



Impact of Rice Distillers Dried Grains with Solubles (RDDGS) on Nutrient Utilization of Nagavali Ram Lambs

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ABSTRACT

Rice Distillers Dried Grains with Soluble (RDDGS) is a byproduct generated during the production of ethanol. The present study was aimed to assess the impact of incorporating Rice Distillers Dried Grains with Soluble (RDDGS) by substituting soybean meal in the concentrate mixture on the growth, digestibility, and cost economics of Nagavali ram lambs. Twenty-four lambs were randomly assigned into four treatment groups. In the treatment groups, soybean meal was replaced with RDDGS at 0% (T₁), 50% (T₂), 75% (T₃), and 100% (T₄) levels. Our results inferred that replacing of soyabean meal with different concentrations of RDDGS did not significantly (P>0.05) affect dry matter Intake (DMI and feed conversion ratio. Further, gross digestibility of different nutrients and cell wall constituents were also unaffected. The cost of feed per kg of weight gain was significantly (P<0.05) reduced. The cost of feed/kg gain was significant (P<0.05) because of the replacement of soybean meal with RDDGS. T₂, T₃, and T₄, showing decreases of ₹ 11.23, ₹ 17.59, and, respectively, in comparison to the control (T₁). We conclude that, complete replacement of soyabean meal with DDGS is possible in sheep without compromising the nutrient efficiency and reduces the cost of production per kg body weight by 12.7% leading to reduced cost of production.

HIGHLIGHTS

- ❶ Complete replacement of soyabean meal with DDGS is possible in sheep.
- ❷ This replacement can reduce the cost of production per kg body weight by 12.7%.

Keywords: RDDGS, Growth, Ram lambs, Digestibility, Cost economics

Sheep rearing is one of the viable options for sustainable rural livelihoods, particularly in semi-arid and arid regions, playing a crucial role in the Indian economy (Benerjee, 2018). Besides providing socioeconomic security in rural areas, sheep rearing provides nutritional security in the form of mutton and supports textile industry through supply of wool. According to the 20th Livestock Census of the Government of India (2019), there are approximately 74.26 million sheep in the country. However, sustainable animal production faces significant challenges, including the scarcity of nutrients in multiple dimensions and the high costs associated with conventional feed ingredients. The traditional protein sources in livestock feeds like soybean meal are becoming disproportionately expensive

to include them at required levels in the rations. To address these challenges, identifying alternative ingredient with comparable protein content becomes imperative. While making such replacements, the substitute feeds must be evaluated for their safety of feeding, maximum level of replacement without compromising the health and productivity. In the current scenario, Rice Distillers Dried Grain with Solubles (RDDGS) emerges as a promising agro-industrial byproduct. The increasing emphasis on ethanol blending with petrol by the government suggests

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a growing availability of grain-based DDGS in the foreseeable future. This product is characterized by its richness in energy and protein at a lower cost compared to conventional feed ingredients like soybean meal (Dinani *et al.*, 2019). Also, the RDDGS lacks any anti-nutritional factors, making it an economically suitable alternative source in animal diets, serving either as a protein source or an energy source. This flexibility depends on the specific nutrient requirements of the animals, the type of diet being fed, and economic considerations. The primary objective of the current experiment is to investigate the impact of replacing soybean meal with RDDGS on the growth performance, nutrient digestibility, and cost economics in ram lambs. This research aims to contribute valuable insights into enhancing the sustainability and efficiency of sheep rearing practices.

MATERIALS AND METHODS

The current experiment was designed to assess in RDDGS in ram lambs through digestion trial. It was carried out in the Livestock Research Station in Garividi, Nagavali

district, Andhra Pradesh. A total of twenty-four ram lambs, aged between 3 to 4 months and weighing 9-11 kg, were divided into four groups, with each group consisting of six animals. The completely randomized design (CRD) was followed for experimental design. During the 90-day of growth trial, animals were provided ad libitum Super Napier and the respective concentrate mixture corresponding to each treatment. In the control group (T_1), the concentrate mixture was formulated using traditional feed ingredients and soybean meal. For treatments, T_2 , T_3 , and T_4 , soybean meal (SBM) was substituted with Rice Distillers Dried Grains with Solubles (RDDGS) at 50%, 75%, and 100% levels, respectively, in the concentrate mixture. The ingredient compositions (iso nitrogenous) of concentrate mixtures of all four treatment groups are detailed in Table 1. The animals were individually housed in pens and received Super Napier as source of roughage and concentrate mixture separately at 9:00 AM and 3:00 PM daily. They had unrestricted access to clean water throughout the day. A daily record was maintained for the feed intake and leftovers (orts). The rations were computed as per body weights of the experimental animals following

Table 1: Ingredient and chemical composition (% DM basis) of experimental diets fed to ram lambs

Nutrient	Super Napier	RDDGS	CM-1	CM-2	CM-3	CM-4
Ingredient composition (%DM basis)						
Maize	—	—	31	34	35	31
DORB	—	—	36	33	32	36
Soybean meal	—	—	30	15	7.5	0
Rice DDGS	—	—	0	15	22.5	30
Mineral mixture	—	—	2	2	2	2
Salt	—	—	1	1	1	1
Chemical composition (%DM basis)						
Dry matter	24.32	91.02	91.34	91.30	91.32	91.33
Organic matter	88.05	94.18	90.67	91.15	90.57	91.28
Crude protein	11.68	47.32	20.05	20.07	20.07	20.08
Ether extract	3.47	6.25	2.96	2.78	3.43	3.84
Crude fibre	37.95	5.70	14.76	15.17	12.84	12.23
Nitrogen free extract	34.95	34.91	52.90	53.13	54.23	55.13
Total ash	11.95	5.82	9.33	8.85	9.43	8.72
Neutral detergent fibre	77.75	41.12	33.92	33.23	32.16	33.09
Acid detergent fibre	42.27	22.78	15.87	14.63	16.08	15.56
Hemi-cellulose	35.48	18.33	18.05	18.6	16.08	17.53
Cellulose	36.54	9.58	13.14	11.55	10.69	15.14
Acid detergent lignin	7.14	9.70	8.63	5.86	6.33	6.78
Silica	3.66	1.34	1.71	1.49	1.57	1.65
Calcium (%)	0.50	0.83	0.61	0.65	0.81	0.70
Phosphorous (%)	0.41	0.89	0.69	0.83	0.79	0.66

the ICAR (2013) feeding standards. Rations were revised as per the fortnightly body weight changes. The chemical composition of the concentrate mixture is presented in Table 1. During the midpoint of the 90-day growth trial, a 6-day digestion trial was conducted. Samples of feedstuffs and orts were collected at 24-hour intervals and dried in triplicate at 100°C in a hot air oven. Following the drying process, samples of feed, feces, and orts were analyzed for proximate composition according to AOAC (2005). Additionally, the cell wall constituents were determined based on the method outlined by VanSoest *et al.* (1991). The data were subjected to one-way analysis of variance procedure using SPSS (2012), using the linear model. The post-hoc comparison of means was done for the significant difference by Duncan multiple range tests. Significant differences of treatments were considered at ($P < 0.05$).

RESULTS AND DISCUSSION

Dry Matter Intake

Daily Dry Matter Intake (DMI) remained similar across all treatments, and this is in line with earlier reports (Huls *et al.*, 2006; Abdelrahim *et al.*, 2014) that yielded similar results. Similarly, McKeown *et al.* (2010) observed that DDGS from corn, wheat, or triticale could replace a mixture of barley grain and canola meal at 20% of the diet DM without altering DMI. Similarly, Rao (2023) also reported that the inclusion of RDDGS up to 30% level, by replacing SBM and gingelly cake, had no effect ($P > 0.05$)

on DMI in Murrah buffalo bull calves. Chandrika *et al.* (2021) in buffalo calves reported that inclusion of RDDGS up to 75% levels had no effect ($P > 0.05$) on DMI. In contrast, Islas *et al.* (2014) reported that supplementation of DDGS at 0.5% and 1% body weight had significant ($P < 0.001$) effect on DMI, both in terms of kg/d and as % BW in calves while, Yang *et al.* (2012) reported that inclusion of wheat DDGS up to 35 % replacing barley grain or barley silage led to linear decrease ($P < 0.01$) in the DMI.

Nutrient digestibility

The digestibility of DM, OM, CP, EE, CF, and NFE (Table 2) remained unaffected ($P > 0.05$) by the inclusion of DDGS up to 100% levels. The absence of differences in digestibility coefficients could be attributed to equal Dry Matter Intake (DMI) across all groups. Consistent with these findings, Singh *et al.* (2021) reported that replacing soybean meal in the concentrate mixture upto 20% with RDDGS did not show any significant effect on the digestibility of nutrients (DM, CP, EE, and CF) among the groups in osamabadi goats. Singh *et al.* (2018) also reported that replacing oil cakes with RDDGS upto 50% levels in murrah heifers did not influence ($P > 0.05$) on DM and CP digestibility. Reddy *et al.* (2021) observed in Nellore ram lambs that replacing PNC with DDGS up to 75% levels did not result in significant ($P > 0.05$) differences in DM, OM, and CP digestibility. Hatamleh and Obeidat (2019) reported that the inclusion of DDGS did not depress ($P > 0.05$) DM and CP digestibility in all

Table 2: Nutrient digestibility in ram lambs fed with different diets

Parameters ^{NS}	Nutrient Digestibility (%)			
	T ₁	T ₂	T ₃	T ₄
DM	65.42 ± 0.89	65.94 ± 0.42	66.05 ± 0.63	66.71 ± 0.47
OM	68.42 ± 0.83	69.13 ± 0.35	69.00 ± 0.61	69.72 ± 0.45
CP	70.73 ± 0.71	71.63 ± 0.36	71.01 ± 0.23	71.04 ± 0.89
CF	75.25 ± 1.65	76.91 ± 0.99	76.66 ± 1.08	76.19 ± 1.79
EE	56.69 ± 1.42	57.36 ± 0.31	57.08 ± 0.93	57.84 ± 0.66
NFE	76.48 ± 0.40	76.87 ± 0.39	76.51 ± 0.52	76.53 ± 0.36
NDF	61.73 ± 0.98	62.20 ± 0.50	62.17 ± 0.82	62.90 ± 0.63
ADF	55.10 ± 1.22	55.28 ± 0.85	55.56 ± 0.96	55.61 ± 1.08
Cellulose	61.88 ± 1.93	61.68 ± 0.40	61.73 ± 0.84	61.91 ± 0.73
HC	65.42 ± 1.14	65.52 ± 1.35	65.08 ± 0.49	65.96 ± 0.70

treatments. In contrast, Matheny *et al.* (2016) noted a linear increase ($P<0.05$) in the digestibility of DM, OM, and CP with the rising concentration of DDGS in dairy heifers.

The digestibility coefficients of NDF, ADF, hemicellulose, and cellulose (Table 2) remained consistent across different levels of RDDGS in the diet. In line with the present findings, Reddy *et al.* (2021) reported that replacing PNC with DDGS up to 100% in lamb diets had no significant ($P>0.05$) effect on the digestibility of NDF and ADF. Hatamleh and Obeidat (2019) similarly found no significant impact ($P>0.05$) on NDF and ADF digestibility with the inclusion of DDGS in lamb diets. Manthey *et al.* (2016) observed that increasing DDGS levels had no effect ($P>0.01$) on the digestibility of NDF and ADF in dairy heifers. Dey *et al.* (2020) reported that replacing soybean meal with RDDGS at 100% level in the concentrate mixture had no significant effect ($P>0.05$) on NDF and ADF digestibility in Jersey crossbred calves.

Nutrient intake and FCR

The digestible CP and TDN intake values (Table 3) remained comparable across all treatments, without any significant differences among different treatment groups. In alignment with the results of current study, Hatamleh and Obeidat (2019) noted that the inclusion of DDGS did not yield a significant ($P>0.05$) effect on CP intake. Similarly, Chandrika *et al.* (2021) observed in buffalo calves that the inclusion of RDDGS up to 75% levels had no significant ($P>0.05$) impact on CP and TDN intake. The Feed Conversion Ratio (FCR) values (Table 3) ranged from 11.19 to 11.36. Feed conversion ratio (kg DMI/kg gain)

remained unaffected at 100% replacement of soybean meal with DDGS in the concentrate mixture for growing ram lambs. However, a more favorable FCR was reported at 100% replacement of RDDGS. These findings align with studies conducted by Schauer *et al.* (2008) and Huls *et al.* (2006), both of which found no significant difference in the feed-to-gain ratio when DDGS substituted part of the maize and soybean meal.

Cost economics

The cost analysis of live weight gain in ram lambs, fed diets incorporating RDDGS is presented in Fig. 1. The average daily feed cost (₹/head/d) was decreased with inclusion of RDDGS (Table 3). A noteworthy ($P<0.05$) reduction in daily feeding cost per ram lamb was observed when substituting SBM with RDDGS up to 100% levels. The cost of feed per kilogram gain (₹/kg gain) was significantly ($P<0.05$), reduced by 5.4%, 8.4% and 12.7% in T_2 , T_3 , and T_4 groups, respectively in comparison with control group. It reveals that there was a substantial reduction ($P<0.05$) in the cost per kilogram of gain in treatments T_2 , T_3 , and T_4 , showing decreases of ₹ 11.23, ₹17.59, and ₹ 26.64, respectively, in comparison to the control (T_1). Consistent with these findings, Chandrika *et al.* (2021) demonstrated a significant ($P\leq0.05$) reduction of 15.67% in feed cost per kilogram of body weight gain in T_1 (50% RDDGS) and a 19.36% reduction in T_2 (75% RDDGS) compared to the control group. Omer *et al.* (2015) also noted a decrease in feed cost/kg gain by 24.89% and 29.83% at 25% and 50% replacement of cottonseed cake with corn DDGS in crossbred calves. Singh *et al.* (2018) reported a decrease in feed cost per kg gain/animal by ₹ 14.90 and ₹ 13.27 at 50% and 75% levels of replacement of oil cake with

Table 3: Nutrient intake cost economics

Parameters	T_1	T_2	T_3	T_4
Nutrient intake (g/d)				
DCP	71.2	71.5	71.0	71.5
TDN	430	430	440	440
Cost of green fodder @ ₹ 2.0/ kg	2.0	2.0	2.0	2.0
Cost of concentrate mixture (₹/kg)	31.16	29.00	27.88	26.36
FCR	11.36	11.32	11.36	11.19
Total cost of feed (₹)/day	12.79	12.15	11.86	11.40
Cost of feed/kg gain (₹/kg gain)	209.62	198.39	192.03	182.98

RDDGS in Murrah heifers. Furthermore, Pandey *et al.* (2023) observed a net saving of ₹ 11.91 and ₹ 23.83/kg BW gain when replacing half and full soya DOC with RDDGS in growing crossbred heifers.

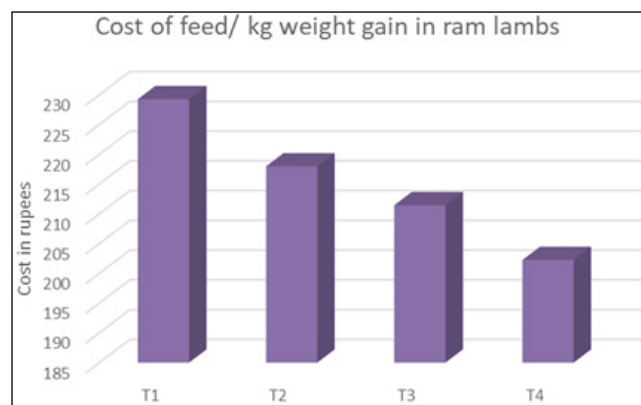


Fig. 1: Cost economics in ram lambs fed with different diets

CONCLUSION

The results of the present investigation indicate that, the RDDGS can replace soybean meal completely, without affecting palatability of ration, growth performance, nutrient utilization, nutritive value of ration and feed conversion ratio in ram lambs with a net saving of ₹ 26.64 in the cost per kilogram of live weight gain. The RDDGS can be chosen as a cost-reducing ingredient in ram lamb rations.

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REFERENCES

- Abdelrahim, G.M., Khatiwada, J. and Gurung, N.K. 2014. Effects of dried distillers grains with solubles on performance and carcass characteristics of lamb. *J. Anim. Sci. Technol.*, **1**(2): 25-30.
- AOAC. 2005. *Official methods of analysis*. 18th ed. Association of official analytical chemists, Washington DC: AOAC International.
- Banerjee, G.C. 2018. A textbook of animal husbandry. Oxford and IBH publishing.
- Chandrika, R.N., Kaur, J., Singh, C., Lamba, J.S. and Grewal, R.S. 2021. Effect of feeding dried distillers grains with solubles on nutrient utilization and blood biochemical profile of buffalo calves. *J. Anim. Res.*, **11**(3): 409-414.
- Dey, D., Sharma, B., Mohammad, A., Mandal, D.K., Bhakat, C., Dutta, T.K. and Chatterjee, A. 2020. Effect of feeding rice distillers dried grain with solubles as major protein source on nutrient digestibility and growth performance of Jersey crossbred calves. *Indian J. Anim. Res.*, **54**(4): 446-451.
- Dinani, O.P., Tyagi, P.K., Mandal, A.B., Tyagi, P.K. and Dutta, N. 2019. Evaluation of feeding value of rice based Distillers Dried Grains with Solubles (DDGS) for broiler chickens. *Indian J. Anim. Res.*, **53**(7): 901-906.
- Duncan, D.B. 1955. Multiple Range and Multiple F-Test. *Biometrics*, **11**: 1-42.
- Hatamleh, S.M. and Obeidat, B.S. 2019. Growth performance and carcass traits responses to dried distillers' grain with solubles feeding of growing Awassi ram lambs. *Animals*, **9**(11): 954.
- Huls, T.J., Bartosh, A.J., Daniel, J.A., Zelinsky, R.D., Held, J. and Wertz-Lutz, A.E. 2006. Efficacy of dried distiller's grains with solubles as a replacement for soybean meal and a portion of the corn in a finishing lamb diet. *Sheep Goat Res. J.*, **21**: 30-34.
- Islas, A., Gilbery, T.C., Goulart, R.S., Dahlen, C.R., Bauer, M.L. and Swanson, K.C. 2014. Influence of supplementation with corn dried distillers grains plus solubles to growing calves fed medium-quality hay on growth performance and feeding behavior. *J. Anim. Sci.*, **92**(2), 705-711.
- ICAR, 2013. Nutrient requirements of sheep and goats. Indian Council of Agricultural Research, New Delhi.
- Manthey, A.K., Anderson, J.L. and Perry, G.A. 2016. Feeding distillers dried grains in replacement of forage in limit-fed dairy heifer rations: Effects on growth performance, rumen fermentation, and total-tract digestibility of nutrients. *J. Dairy Sci.*, **99**(9): 7206-7215.
- McKeown, L.E., Chaves, A.V., Oba, M., Dugan, M.E, Okine, E. and McAllister, T.A. 2010. Effects of corn-, wheat-or triticale dry distillers' grains with solubles on in vitro fermentation, growth performance and carcass traits of lambs. *Can. J. Anim. Sci.*, **90**(1): 99-108.
- National Livestock Census. 2019. *20th Livestock census*. All India reports. Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries, Krishi Bhawan, NewDelhi .
- Omer, H.A.A, Abdel-Magid, S.S., El-Nameary, Y.A.A., Nassar, S.A., Nasr, S.M. and Abou-Zeina, H.A.A. 2015. Nutritional impact of partial replacement of cotton seed meal with distillers dried grain with solubles (DDGS) on animal performance, digestion coefficients and some blood



- constituents in crossbred calves. *World Appl. Sci. J.*, **33**(4): 580-589.
- Pandey, M., Shah, S., Wadhwani, K., Lunagariya, P., Islam, M. and Kalola, A. 2023. Economics of Feeding Rice DDGS and Mixture of Wheat Straw and Groundnut Straw to Growing Crossbred Heifers. *Indian J. Anim. Production and Management.*, **37**(2): 123-130.
- Rao, H. 2023. Effect of inclusion of rice distillers dried grains with solubles in the concentrate mixture on growth performance of buffalo calves. M.V.Sc Thesis submitted to Sri Venkateswara Veterinary University, Tirupati.
- Reddy, P.P.R., Chakrawarthy, M.K., Reddy, D.M., Venkateswarlu, S., Reddy, J.B., Babu, P.R. and Reddy, P.R.K. 2021. Effect of dried distillers' grain with solubles as a replacer of peanut cake for sheep fed on low quality forage. *Trop. Anim. Health Prod.*, **53**: 1-13.
- Schauer, C.S., Stamm, M.M., Maddock, T.D. and Berg, P.B. 2008. Feeding of DDGS in lamb rations. *Sheep Goat Res. J.*, **23**: 15-19.
- Singh, S.K., Thakur, S.S., Yogi, R.K. and Ud-deen, A. 2018. Effect of replacing oil seed cakes with rice dried distiller's grains with solubles in concentrate mixture on growth and nutrient utilization in murrah heifers. *Indian J. Anim. Nutr.*, **35**(2): 144-148.
- Singh, S., Dubey, M., Prusty, S., Gadpayle, R. and Doneria, R. 2021. Effect of dietary supplementation of rice dried distillers' grain on nutrient utilization and blood biochemical profile in Osmanabadi kids. *Indian J. Anim. Sci.*, **91**(11): 983-986.
- SPSS. 2012. Statistical Packages for Social Sciences Version 22.0. SPSS Inc.
- Van-Soest, P.J., Robertson, J.B. and Lewis, B.A. 1991. Methods for dietary fibre, neutral detergent fibre, and non-starch polysaccharides in relation to animal nutrition. *J. Dairy Sci.*, **74**: 3583-3597.
- Yang, W.Z., Li, Y.L., McAllister, T.A., McKinnon, J.J. and Beauchemin, K.A. 2012. Wheat distillers grains in feedlot cattle diets: Feeding behavior, growth performance, carcass characteristics, and blood metabolites. *J. Anim. Sci.*, **90**(4): 1301-1310.