>0.05$).

Srikala (2017), Shirisha *et al.* (2021) and Elbaz *et al.* (2022) reported no effect (p>0.05) on DM digestibility compared to control. OM digestibility is not significantly (p>0.05) different among the treatments (Table 3).

CP digestibility decreased significantly (p<0.01) as level of RDDGS increased (0 to 25%) with or without enzyme supplementation in the diet (Table 3). Similarly, Mikhail *et al.* (2013) reported a significant decrease in CP digestibility when quails fed diets with 0, 10, 20 or 30% DDGS. On contrary, Abousekken (2014) and Youssef *et al.* (2008) reported non-significant crude protein digestibility in laying quails (0, 10, 15 or 20% DDGS in diet) and in broilers (0, 5, 10 or 15%) respectively with DDGS inclusion in diets.

EE digestibility was not significantly (p>0.05) different among the treatments (Table 3). Similarly, Srikala (2017), Borah *et al.* (2020), and Elbaz *et al.* (2022) also reported that digestibility of EE was not affected (p>0.05) by the inclusion of different levels of DDGS.

CF digestibility was not significantly (p>0.05) different among the treatments (Table 3). Similarly, Borah *et al.* (2020) reported that digestibility of CF was not affected (p>0.05) by the inclusion of different levels of DDGS. On contrary, Srikala (2017) reported that decrease in CF digestibility in grower and J.quail included graded levels of DDGS (10, 15, 20 and 25%) with or without SBY supplementation respectively.

The digestibility of calculated NFE is not significantly (p>0.05) different among the treatments (Table 4). Similarly, Srikala (2017), Borah *et al.* (2020) and Elbaz *et al.* (2022) reported that digestibility of NFE was not affected (p>0.05) by the inclusion of different levels of DDGS.

Feed cost per kg live weight gain was significantly (p<0.01) lower at 20% RDDGS with enzyme level (Table 4). The results were similar with the findings of Ghazalah *et al.* (2011) who reported that hens fed a diet containing 50% DDGS substitution for soybean meal with Avizyme addition were economically best followed by 25% substitution. Ghazalah *et al.* (2012) reported chicken fed diet with 40% DDGS in combination of enzymes recorded the highest economical and relative efficiency

Table 3: Mean (± S.E) digestibility of proximate constituents of diets of Japanese quail fed with varying levels of RDDGS with or without enzyme from day old to five weeks of age.

Treatment	Dry Matter (%)	Organic Matter (%)	Crude Protein (%)	Ether Extract (%)	Crude Fibre (%)	NFE (%)
T_1 (Control)	67.57±0.46	71.20±0.02	64.66^{a}±0.52	83.82±0.53	14.17±0.96	79.31±0.28
T_2 (Control+ E)	67.42±0.34	70.96±0.22	64.07^{ab}±0.66	82.93±0.76	13.96±1.13	79.29±0.12
T_3 (20%)	67.27±0.23	70.36±0.41	62.70^{bc}±0.22	83.16±0.84	13.70±0.92	78.83±0.70
T_4 (20%+E)	66.62±0.33	70.46±0.26	63.21^{abc}±0.31	84.17±0.59	14.39±1.64	79.25±0.22
T_5 (25%)	66.40±0.34	71.76±0.84	61.78^{c}±0.59	82.90±0.25	13.43±1.65	81.89±0.40
T_6(25%+E)	66.39±0.33	71.34±0.28	62.15^{c}±0.28	80.49±0.60	13.21±0.77	80.75±0.36
SEM	0.16	0.18	0.29	0.49	0.40	0.31
n	3	3	3	3	3	3
p	0.098	0.228	0.006	0.357	0.975	0.147
SS	NS	NS	**	NS	NS	NS

^{abc}Values in column bearing different super scripts differ significantly ** (p<0.01), NS (p>0.05).

Table 4: Mean (±S.E) cost economics values of Japanese quail fed with varying levels of RDDGS with or without enzyme from day old to five weeks of age.

Treatment	Cost of feed/ 100 kg (₹)	Cumulative Feed intake (g)	Cost of feed/ bird (₹)	Body Weight gain (g)	Feed cost/kg live weight gain (₹)
T_1 (Control)	4258.15	620.30^{a}±2.07	26.41^{a}±0.09	176.07^{d}±1.57	150.02^{a}±0.51
T_2 (Control+ E)	4260.65	613.90^{ab}±2.96	26.15^{a}±0.25	179.40^{cd}±2.89	145.81^{b}±1.81
T_3 (20%)	3592.75	606.23^{abc}±3.68	21.78^{b}±0.13	183.67^{cd}±1.93	118.59^{c}±0.73
T_4 (20%+E)	3595.25	581.97^{d}±2.81	20.92^{c}±0.10	198.17^{a}±2.28	105.59^{e}±1.03
T_5 (25%)	3438.75	600.40^{bc}±3.11	20.65^{c}±0.21	187.27^{bc}±2.28	110.25^{d}±1.19
T_6(25%+E)	3441.25	592.83^{cd}±2.63	20.40^{c}±0.30	191.27^{ab}±2.44	106.27^{e}±1.61
SEM		3.60	0.62	1.22	4.46
n		3	3	3	3
p		0.003	0.001	0.001	0.001
SS		**	**	**	**

^{abc}Values in column bearing different super scripts differ significantly ** (p<0.01).

values followed by chicken which fed a diet containing 20%. Likely, Dinani *et al.* (2019), incorporated rice DDGS at 0, 7.5, 10, 12.5 and 15% levels in broiler diet and concluded that the cost of production per kg live weight and meat yield were significantly ($p<0.01$) lower at 15% level and Thein *et al.* (2020) also reported significantly ($p<0.05$) lowest feed cost per kg live weight gain at 20% level of DDGS in broilers.

The decreased feed cost/kg gain in 20% RDDGS with enzyme group of quails was observed in the present study might be attributed to better feed efficiency and increased weight gains in quails fed at 20% RDDGS with enzyme level as compared to the other groups. Further, the cost/kg of RDDGS is less when compared with soybean meal, so incorporation at 20% with enzyme had decreased the feed cost.

CONCLUSION

Based on the results of the present study it can be concluded that RDDGS can be included at 20% level along with enzyme in diets of quails to improve overall performance.

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