RESEARCH ARTICLE Indian Journal of Animal Research, Volume 59 Issue 10: 1709-1713 (October 2025)

Effects of Dietary Level of Rice Distiller's Dried Grains on Performance and Meat Quality of Chickens

P.K. Dang[1], N.T.P. Giang[1], T.T. Nguyen[2], S. Chu-Ky[2], N.C. Oanh[1], N.T. Vinh[1], T.T.B. Ngoc[1,3]

10.18805/IJAR.B-1392

ABSTRACT

Background: In Vietnam, animal feed mainly depends on imported raw materials, while available agro-industrial by-products are often released into the environment and only a its unsubstantial portion used as an animal feed. Therefore, efficient use of these by-products as animal feed is essential. This work aimed to evaluate the effect of dietary levels of rice distiller's dried grain (Rice DDG) on broiler performance, meat yield and meat quality.

Methods: The research was conducted at the experimental station, Vietnam National University of Agriculture, Vietnam, from May to September 2020. A total of 240 a day-old broiler chicks were randomly assigned into 4 groups with 3 replications to receive 4 diets with different levels of RDDG at 0, 5, 8 and 10% for 14 weeks. Growth, meat yield and meat quality were estimated.

Result: ADG was higher in broiler chickens fed diets with rice DDG compared to that in control diet at 12 and 14 weeks (P<0.05) while ADFI and FCR were not affected by the diets. There were significantly no differences in meat yield and quality among the diets. In conclusion, rice DDG could be used to partially replace main ingredients in chicken diets.

Key words: Meat yield and quality, Performance, Rice distiller's dried grain.

INTRODUCTION

Distillers dried grain (DDG) is a co-product of ethanol production from cereal grains. DDG contains high protein, lipid, mineral, fiber content and other unfermented components of the grain and yeast cells (Oanh *et al.*, 2019a; Salim *et al.*, 2010). Hence, DDG has been of great interest to researchers in the area of animal science, especially to the animal feeding industry as the majority of this has been sold as feed ingredients for livestock (Dinani *et al.*, 2018; Dipak *et al.*, 2019; Oanh *et al.*, 2019b; Raju *et al.*, 2021).

In Vietnam, feed production is primarily depending on imported raw materials resulting in domestic livestock products more uncompetitive compared to imported animal products. Therefore, to reduce the production cost, the use of local feed resources and agro-industrial by-products is essential. Rice distillers dried grain (rice DDG) is a by-product of ethanol production from rice grains. Rice DDG contains 70.4% crude protein (approximately 3.6% lysine), 9.7% lipid, 2.9% crude fiber (Taranu *et al.*, 2019). This by-product is considered as good source of protein for animal production. In previous study which showed that broiler chickens fed diets with inclusions of rice DDG at up to 12.5% had no differences in daily gain, feed intake, feed to gain ratio in comparison with control standard diet.

Previous studies have shown that the safe ratio of DDG in the diet is 5-8% (early stage for broilers and turkeys), 10-15% (in fattening-stage for broilers, turkey and layer hens), with these proportions being part of the cost of using soybean meal and corn or other expensive grains (Batal and Dale, 2003; Lumpkins *et al.*, 2004). These authors also showed that laying hen diets containing 15% corn DDG would reduce egg productivity in layer hens because these by-products have a high proportion of crude fiber and non-starch polysaccharides. Around the world, DDG by-products of alcohol processing from corn and wheat have been widely used in livestock production in the past 15 years. However, by-products from rice-based ethanol processing are little researched and used as animal feed. Therefore, this study aimed to evaluate the effect of dietary level of rice DDG on performance, meat yield and quality of broiler.

[1]Faculty of Animal Science, Vietnam National University of Agriculture, Gialam, Hanoi 131000, Vietnam.
[2]School of Biotechnology and Food Technology, Hanoi University of Science and Technology, 1 Dai Co Viet Hai Ba Trung, Hanoi 100000, Vietnam.
[3]National Institute of Animal Sciences, Bac Tu Liem, Hanoi 29909, Vietnam.

Corresponding Author: T.T.B. Ngoc, National Institute of Animal Sciences, Bac Tu Liem, Hanoi 29909, Vietnam.
Email: bichngocniah75@hotmail.com

How to cite this article: Dang, P.K., Giang, N.T.P., Nguyen, T.T., Chu-Ky, S., Oanh, N.C., Vinh, N.T. and Ngoc, T.T.B. (2025). Effects of Dietary Level of Rice Distiller's Dried Grains on Performance and Meat Quality of Chickens. *Indian Journal of Animal Research*. **59(10):** 1709-1713. doi 10.18805/IJAR.B-1392.

Submitted: 28-05-2021 **Accepted:** 23-09-2021 **Online:** 11-10-2021

MATERIALS AND METHODS

Animals, experimental design and diets

The experiment was carried out on Ri - DABACO colored broilers from birth to 14 weeks of age at the experimental

station of Faculty of Animal Science, Vietnam National University of Agriculture, Vietnam from May to September 2020.

A total of 240 birds were arranged into 4 dietary treatments, including a basal diet (control, DDG0) and 3 experimental diets containing 5% (DDG5), 8% (DDG8) and 10% (DDG10) of rice DDG according to a completely randomly design, with three replications. Each replication comprises 20 birds (10 males and 10 females). All animals were individually numbered, housed in pens and given feed, clean and fresh water *ad libitum*.

Wet distiller grain samples from a rice-based beverage ethanol distillery located in Phu Tho province (North Vietnam) was collected immediately after production. These samples were then dried at 90°C for 30 min, 80°C for 2.5-3.0 h and 70°C for 1.0 h respectively. After that, rice DDG was packed in a plastic bag and stored at room temperature for further chemical analysis.

The basal diet (DDG0) was formulated to meet the nutrient requirements of broilers according to NRC (1994). The other experimental diets were established by the partial replacement of soybean meal in the basal diets to different levels of rice DDG. After the individual feed was made, a representative sample was taken from each dietary treatment for the determination of chemical compositions. The ingredients and chemical composition of the diets are presented in Table 1. Rice DDG and diets were analyzed for moisture, crude protein, fat, ash, calcium, phosphorous, crude fiber (AOAC, 1990), starch was determined by the method as previously described (Le *et al.*, 2006). For amino acids analysis, the HPLC analysis of the Agilent 1200 series (Germany) with a DAD detector was performed.

Measurements

Chickens were individually weighed every week from the initial day to the final day of the experiment for calculation of the body weight and average daily gain (ADG). Average daily feed intake (ADFI) was determined daily per pen by measuring feed residues. The feed conversion ratio (FCR) was calculated by dividing feed intake by body weight gain.

At the end of the experiment, for each treatment, six chickens (3 males and 3 females) with weight around the average weights of birds were used to evaluate carcass characteristics such as carcass, heart, liver, thigh and breast weight.

Muscle pH

At 15 min and 24 h post-mortem, the breast and leg muscle pH was respectively determined at a depth of 2.5 cm below the surface by using Testo 230 (Germany).

Color measurement

Surface color of chicken rolls was measured in package using a Minolta CR-410 (Japan) colorimeter and expressed as color L*(lightness), a*(redness) and b*(yellowness) values as previously described (Oanh *et al.*, 2019a).

Tenderness

Tenderness of thigh and breast muscle 24 h post-mortem was evaluated by using Warner - Bratzler 2000D machine (USA).

Statistical analysis

The effect of different levels of rice DDG in the diets on performance and meat yield and quality of broilers were determined by one-factor variance analysis using SAS 9.1 (2002). The statistical model was:

$$Y_{ij} = \mu + F_i + e_{ij},$$

Where

Y_{ij} = Observed values.

μ = Average normalized record.

F_i = Effect of different levels of rice DDG in the diets (i = 4: 0, 5, 8, 10).

e_{ij} = Residual error.

Table 1: Ingredient and chemical composition of dietary treatments.

Items	Dietary treatments			
	DDG0	DDG5	DDG8	DDG10
Ingredient (%)				
Bone meal 50%	5	3	2	3
Rice bran	5.5	7	7	5
Wheat bran	3.5	5	7.5	5
Rice DDG	-	5	8	10
Fish meal	1.6	1.5	1.7	1.7
Soybean meal 46%	18	13	10	8
Maize	58	57.5	55	59
Wheat	7	5	5	5
Choline Chloride 60%	0.07	0.07	0.07	0.07
DL - Methionine 99%	2.5	0.2	0.18	0.11
L- Lysine 98%	0.25	0.32	0.35	0.35
L - Threonine 98.5%	0.07	0.1	0.12	0.08
Carophill Red 1%	0.06	0.06	0.05	0.06
Yellow 2%	0.09	0.09	0.1	0.1
Kemzyme V[1]	0.05	0.05	0.05	0.05
Phytase 5000	0.01	0.01	0.01	0.01
Bacillus Eco[2]	0.05	0.05	0.05	0.25
Mineral vitamin premix[3]	0.25	0.25	0.25	0.2
Limestone	1	1.5	1.5	1.5
Dicalcium phosphate	0.2	1	1.1	1.0
Salt	0.22	0.22	0.22	0.22
Chemical composition (% DM)				
ME, kcal/kg	3000	3000	3025	3050
Crude protein	17.8	18.1	18.7	19.2
Lipids	5.3	5.3	5.3	5.3
Crude fiber	3.2	3.4	3.4	3.4
Ash	4.5	4.8	4.8	4.8
Calcium	1.05	1.09	1.09	1.09
Phosphorus	0.65	0.7	0.7	0.7
Na	0.175	0.175	0.175	0.175
Lysine	1.05	1.05	1.05	1.05
Methionine	0.5	0.51	0.51	0.51
Threonine	0.7	0.7	0.7	0.7
Tryptophan	0.175	0.19	0.2	0.2

Treatment means were compared by Duncan's new multiple range test.

RESULTS AND DISCUSSION

Nutritional values of rice DDG

The result of chemical compositions and nutritional values of rice DDG analysis show that rice DDG has relatively high contents of crude protein (70.4%), digestible energy (DE, 5791 kcal/kg) and ME (4592 kcal/kg). The amino acid content in rice DDG is also quite high with 3.6% lysine, 2.6% tryptophan and 2.1% threonine. However, crude fiber content (2.9%) was low in rice DDG (Table 2). The nutritional value of rice DDG was mentioned in a previous studies (Dinani *et al.*, 2018; Oanh *et al.*, 2019b; Taranu *et al.*, 2019). Being compared to other DDG sources, rice DDG contained more protein, thus higher in amino acid content. Several authors reported that the protein content in corn DDGS was ranged from 26 to 32% (Belyea *et al.*, 2010; Spiehs *et al.*, 2002) with lysine, methionine and threonine were 0.89, 0.53 and 1.14% respectively. Similarly, the wheat DDG contained 38.48% crude protein, 0.97% lysine, 0.36% tryptophan and 1.09% threonine (Cozannet *et al.*, 2009). Thus, with high protein, amino acid and low fiber content, rice DDG can be a potential source of raw materials to replace protein-rich feeds for poultry.

Table 2: Chemical compositions and nutritional values of rice DDG.

Item (% DM)	Mean	SD
Crude protein	70.39	2.56
Starch	10.06	1.78
Crude fiber	2.88	0.27
Fats	9.75	0.71
Ash	2.88	0.19
Calcium	0.03	0.007
Phosphorus	0.37	0.02
DE (kcal/kg)	5791	0.56
ME (kcal/kg)	4952	0.34
Lysine	3.60	0.25
Tryptophan	2.55	0.14
Threonine	2.09	0.10

Effect of rice DDG on production parameters

There were no significant differences among treatments in body weight of broilers at 4 and 8 weeks of age (Table 3). However, at 12 and 14 weeks of age, chickens fed with diets containing different levels of rice DDG were higher in body weight than chickens fed the control diet (P<0.05). From 4 to 8 and from 8 to 12 weeks of age, the ADG was not significantly different (P<0.05) by levels of rice DDG in the diet. However, in the period of 12-14 and 4-14 weeks of age, ADG was a significant difference among treatments (P<0.05) with the greatest values for the diet containing 10% rice DDG and followed by 8 and 5% rice DDG in the diets. The level of rice DDG in the diet did not significantly affect ADFI and FCR. In some previous studies have shown that distillers dried grains with solubles (DDGS) did not affect ADG, ADFI and FCR of broiler chickens (Sariozkan *et al.,* 2015; Thein *et al.,* 2020; Wang *et al.*, 2007). Some others indicated that the use of DDGS in the diets improved the growth performance (Kaya and Şahin, 2013; Shim *et al.*, 2011). Dinani *et al.* (2018) found that broiler diet containing 15% rice DGS reduced ADG, ADFI and FCR. The different above results may be due to the different grain DDGS sources, nutritional values of DDGS sources and the different levels of DGS used in the diets, as well as different broiler breeds. In this study, the usage of rice DDG up to 10% in the diets resulted in a positive effect on body weight and ADG at 12 and 14 weeks of age.

Effect on meat yield and quality

Different levels of rice DDG used in the diets did not significantly affect meat yield and quality (Table 4). The results of this study are consistent with some previous studies

Table 3: Effect of dietary inclusion level of rice DDG on performance of broilers.

Items	Dietary treatments				SEM	P
	DDG0	DDG5	DDG8	DDG10		
Body weight (g/bird)						
4 week of age	358.5	369.8	365.5	358.3	3.12	0.06
8 week of age	987.0	998.8	1007.8	1011.0	7.81	0.18
12 week of age	1583.8^{b}	1603.5^{a}	1601.8^{a}	1603.3^{a}	2.60	<0.01
14 week of age	2089.5^{b}	2157^{a}	2164.5^{a}	174.3^{a}	5.36	<0.01
Average daily gain (g/bird/day)						
4-8 week of age	22.45	22.46	22.94	23.31	0.24	0.08
8-12 week of age	21.31	21.59	21.21	21.15	0.23	0.54
12-14 week of age	36.13^{c}	39.54^{b}	40.19^{ab}	40.79^{a}	0.38	<0.01
4-14 week of age	24.73^{c}	25.53^{b}	25.70^{b}	25.94^{a}	0.06	<0.01
Average daily feed intake (g/bird/day)	81.32	80.82	79.68	80.07	3.92	0.99
Total feed intake (g/bird)	5931	5903.5	5821.5	5847.5	94.29	0.84
Feed conversion ratio (kg/kg)	3.29	3.17	3.11	3.09	0.16	0.79

Mean in the same row with different superscripts are significantly different (P<0.05).

Table 4: Effect of dietary inclusion level of rice DDG on meat yield and quality.

Items	Dietary treatments				SEM	P
	DDG0	DDG5	DDG8	DDG10		
Meat yield						
Live weight (g)	1999.5	2005.3	2012.5	2085.3	301	0.71
Carcass weight (g)	1447.6	1442.2	1447.6	1503.1	214	0.35
Carcass percentage (%)	72.40	71.92	71.93	72.08	2.54	0.59
Heart and liver (g)	50.82	50.97	51.15	53.00	8.23	0.64
Thigh (g)	180.5	181.0	181.7	188.2	30.3	0.72
Breast (g)	135.8	136.1	136.6	141.6	15.5	0.61
Meat quality						
pH 15 min	6.30	6.29	6.26	6.27	0.15	0.38
pH 24 h	6.13	6.08	5.98	6.09	0.18	0.93
L* (lightness)	50.42	51.81	50.89	50.63	1.26	0.45
a* (redness)	16.15	15.67	16.74	16.62	0.72	0.48
b* (yellowness)	11.90	11.78	11.61	11.54	1.64	0.89
Tenderness (N)	22.62	21.98	21.24	21.88	3.82	0.58

(Dinani *et al.*, 2018; Raju *et al.*, 2021) which also found that the use of rice DGS in chicken diets did not affect carcass traits. Similarly, the diets containing 10-15% DDGS had similar carcass yield to the control (Sariozkan *et al.*, 2015; Wang *et al.*, 2007). Moreover, Youssef *et al.* (2013) found that using 10-15% DDGS as a protein source in broiler diets did not have any significant effect on the weight of organs such as the heart, liver and gizzard. On the other hand, broiler chickens fed diets containing inclusion of rice DDG levels also had no significant effect on meat color parameters (L*, a* and b*), which are consistent with earlier works (Choi *et al.*, 2008; Schilling *et al.*, 2010).

CONCLUSION

Inclusion of 5, 8 and 10% rice DDG in the diet for broilers did not affect body weight, average daily gain in the early experimental period (4-8 weeks of age) but had a positive effect on these parameters in the post-experimental period (12-14 weeks of age). Feed intake, feed conversion ratio, meat yield and quality were not significantly affected by the dietary inclusion level of rice DDG. It could be suggested that rice DDG can be a potential source of raw materials to replace protein-rich feeds for poultry.

ACKNOWLEDGEMENT

The authors acknowledge financial support from the Ministry of Science and Technology (Vietnam) and the Ministry of Education and Scientific Research (Romania) via the bilateral project (Grant No. 15/2014/HD-NDT).

Conflict of interest

All authors declare that they have no conflict of interest.

REFERENCES

AOAC. (1990). Official Methods of Analysis. Association of Official Analytical Chemists, 15th Edn, Washington, DC.

Batal, A. and Dale, N. (2003). Mineral composition of distillers dried grains with solubles. *Journal of Applied Poultry Research*. **12:** 400-403.

Belyea, R.L., Rausch, K.D., Clevenger, T.E., Singh, V., Johnston, D.B., Tumbleson, M.E. (2010). Sources of variation in composition of DDGS. *Animal Feed Science and Technology*. **159:** 122-130.

Choi, H.S., Lee, H.L., Shin, M.H., Jo, C., Lee, S.K., Lee, B.D. (2008). Nutritive and economic values of corn distiller's dried grains with solubles in broiler diets. *Asian-Australasian Journal of Animal Sciences*. **21:** 414-419.

Cozannet, P., Primot, Y., Metayer, J.P., Gady, C., Lessire, M., Geraert, P.A., Tutour, L. le, Skiba, F. and Noblet, J. (2009). Wheat dried distiller grains with solubles for pigs. *INRA Productions Animales*. **22:** 11-16.

Dinani, O.P., Tyagi, P.K., Mandal, A.B., Tyagi, P.K., Dutta, N. (2018). Evaluation of feeding value of rice based distillers dried grains with solubles (DDGS) for broiler chickens. *Indian Journal of Animal Research*. **53(7):** 901-906. doi: 10.18805/ijar.B-3607.

Dipak, D., Sharma, B., Mohammad, A., Mandal, D.K., Bhakat, C., Dutta, T.K., Chatterjee, A. (2019). Effect of feeding rice distillers dried grain with solubles as major protein source on nutrient digestibility and growth performance of Jersey crossbred calves. *Indian Journal of Animal Research*. **54(4):** 446-451. doi: 10.18805/ijar.B-3788.

Kaya, Ö. and Şahin, T. (2013). Effects of different levels distillers dried grains with solubles on growth performance, carcass quality and some blood parameters in broilers. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*. **19:** 161-166.

Le, T.M., Nguyen, T.H., Pham, T.T., Nguyen, T.H., Le, T.L.C. (2006). Analytical Methods in Fermentation Technology. Science and Technology Publishing House, Vietnam.

Lumpkins, B.S., Batal, A.B., Dale, N.M. (2004). Evaluation of distillers dried grains with solubles as a feed ingredient for broilers. *Poultry Science*. **83:** 1891-1896.

NRC. (1994). National Research Council. Nutrient Requirements of Poultry, 9th Edn, Washington, DC.

Oanh, N.C., Bernard, T., Kim, D.P., Luc, D.D., Nassim, M., Huyen, N.T., Thinh, N.H., Georges, D., Jérôme, B., Ton, V.D., Hornick, J.L. (2019a). Growth performance, carcass quality characteristics and colonic microbiota profiles in finishing pigs fed diets with different inclusion levels of rice distillers' by-product. *Animal Science Journal*. **90:** 948-960.

Oanh, N.C., Dang, P.K., Bindelle, J., Ton, V.D., Hornick, J.L. (2019b). In growing pigs, nutritive value and nutrient digestibility of distillers' by-products obtained from two varieties of rice. *Tropical Animal Health and Production*. **51:** 1679-1687.

Raju, M.V.L.N., Rama Rao, S.V., Prakash, B. (2021). Performance, serum biochemical profile, slaughter characteristics and nutrient retention of vanaraja chicks fed rice-based distillers dried grains with solubles in diet. *Indian Journal of Animal Research*. **56(22):** 182-186. doi: 10.18805/IJAR.B-4190.

Salim, H.M., Kruk, Z.A., Lee, B.D. (2010). Nutritive value of corn distillers dried grains with solubles as an ingredient of poultry diets: A review. *World's Poultry Science Journal*. **66:** 411-432.

Sariozkan, S., Konca, Y., Guclu, B.K., Kanber, K., Ildiz, N., Kirkpinar, F., Beyzi, S.B., Kaliber, M. (2015). Effects of dietary supplementation of dried distillers grain with solubles (DDGS) and yucca (Yucca schidigera) on broiler performance, carcass traits, intestinal viscosity and marketing. *Journal of Poultry Research*. **12:** 5-11.

Schilling, M.W., Battula, V., Loar II, R.E., Jackson, V., Kin, S., Corzo, A. (2010). Dietary inclusion level effects of distillers dried grains with solubles on broiler meat quality. *Poultry Science*. **89:** 752-760.

Shim, M.Y., Pesti, G.M., Bakalli, R.I., Tillman, P.B., Payne, R.L. (2011). Evaluation of corn distillers dried grains with solubles as an alternative ingredient for broilers. *Poultry Science*. **90:** 369-376.

Spiehs, M.J., Whitney, M.H., Shurson, G.C. (2002). Nutrient database for distiller's dried grains with solubles produced from new ethanol plants in Minnesota and South Dakota. *Journal of Animal Science*. **80:** 2639-2645.

Taranu, I., Nguyen, T.T., Pham, K.D., Gras, M.A., Pistol, G.C., Marin, D.E., Rotar, C., Habeanu, M., Ho, P.H., Le, T.M. (2019). Rice and cassava distillers dried grains in Vietnam: Nutritional values and effects of their dietary inclusion on blood chemical parameters and immune responses of growing pigs. *Waste and Biomass Valorization*. **10:** 3373-3382.

Thein, S.M., Thu, T.M., Thu, K.L., Thu, W.W.W., Thae, C., Thet, M., Thant, M.K., Thant, K.Z., Thant, M., Than, Z.M. (2020). Effects of dietary supplementation of rice distillers dried grains in grower phase on growth performance and digestibility of broiler chicken. *Advances in Animal and Veterinary Sciences*. **8:** 444-451.

Wang, Z., Cerrate, S., Coto, C., Yan, F., Waldroup, P.W. (2007). Utilization of distillers dried grains with solubles (DDGS) in broiler diets using a standardized nutrient matrix. *International Journal of Poultry Science*. **6:** 470-477.

Youssef, A.W., Abd El-Azeem, N.A., El-Daly, E.F., El-Monairy, M.M. (2013). The impact of feeding graded levels of distillers dried grains with solubles (DDGS) on broiler performance, hematological and histological parameters. *Asian Journal of Poultry Science*. **7:** 41-54.