

# Effect of dietary inclusion of rice distillers' dried grains with solubles (RDDGS) on growth performance and nutrient utilization in Murrah buffalo bull calves

C. Hanumantha Rao<sup>1</sup>, D. Srinivas Kumar<sup>2</sup>, K. Ananda Rao<sup>3</sup>, K. Sudha Rani<sup>\*2</sup>

<sup>1</sup>Department of Animal Nutrition, NTR College of Veterinary Science, Gannavaram. <sup>2</sup>Department of Animal Nutrition, College of Veterinary Science, Garividi. <sup>3</sup>Buffaloe Research Station, Venkata Ramanna Gudem. Sri Venkateswara Veterinary University, Andhra Pradesh State, India

\*Corresponding Author: [drsudha0606@gmail.com](mailto:drsudha0606@gmail.com)

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## Abstract

The present study was conducted to evaluate the effect of incorporating rice distillers' dried grains with solubles (RDDGS) on growth performance and nutrient utilization in Murrah buffalo bull calves. Eighteen calves were randomly allocated to three dietary treatments for a 90-day growth trial: T1 (0% RDDGS), T2 (15% RDDGS) and T3 (30% RDDGS). All groups were fed Super Napier green fodder and concentrate mixtures formulated to meet nutrient requirements. Inclusion of RDDGS up to 30% in the concentrate mixture had no significant ( $P>0.05$ ) effect on total body weight gain, average daily gain (ADG) or feed conversion ratio compared to the control. The average feed cost per kilogram of body weight gain was numerically lower by ₹6.61 and ₹7.18 in T2 and T3, respectively, as compared to T1. Apparent digestibility coefficients of Dry Matter (DM), Organic Matter (OM), Crude Protein (CP), Ether Extract (EE), Crude Fiber (CF), Nitrogen-Free Extract (NFE), Neutral Detergent Fiber (NDF), Acid Detergent Fiber (ADF), cellulose and hemicellulose were comparable ( $P>0.05$ ) among the dietary treatments. There were no adverse effects on feed intake or nutrient digestibility due to RDDGS inclusion. The findings indicated that, when RDDGS included in concentrate mixture up to 30%, did not affect growth performance or nutrient utilization in Murrah buffalo bull calves, which offers economic advantages by reducing the cost of feeding.

**Keywords:** Rice DDGS; buffalo calves; growth performance; feed economics

## Introduction

The rapid growth of the livestock sector has intensified efforts to optimize feed resources for enhanced animal productivity. Among various livestock species, buffaloes play a crucial role in dairy and meat production across many regions (Chandra Prasad *et al.*, 2019). Ensuring that buffalo calves receive a well-balanced diet is essential for their healthy growth and development, as they are the future producers. A significant challenge in buffalo calf nutrition is formulating affordable and sustainable feeds that promote optimal growth. In this context, alternative feed ingredients like distillers dried grains with solubles (DDGS) have gained considerable attention (Sihag *et al.*, 2018). Rice DDGS, a by-product of the rice-based ethanol production process, is rich in proteins, fibre, and essential micronutrients (Iram *et al.*, 2021). Several studies have demonstrated its potential as a cost-effective supplement in animal feeds, enhancing growth performance and feed conversion efficiency in various livestock species, including cattle (Buenavista *et al.*, 2021). For instance, Chandrika *et al.* (2021) reported that replacing soybean meal with rice DDGS up to 75% in buffalo calf diets did not adversely affect nutrient digestibility or growth performance. Similarly, Sihag *et al.* (2020) found that substituting mustard cake protein with DDGS protein at a 75% level in crossbred calf diets-maintained growth performance without detrimental effects on nutrient utilization. However, limited research has specifically focused on its inclusion in buffalo calf diets. Exploring the potential of rice DDGS as a dietary supplement for buffalo calves could offer significant benefits, improving both economic and nutritional outcomes in buffalo farming. The high-energy content, amino acid profile, and fiber content of rice DDGS make it an appealing feed ingredient for ruminants (Chelkapally *et al.*, 2023). Moreover, utilizing rice DDGS in buffalo diets contributes to sustainable farming practices by repurposing a by-product that might otherwise be wasted, thereby reducing feed costs (Fonseca *et al.*, 2020). In addition to its cost-effectiveness and sustainability, rice DDGS provides essential amino acids, fatty acids, and trace minerals that support improved growth performance in livestock, potentially leading to healthier and more productive animals (Gao *et al.*, 2015). This study aims to investigate the impact of rice DDGS in concentrate mixtures on the growth performance of buffalo calves. Specifically, this research will assess weight gain and feed conversion ratio (FCR), providing valuable insights into the optimal inclusion levels of rice DDGS for buffalo calf growth. Furthermore, this study will explore the optimum inclusion level of rice DDGS in concentrate mixtures for buffalo calves and evaluate its effect on nutrient utilization.

**Table 1:** Chemical composition (% DM basis) of concentrate mixtures

| Nutrient<br>(% DM basis) | T1<br>(Control / 0% RDDGS) | T2<br>(15% RDDGS) | T3<br>(30% RDDGS) |
|--------------------------|----------------------------|-------------------|-------------------|
| Dry Matter               | 90.78                      | 90.19             | 90                |
| Organic Matter           | 89.51                      | 90.09             | 90.67             |
| Crude Protein*           | 24.52 (22.26)              | 24.56 (22.15)     | 24.57 (22.11)     |
| Ether Extract            | 2.46                       | 2.75              | 3.03              |
| Crude Fibre              | 9.15                       | 8.46              | 7.77              |
| Nitrogen Free Extract    | 53.43                      | 54.36             | 55.34             |
| Total Ash                | 10.44                      | 9.87              | 9.29              |
| Neutral Detergent Fibre  | 29.41                      | 31.47             | 33.54             |
| Acid Detergent Fibre     | 15.01                      | 15.8              | 16.6              |
| Hemi-Cellulose           | 14.41                      | 15.67             | 16.94             |
| Cellulose                | 10.37                      | 12.79             | 6.13              |
| Acid Detergent Lignin    | 5.24                       | 5.82              | 6.4               |
| Calcium                  | 0.73                       | 0.63              | 0.61              |
| Phosphorous              | 0.88                       | 0.99              | 1.04              |

Values in the parenthesis for CP are on fresh basis

## Materials and methods

The experiment was conducted at the Buffalo Research Station in Venkataramannagudem, Andhra Pradesh, located at an altitude of 44.7 meters above mean sea level (16.8831° N, 81.4513° E). A Completely Randomized Design (CRD) was utilized, assigning eighteen buffalo bull calves (102–103.5 kg; 8–9 months of age) to three dietary treatments. The dietary treatments consisted of green fodder (Super Napier) and concentrate mixtures. The control group (T1) received a concentrate mixture with 22% crude protein (CP) formulated from conventional feed ingredients. These ingredients included maize, de-oiled rice bran (DORB), soybean meal, gingelly cake, mineral mixture, and salt, all sourced from the local market. Rice distillers' dried grains with solubles (RDDGS) were incorporated into the concentrate mixtures in T2 (15% inclusion) and T3 (30% inclusion), replacing soybean meal and gingelly cake at 50% and 100% levels, respectively. The inclusion levels of 15% and

30% RDDGS in the concentrate mixtures were specifically selected to evaluate the effects of replacing conventional protein sources (soybean meal and gingelly cake) at exact 50% and 100% substitution levels. This targeted approach aimed to determine the optimal threshold for cost reduction without risking potential palatability issues associated with total conventional protein replacement. All concentrate mixtures were formulated to be iso-nitrogenous (Table 1). The calves were offered green fodder ad libitum and the respective concentrate mixtures in two equal servings (9:00 AM and 3:00 PM) to meet their growth requirements. The trial lasted for 60 days, with body weights recorded before and after the experimental period. Following the growth trial, a 7-day digestion trial was conducted to assess nutrient utilization. During this period, daily records of feed intake, feed refusals, and fecal output were kept. Representative feed and fecal samples were collected and analyzed for proximate composition, fibre content (NDF, ADF, cellulose, and ADL), by using standard laboratory methods. The RDDGS was procured locally from M/S G.S.K Feeds, Vijayawada, Andhra Pradesh, India. The procurement cost of the RDDGS was 34.90 ₹/kg. The cost of the experimental concentrate mixtures was calculated based on prevailing market prices and processing costs. The relative economics of the experiment were evaluated by comparing feed costs and weight gain. Statistical analysis was performed using SPSS version 25.0, with significance determined using Duncan's Multiple Range Test.

**Table 2:** Growth Performance, Nutrient Digestibility, and Cost Economics in Buffalo Calves Fed Diets Containing RDDGS

| Parameter                               | T1<br>(Control / 0% RDDGS) | T2<br>(15% RDDGS)           | T3<br>(30% RDDGS)         |
|-----------------------------------------|----------------------------|-----------------------------|---------------------------|
| <b>Growth Performance</b>               |                            |                             |                           |
| Initial Body Weight (kg)                | 104.06 ± 11.27             | 104.82 ± 12.07              | 105.41 ± 6.36             |
| Final Body Weight (kg)                  | 148.90 ± 13.46             | 152.25 ± 14.25              | 154.43 ± 8.46             |
| Total Weight Gain (kg)                  | 44.84 ± 2.70               | 47.44 ± 2.25                | 49.02 ± 2.24              |
| Average Daily Gain (g/d)                | 498.26 ± 30.00             | 527.06 ± 24.97              | 544.70 ± 24.86            |
| Feed Conversion Ratio (kg feed/kg gain) | 6.35 ± 0.20                | 6.17 ± 0.47                 | 6.56 ± 0.45               |
| <b>Apparent Digestibility (%)</b>       |                            |                             |                           |
| Dry Matter                              | 63.10 ± 2.90               | 62.75 ± 2.06                | 61.88 ± 2.97              |
| Organic Matter                          | 65.25 ± 2.38               | 64.86 ± 2.05                | 63.69 ± 2.81              |
| Crude Protein                           | 70.84 ± 1.67               | 69.88 ± 2.39                | 68.51 ± 2.56              |
| Ether Extract                           | 73.68 ± 1.36               | 72.46 ± 1.55                | 71.22 ± 1.75              |
| Crude Fibre                             | 54.55 ± 2.75               | 53.23 ± 2.86                | 52.75 ± 2.91              |
| Neutral Detergent Fibre                 | 61.33 ± 2.96               | 60.62 ± 2.16                | 59.78 ± 2.88              |
| Acid Detergent Fibre                    | 52.90 ± 3.47               | 51.22 ± 2.18                | 49.79 ± 2.75              |
| <b>Cost Economics</b>                   |                            |                             |                           |
| Total Dry Matter Intake (kg/d)          | 4.11 ± 0.22                | 4.16 ± 0.32                 | 4.53 ± 0.22               |
| Cost of Feed per kg Gain (₹)*           | 106.70 <sup>a</sup> ± 2.52 | 100.09 <sup>ab</sup> ± 2.03 | 99.52 <sup>b</sup> ± 2.08 |

## Results

### Effect on body weight gain and average daily gain (ADG)

The body weight gain and average daily gain of buffalo bull calves fed diets containing varying levels of rice distillers' dried grain with solubles (RDDGS) in the concentrate mixture were summarized in Table 2. During the experimental growth study, the total body weight gain (kg) of buffalo calves was 44.84 ± 2.70, 47.44 ± 2.25, and 49.02 ± 2.24 kg for T1, T2, and T3, respectively, while the average daily gain (g) was 498.26 ± 30.00, 527.06 ± 24.97, and 544.70 ± 24.86 g for T1, T2, and T3. Although body weight gain and ADG increased with higher levels of RDDGS inclusion (0 to 30%) in the concentrate mixture, the differences between the treatments were not statistically significant ( $P > 0.05$ ).

### Effect on feed conversion ratio (kg feed/kg gain)

The feed conversion ratio (FCR, kg feed/kg gain) of buffalo bull calves fed diets containing varying levels of rice distillers' dried grain with solubles (RDDGS) in the concentrate mixture was presented in Table 2. The FCR values were 6.35 ± 0.20, 6.17 ± 0.47, and 6.56 ± 0.45 in T1, T2, and T3 groups, respectively, with the lowest FCR observed in T2, followed by T1 and T3. However, the differences in FCR between the treatments were not statistically significant ( $P > 0.05$ ).

### Effect of inclusion of RDDGS on digestibility of Gross nutrients

The inclusion of rice distillers' dried grains with solubles (RDDGS) in buffalo bull calves' diets at levels of 0%, 15%, and 30% did not significantly affect ( $P > 0.05$ ) the apparent digestibility of gross nutrients or cell wall constituents, including dry matter (DM), organic matter (OM), crude protein (CP), ether extract (EE), crude fiber (CF), nitrogen-free extract (NFE), neutral detergent fiber (NDF), acid detergent fiber (ADF), cellulose, and hemicellulose.

### Effect on cost economics

The cost economics of the growth study were presented in Table 2. The cost of green fodder (Super Napier) fed to buffalo bull calves during the growth trial was taken as 2.0 /kg, while the costs of the concentrate mixtures were 28.02, 26.75, and 25.49 for CM1, CM2, and CM3, respectively. The dry matter (DM) intake (kg/d) was  $4.11 \pm 0.22$ ,  $4.16 \pm 0.32$ , and  $4.53 \pm 0.22$  in T1, T2, and T3 groups, respectively. The cost of feed per kg gain was  $106.70 \pm 2.52$ ,  $100.09 \pm 2.03$ , and  $99.52 \pm 2.08$  in T1, T2, and T3 groups, respectively. The cost of feed per kg gain was lowest in the T3 group, followed by T2 and T1, and the differences between the treatments were statistically significant ( $P < 0.05$ ).

## Discussion

### Effect on body weight gain and average daily gain (ADG)

The inclusion of RDDGS up to 30% in the concentrate mixture had no significant effect ( $P > 0.05$ ) on body weight gain and ADG of buffalo bull calves compared to the control group. These findings align with multiple studies reporting that replacing conventional protein sources with DDGS does not adversely impact the growth performance of ruminants, including reports by Chandrika et al. (2021), Singh et al. (2018), and Omer et al. (2015). While Dey et al. (2020) observed a significant increase in body weight gain when replacing 100% of soybean meal with RDDGS, such discrepancies are likely due to differences in experimental conditions, diet formulation, and animal species.

### Effect on feed conversion ratio (kg feed/kg gain)

Feeding diets containing varying levels of RDDGS had no significant effect ( $P > 0.05$ ) on FCR in Murrah buffalo bull calves. This is in agreement with several previous studies indicating that the inclusion of DDGS in the diets of calves, heifers, and lambs does not significantly affect feed conversion efficiency, as observed by Dey et al. (2020), Chandrika et al. (2021), and Singh et al. (2018). Although Omer et al. (2015) found that feeding DDGS improved the FCR, these discrepancies might be attributed to differences in animal species, diet composition, inclusion levels, and trial duration.

### Effect of inclusion of RDDGS on digestibility of Gross nutrients

The apparent digestibility of gross nutrients and cell wall constituents remained unaffected across treatments. This is consistent with previous research demonstrating no significant changes in nutrient digestibility when replacing traditional protein sources with RDDGS in ruminant diets, as supported by Chandrika et al. (2021), Singh et al. (2018), Dey et al. (2020), and Fonseca et al. (2020). Recent studies by Omer et al. (2015), Madhukar et al. (2024), and Singh et al. (2021) further support these findings. Overall, the evidence supports the safe and cost-effective inclusion of RDDGS up to 30% without impairing nutrient absorption or fiber digestion.

### Effect on cost economics

The cost of feed per kg of gain was significantly reduced in the RDDGS-fed groups, decreasing by ₹6.61 and ₹7.18 in the 15% (T2) and 30% (T3) inclusion groups, respectively, compared to the control. This confirms previous reports that DDGS is a highly cost-effective alternative protein source that provides notable feed cost benefits, as reported by Omer et al. (2015), Obeidat (2017), Singh et al. (2018), and Pandey et al. (2023).

## Conclusion

The present study indicated that feeding diets containing RDDGS at 15 and 30% level replacing soybean meal and gingelly cake at 50 and 100% levels in the concentrate mixture had resulted in decreased cost of feed/kg gain without affecting the growth, digestibility of gross nutrients and serum biochemical profile in buffalo bull calves. Thus, it can be concluded that RDDGS can be included up to 30% level in the concentrate mixture replacing conventional protein supplements up to 100% level for feeding buffalo bull calves to decrease the cost of feeding without any adverse effects ensuring profits to the farmers dairy entrepreneurs.

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### Conflict of interest

The researchers reveal no conflicts of interest.

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