



Effect of dietary supplementation of rice dried distillers' grain on nutrient utilization and blood biochemical profile in Osmanabadi kids

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Received: 13 September 2020; Accepted: 28 August 2021

Keywords: Digestibility, Economics, Growth, Osmanabadi goat, Rice DDGS

Dried distillers grains with solubles (DDGS) is a co-product of ethanol industry. After distilling off the alcohol, the water and solids remaining are centrifuged to separate coarse solids from liquid. After evaporating the additional moisture from the liquid, the resulting condensed distillers solubles (syrup with approximately 30% dry matter) is combined with the coarse solid fraction and dried in hot air oven to produce dried distillers grains with solubles (DDGS). As per several studies (Dimova *et al.* 2009, Urriola *et al.* 2009, Sally 2013, Abdelrahim *et al.* 2014) on the nutrient composition of DDGS from different grains, crude protein ranged from 23.4–33.9%, energy 3079–3810 kcal ME/kg, fat 2.9–15.9%, crude fibre 6.77.2%, ash 2.7511.9%, neutral detergent fibre (NDF) 20.6–40.3%, acid detergent fibre (ADF) 10.3–18.1% and starch 2.45–9.25%. High levels of protein and energy suggest potential of DDGS inclusion in concentrate feeds in ruminant rations. Studies revealed higher (47 and 64%) ruminal undegradable protein (RUP) value of high quality DDGS (Kononoff *et al.* 2007). Researchers have studied effect of DDGS by replacing protein sources in diet of small ruminants. Held (2006) observed no significant difference in ewe body condition score and suckling lamb weight gain by introducing DDGS replacing soybean meal in lactating ewe diet. Similarly, no significant ($p>0.05$) difference in average daily gain, dry matter intake (DMI), gain: feed ratio and carcass characteristics were observed by replacing a portion of corn and soybean meal with DDGS in the diet of finishing lambs (Huls *et al.* 2006). Archibeque *et al.* (2008) demonstrated that feeding DDGS improved amino acid nutrition of lambs consuming moderate quality forages. Based on the positive findings of DDGS in diet of small ruminants and rare available study on its effects in Osmanabadi goats, the present study was conducted to study the effect of inclusion of rice dried distillers grain with

soluble (RDGS) on growth performance, nutrient utilization and blood biochemical parameters in Osmanabadi goats.

The study was conducted on Osmanabadi goats in the goat shed of College of Veterinary Science and Animal Husbandary, Anjora, Durg for a period of 90 days. Osmanabadi kids (15) of 4–5 months age weighing between 14–15 kg were selected. The kids during the experiment were housed in a well-ventilated goat shed with facilities for individual feeding under hygienic conditions by intensive method. Before the start of experiment, all kids were dewormed with Albendazole (Albomar, 2.5% w/v albendazole suspension) @ 7.5 mg/kg body weight orally.

The kids ($n=15$) were divided into three groups (T1, T2 and T3) of five kids each. Three types of concentrate mixtures 1, 2 and 3 were prepared using commonly available feed ingredients, viz. maize, deoiled rice bran, soybean meal, molasses, mineral mixture and salt. Rice DDGS was added at the rate of 0, 10 and 20% level replacing soybean meal in the concentrate mixture I, II and III, respectively. Concentrate mixture I, II and III were offered to kids in group T1, T2 and T3, respectively @ 200 g/day. MP-chari grass was chopped and offered *ad lib.* after the animals fed on concentrate mixture. Fresh and clean drinking water was made available *ad lib.* thrice a day. Daily feed intake and fortnightly body weight were recorded up to 90 days. At 45th day, a digestion trial of 5 days was conducted to evaluate the effect of feeding different levels of RDGS on nutrient utilization in kids. DM, crude protein, crude fibre and ether extract in the feed, faeces and residue sample were analysed by AOAC (2005) standard procedure. Ca and P absorption were also determined by analysing Ca (Talapatra *et al.* 1940) and P (colorimetric method, Fiske and Subbarao 1925) in feed, faeces and residue samples. For biochemical parameters, blood samples were collected from jugular vein on 45th day of experiment and serum was separated. Serum samples were then analyzed for total protein (Henry *et al.* 1974), albumin (Doumas *et al.* 1971), globulin by difference, albumin: globulin ratio and total cholesterol (Allain *et al.* 1971) in semi-automated analyzer using diagnostic kits (Beacon Diagnostic Pvt. Ltd.). The economics of feeding

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kids was calculated as feed cost per kg weight gain. The cost of concentrate mixture and green fodder was calculated based on prevailing price of different feed ingredients during the study period.

For interpretation, the data obtained in the experiment were subjected to analysis of variance following completely randomized design as per Snedecor and Cochran (1994) and significance of differences among groups were analysed by Duncan Multiple Range Test.

The proximate composition of RDGS was DM- 91.12%, CP- 44%, crude fat- 5.73%, crude fibre- 4.23% and total ash- 5.26%. The finding of present study agrees with the reports of Rao (2016) and Gupta *et al.* (2015). They reported 45% CP in DDGS, but Patil *et al.* (2015) reported lower CP (30%) in RDGS.

The initial body weight (kg) of kids in group T1, T2 and T3 was 15.14±0.84, 14.28±0.79 and 14.70±0.65, respectively. The respective final body weight of kids after 90 days of feeding trial was 18.94±0.93, 18.34±0.85 and 19.40±0.77 kg. No significant effect of inclusion level of RDGS on change in body weight was found during different fortnights. The results agree with previous findings (Rao 2016 and Huls *et al.* 2006) who stated that DDGS could be included in the ration without any negative effect on lamb performance. Similarly, Zelinsky *et al.* (2006) and McEachern *et al.* (2009) observed no treatment differences in performance when DDGS was included in finishing lamb ration. McKeown *et al.* (2010) also reported that DDGS from corn, wheat or triticale could replace a mixture of barley grain and canola meal at 20% of dry matter without adversely affecting the growth rate in lambs. Similarly, Felix *et al.* (2012) reported that inclusion of DDGS at 20% level in diet dry matter was optimal. The average daily weight gain (Table 1) did not differ significantly between the groups up to 75 days of study. The findings corroborate with the observation of previous researcher (Rao 2016 and Whitney and Lupton 2010) who reported no significant effect on ADG when DDGS was included in the diet. The ADG during last fortnight was significantly high in kids fed

Table 1. Effect of dietary inclusion of rice distillers grain with soluble on average daily gain (g) in Osmanabadi kids

Period (day)	Average daily gain (g)			Significance
	T1 (Control)	T2 (10% RDGS)	T3 (20% RDGS)	
0–15	38.66±4.42	40.00±4.21	45.33±2.49	NS
15–30	41.33±3.26	41.33±3.88	45.33±4.42	NS
30–45	42.66±4.00	45.33±8.00	53.33±10.11	NS
45–60	44.00±4.52	44.00±5.41	54.66±5.73	NS
60–75	44.00±5.81	52.00±10.83	54.66±4.46	NS
75–90	44.00±3.39 ^a	48.00±6.46 ^{ab}	60.00±2.98 ^b	*
Overall ADG (g)	42.22	45.11	52.22	

Means in the same row with different superscript a, b, differ significantly. *, P< 0.050; NS, non-significant.

Table 2. Effect of dietary inclusion of rice distillers grain with soluble on dry matter intake (g/day) in Osmanabadi kids

Period (day)	Dry matter intake (g/day)			Significance
	T1 (Control)	T2 (10% RDGS)	T3 (20% RDGS)	
0–15	493.60±30.49	531.86±22.18	542.13±7.64	NS
15–30	527.33±36.34	566.66±37.90	601.06±11.86	NS
30–45	527.40±33.91	516.83±64.21	603.89±30.36	NS
45–60	554.00±23.64	586.66±52.31	668.13±36.06	NS
60–75	545.68±69.06	645.37±35.29	683.00±39.46	NS
75–90	529.81 ^a ±44.42	617.45 ^{ab} ±51.94	685.20 ^b ±49.23	*

Means in the same row with different superscript a, b differ significantly. *, P< 0.05; NS, non-significant.

concentrate mixture with 20% RDGS. Shwerab *et al.* (2010) reported high ADG in breeding ewes on inclusion of 20% DDGS in the ration, however, Gutierrez *et al.* (2009) reported reduction in weight gain when lambs were fed diet containing 30% DDGS in the concentrate mixture.

The daily DMI (Table 2), due to inclusion of different levels of RDGS did not vary significantly from 0–75 d of study, though the intake was high in kids fed concentrate diet containing RDGS. The result agrees with the findings of Buckner *et al.* (2007) and Van emon *et al.* (2008) who reported no effect of increasing levels of DDGS on dry matter intake in finishing steers. 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 diet DM without altering DMI. In present study, the DMI increased significantly during last fortnight in kids fed diet with increased level of RDGS which corroborated with the results of Janicek *et al.* (2008) who observed increased dry matter intake with increasing concentrations of DDGS in dairy cow. The FCR (kg feed consumed / kg weight gain) value ranged from 12.07 (T3) to 14.14 (T2) during different fortnights. No significant effect of rice DDGS inclusion on feed conversion ratio was reported among the groups, though it was better in kids fed concentrate diet containing 20% RDGS. The findings corroborate with report of Huls *et al.* (2006), Schauer *et al.* (2008), Rao (2016), Avila Stagno *et al.* (2015) also reported that partial replacement of SBM and portion of corn with DDGS has no effect on feed to gain ratio.

Inclusion of different levels of RDGS in concentrate feed

Table 3. Effect of dietary inclusion of rice distillers grain with solubles on nutrient digestibility

Digestibility (%)	T1 (Control)	T2 (10% RDGS)	T3 (20% RDGS)
DM	61.56±0.46	62.56±0.14	63.32±0.16
CP	76.90±2.66	76.53±0.1.29	78.72±2.27
EE	73.86±0.55	68.78±0.49	73.32±0.74
CF	65.75±1.10	66.89±0.55	63.87±1.07

Table 4. Effect of dietary inclusion of rice distillers grain with soluble on blood biochemical parameters in Osmanabadi kids

Parameter	T1 (Control)	T2 (10% RDGS)	T3 (20% RDGS)
Total protein (g/dl)	5.14±0.337	5.44±0.273	5.65±0.352
Serum albumin (g/dl)	2.92±0.073	2.98±0.066	3.18±0.128
Serum globulin (g/dl)	2.22±0.160	2.46±0.122	2.47±0.146
A : G ratio	1.23±0.027	1.09±0.032	1.28±0.148
Total cholesterol (mg/ dl)	78.8±1.157	73.6±3.544	72.4±3.310

did not show any significant effect on the digestibility of nutrients (DM, CP, EE, and CF) among the groups (Table 3). Previous works report no effect of inclusion of DDGS on nutrient (DM, CP, EE and CF) digestibility (Rao 2016 and Mckeown *et al.* 2010). Whereas contrary to the present findings Sahin *et al.* (2013) reported significantly reduced nutrient digestibility in DDGS supplemented groups as compared to control. Felix *et al.* (2012) found increased digestibility of DM ($P<0.01$), EE ($P<0.05$) and N ($P<0.05$) on inclusion of DDGS at 20%.

Inclusion of different levels of RDGS on total serum protein content (g/dl), serum albumin and globulin content (g/dl) and albumin: globulin ratio of kids did not vary significantly amongst the groups (Table 4). Total protein concentration was numerically high in kids fed diet with RDGS, however, the variation was statistically non-significant. The total cholesterol (mg/dl) content in kids fed either control diet or fed concentrate containing different levels of RDGS did not vary significantly. Inclusion of RDGS reduced the cholesterol content, however, the difference was statistically not significant. Abd El-Hack (2015) also observed non-significant difference in serum total protein, albumin and globulin when soybean meal was replaced at 25% level by DDGS. Ghazalah *et al.* (2011) reported that DDGS incorporation significantly depressed total protein compared to the control group. In contrast to present findings, Zhang (2014) observed reduced liver cholesterol on diets containing DDGS and decrease of DDGS co-products.

Inclusion of RDGS decreased the cost of concentrate mixture as the cost of RDGS was low (₹ 25/kg) as compared to soybean meal (₹ 36/kg). The cost of concentrate mixture was calculated based on prevailing price of different feed ingredients. The cost of concentrate 1, 2 and 3 was ₹ 2022, 1912 and 1840 per 100 kg, respectively. The average total weight gain of kids was 3.82, 4.06 and 4.7 kg in groups, T1, T2 and T3, respectively and total expense on feed, medicine, etc. per kid was ₹ 618, 651 and 663 for group T1, T2 and T3, respectively. The cost per kg weight gain (₹) based on total feed cost and total weight gain was low in kids fed diet with RDGS at 20% level. The expenditure was ₹ 161.78, 160.34 and 141.06 for group T1, T2 and T3, respectively. The net profit per kg weight gain was ₹ 20

when soybean meal was completely replaced by RDGS. It can be concluded that RDGS is a viable feedstuff for goat and it can be included up to 20% in concentrate diet on DM basis without altering growth performance, nutrient digestibility and blood biochemical parameters. Inclusion of RDGS by replacement of soybean meal reduced the cost of concentrate, hence economized the cost of rearing goat.

SUMMARY

A study on 15 Osmanabadi kids (4–5 months old) was conducted for 90 days to find out the effect of dietary inclusion of rice dried distillers grain with solubles (RDGS) on growth performance, nutrient utilization and blood biochemical parameters. They were divided randomly into 3 groups T1, T2 and T3. In the concentrate mixture, RDGS was included at 0% (T1), 10% (T2) and 20% (T3) levels replacing soybean meal. There was higher average daily gain in T3 compared to control (T1), however, the variation was non-significant up to 75 days. During last fortnight (75–90 d) the ADG was significantly higher in group T3 than T1. There was no significant effect of dietary inclusion of RDGS on percentage DMI and digestibility of nutrients, however from 75 to 90 days, DMI ($\text{kg}/\text{W}^{0.75}$) was significantly ($P<0.05$) higher in T3 compared to T1 and T2. The effect of dietary RDGS on serum biochemical parameters, viz. total protein, albumin, globulin (g/dl) and A: G ratio was non-significant. Inclusion of RDGS reduced the cholesterol content, however, the difference was non-significant. The feed cost per kg BW weight gain (₹) was low in T3 (₹ 141.06) compared to T1 (₹ 161.78) and T2 (₹ 160.34). RDGS inclusion up to 20% of DM in the concentrate feed replacing soybean meal improved the economy of goat rearing without affecting growth performance, nutrient digestibility and blood biochemical parameters of Osmanabadi goats.

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