



Effect of dietary supplementation of rice dried distillers grains (rDDGS) on blood profile in Barbari goats

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ABSTRACT

The present study was carried out to determine the effect of feeding different levels of rice dried distiller grains (rDDGS) on haemato-biochemical profile of Barbari goats. Twenty-four Barbari goats of 1-2 years of age were randomly divided into four groups (Control, T1, T2 and T3) having six animals in each group. Barbari goats in control group were fed with basal diet comprising of wheat straw, chaffed green maize fodder and compounded concentrate mixture in a ratio of 20:30:50. The animals in T1, T2 and T3 groups were fed with basal diet supplemented with 10, 20 and 30% of rDDGS on dry matter basis, respectively for the period of 90 days. Results revealed no significant differences on blood profile except WBC ($\times 10^3/\mu\text{l}$), neutrophil (%) and lymphocytes (%) in the groups supplemented with rDDGS. Total protein was found highly significant in T2 group followed by T1 and T3 groups. Total immunoglobulin, catalase, TBARS and ALT in rDDGS supplemented groups were also found significantly different. It was concluded that rDDGS can be incorporated in Barbari goat ration up to level of 20% without having any detrimental effect on health of goats.

Keywords: Barbari goat, Biochemical, rDDGS

Goat husbandry provides glimpses of future hope for employment generation, nutritional security and prosperity to the millions of small and marginal farmers in the country. As such, goat producers are shifting to husbandry practices. The majority of the goat population can be found in Asia and Middle East. Well-known amongst Indian breeds are Jamunapuri, Barbari, Beetal, Surti, and Jakhana. Barbari has mainly evolved and adopted around Agra, Etawah, Aligarh, Hathras, Mathura districts of Uttar Pradesh. Goats produce about 2% of the world's total milk supply. Goat milk has high demand for its health and medicinal properties (Liang and Paengcoum 2019). Now as per the 20th Livestock census, goat population in the country in 2019 was 148.88 million showing an increase of 10.1% over the previous census. At present, the country faces a net deficit of 28.9% concentrate feed ingredients, 23.4% dry crop residue and 11.24% green fodder (Roy *et al.* 2019). The high cost and less supply of conventional animal feed ingredients along with need for achieving high productive potential, requires specific feeding having higher nutrient content (Novais *et al.* 2015 and Souza *et al.* 2016). Rice Distillers Dried Grains with

Solubles (rDDGS) is an industrial by-product produced from the distillation of fermented rice (at 131°C and 2.6 kg/m² pressure and yeast added to the cooked rice for fermentation) during the processing of alcohol (Huang *et al.* 1999), and high in both crude protein (44.68%) and gross energy (4232 kcal/kg) (Dinani *et al.* 2019). Feed ingredients should not affect the health of animals, and the blood biochemistry can reflect the overall health of animals. All the blood parameters were within normal physiological range in feeding of rice DDGS and had no adverse effect on hematology, blood biochemical parameters (Pandey *et al.* 2022). Based on the positive findings of DDGS in the diet of small ruminant and little available studies on rice based DDGS in small ruminant species and none in case of Indian goat breeds the present study was conducted to evaluate the influence of rDDGS upon haemato-biochemical parameters and immune response of Barbari goats.

MATERIALS AND METHODS

Ethical approval: All the procedures carried out and animal welfare were reviewed and approved by the Institutional Animal Ethics Committee of the Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, India (IAEC/SVPUAT/2022/80).

Experimental protocol: This experiment was conducted at Livestock Farm Complex II, Sardar Vallabhbhai Patel University of Agriculture and Technology, Modipuram,

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Meerut. Total 24 female Barbari goats on the basis of similar body weight and age group (1-2 years) were randomly divided into four groups and 1st group was treated as control, whereas 2nd, 3rd and 4th groups were taken as treatment group T1, T2 and T3, respectively. The initial mean BW in Control, T1, T2 and T3 groups was 14.90, 14.92, 14.90 and 14.94 kg, respectively. The nutrient requirement of Barbari goats was met by feeding concentrate mixture, wheat straw and available fodder as per NRC standards. Animals in control group were fed with roughage based diet, i.e. wheat straw (particle size 1.5 to 2.0 cm), chaffed green maize fodder and compounded concentrate mixture in a ratio of 20:30:50. Concentrate mixture was prepared by mixing barley grain, wheat grain, oat grain, wheat bran, gram chunni, mustard oil cake and mineral mixture in 20, 20, 10, 10, 10, 28 and 2 parts, respectively. Animals in T1, T2 and T3 group were fed individually with basal diet supplemented with different percentage of rDDGS offered (as in TMR) @ 10, 20 and 30% of dry matter, respectively under the standard managerial conditions for a period of 90 days. They were provided fresh and clean water throughout the experiment.

The chemical composition of experimental diet and dietary components (on dry matter basis) are presented in Table 1. Blood samples were collected from jugular vein following aseptic measures from experimental Barbari goats in the morning hours before the feeding and watering at monthly interval to analyse the hematological parameters. After that, blood samples were centrifuged at 3,000 rpm for 15 min, and plasma was separated. Collected plasma samples were analyzed for blood biochemicals with the help of UV-vis spectrophotometer (cistrionics) using standard procedures through ERBA diagnostics Mannheim Germany diagnostic kits. Total antioxidant activity was measured by FRAP assay of Benzie and Strain (1999). The catalase activity was estimated spectrophotometrically using the method described by Aebi (1984). The extent of lipid peroxidation, an index of oxidative stress was measured as Thio barbituric acid reactive substances formed. Lipid peroxides were measured by TBA test method of Asakawa and Matsushita (1979). Zinc turbidity

method (Mc Ewan *et al.* 1970) was used to measure plasma immunoglobulins.

Statistical analysis: The experimental data was subjected to analysis by completely randomized design with the simple analysis of variance technique (Snedecor and Cochran 1994) using Statistical Package for the Social Sciences (SPSS 2011). Homogenous subsets were separated by using Duncan's multiple range test described by (Duncan 1955). Differences among treatments were considered significant at $P \leq 0.05$.

RESULTS AND DISCUSSION

Hematological parameters: The results revealed no significant ($P > 0.05$) differences between control and other different dietary treatments supplemented with different levels of rDDGS in blood profile, except WBC ($\times 10^3/\mu\text{l}$), neutrophil (%) and lymphocytes (%) which were found significantly ($P < 0.05$) affected by rDDGS supplementation in Barbari goat diet (Table 2). All the blood parameters studied were well within the normal physiological range. Due to main effect of treatment, i.e. incorporation of rDDGS in Barbari goats ration, the mean values of WBC ($\times 10^3/\mu\text{l}$), neutrophil (%) and lymphocytes (%) were found to be 6.13, 6.09 and 6.71; 7.26; 33.50 and 32.00; 30.74, 30.88 and 55.22; 56.16, 58.60 and 60.67, in Control, T1, T2 and T3 groups, respectively. The present study is in agreement with the findings of Konia (2016), who also observed no significant effect of DDGS incorporation in piglet ration on hemoglobin (Hb), packed cell volume (PCV) and total erythrocyte count (TEC).

Blood biochemical parameters: Blood biochemical parameters of Barbari goats were found non-significantly affected by the incorporation of rDDGS except, total protein which was significantly ($P < 0.05$) higher in T2 group followed by T1 and T3 than control group with a mean value of 6.82, 6.50, 6.47 and 6.14, respectively. The mean values increased as the concentration of rDDGS increased up to 20% (T2) and then decreased (Table 3). Etman *et al.* (2014) revealed that the serum total protein increased in the sheep fed ration supplemented with the increasing level of DDGS, as 6.48, 6.52, 6.64 and 6.76 g/dl.

Table 1. Chemical composition (% DM basis) of dietary feed ingredients fed to Barbari goat

Ingredient	Wheat straw	Maize fodder	Concentrate	Rice dried distillery grains
Dry matter	90.45±0.25	22.76± 1.24	87.15±1.25	91.28±0.47
Organic matter	86.50±0.50	88.18±0.77	91.65±0.30	95.02±0.28
Total ash	14.50±0.50	11.73±0.77	8.41±0.30	4.98±0.28
Crude protein	3.07±0.13	9.43±0.79	21.05±0.82	30.98±2.02
Ether extract	0.57±0.07	3.39±0.20	3.59±0.32	8.72±3.22
Crude fibre	37.20±1.18	24.69±0.78	8.19±1.34	7.05±0.35
Nitrogen free extract	45.12±0.02	52.19±2.54	58.06±1.13	48.27±1.83
Neutral detergent fibre	85.50±2.50	61.00±1.00	35.50±0.50	34.03±0.52
Acid detergent fibre	53.79±0.79	49.50±1.50	14.00±1.00	13.26±0.95
Hemicellulose	31.71±3.29	9.50±0.50	21.50±1.50	20.77±0.42
Acid detergent lignin	3.85±0.15	2.40±0.20	1.35±0.05	1.95±0.04
Cellulose	49.05±0.64	47.10±1.30	13.65±0.95	11.46±0.48

Table 2. Effect of feeding rice DDGS on hematological parameters in Barbari goats

Attribute	Treatment				SEM	P Value
	Control	T1	T2	T3		
Hb (g/dl)	12.16	12.23	12.47	12.40	0.15	0.42
PCV (%)	36.36	36.42	36.61	36.56	0.57	0.99
RBC ($\times 10^6/\mu\text{l}$)	12.01	12.04	12.36	12.01	0.27	0.75
WBC ($\times 10^3/\mu\text{l}$)	6.13 ^a	6.09 ^a	6.71 ^{ab}	7.26 ^b	0.19	<0.01
Neutrophil (%)	33.50 ^b	32.00 ^{ab}	30.74 ^a	30.88 ^a	0.49	<0.01
Lymphocytes (%)	55.22 ^a	56.16 ^a	58.60 ^b	60.67 ^c	0.50	<0.01
Eosinophils (%)	3.55	3.52	3.59	3.57	0.22	1.00

Control, Basal Diet; T1, Basal diet replaced with 10% rDDGS on DM basis; T2, Basal diet replaced with 20% rDDGS on DM basis; T3, Basal diet replaced with 30% rDDGS on DM basis. Means bearing different superscript in a row differ significantly (P<0.05).

Table 3. Effect of feeding rice DDGS on blood biochemical parameters in Barbari goats

Attribute	Treatment				SEM	P-value
	Control	T1	T2	T3		
Glucose (mg/dl)	56.16	55.16	55.62	57.53	0.91	0.31
Total protein (g/dl)	6.14 ^a	6.51 ^b	6.82 ^c	6.47 ^b	0.05	<0.01
Albumin (g/dl)	3.63	3.81	3.91	3.75	0.14	0.59
Globulin (g/dl)	2.51	2.70	2.91	2.72	0.15	0.07
Total Cholesterol (mmol/L)	79.86	76.13	75.83	77.42	1.45	0.22
BUN (mg/dl)	16.32	16.48	16.69	16.42	0.40	0.93
Creatinine (mg/dl)	1.01	0.99	0.97	0.99	0.02	0.53

Control, Basal Diet; T1, Basal diet replaced with 10% rDDGS on DM basis; T2, Basal diet replaced with 20% rDDGS on DM basis; T3, Basal diet replaced with 30% rDDGS on DM basis. Means bearing different superscript in a row differ significantly (P<0.05).

Table 4. Effect of feeding rice DDGS on immunological, antioxidant and liver enzymes, parameters in Barbari goats

Attribute	Treatment				SEM	P-value
	Control	T1	T2	T3		
Total Immunoglobulins (mg/ml)	36.01 ^a	38.44 ^b	41.43 ^c	42.39 ^c	0.27	<0.01
Catalase (mole of H ₂ O ₂ consumed/min/mg Hb)	106.10 ^a	107.51 ^{ab}	112.84 ^b	110.92 ^{ab}	1.44	<0.01
Super oxidase activity concentration (10 ³ × unit/g Hb)	1.27	1.41	1.43	1.34	0.07	0.33
TBARS (nM/ml)	1.30 ^b	1.03 ^a	1.05 ^a	1.01 ^a	0.02	<0.01
FRAP (μmole/L)	757.84	760.38	763.79	758.17	8.60	0.96
ALP (IU/L)	110.04	109.91	108.26	105.88	2.04	0.46
AST (IU/L)	152.33	142.54	136.07	138.83	4.12	0.06
ALT (IU/L)	32.24 ^b	27.88 ^a	25.97 ^a	25.60 ^a	0.73	<0.01

Control, Basal Diet; T1, Basal diet replaced with 10% rDDGS on DM basis; T2, Basal diet replaced with 20% rDDGS on DM basis; T3, Basal diet replaced with 30% rDDGS on DM basis. Means bearing different superscript in a row differ significantly (P<0.05).

Abd El-Hack (2015) also observed that replacement of rDDGS at a level of 25% with soybean had no significant (P>0.05) difference on total protein, albumin and globulin level. The mean total cholesterol (mg/dl), glucose (mg/dl), albumin (g/dl), globulin (g/dl), BUN (mg/dl) and creatinine (mg/dl) values in Barbari goats either on control diet or fed different levels of rDDGS did not vary significantly (P>0.05). Gurung *et al.* (2009) reported no significant difference in the concentrations of serum glucose levels due to DDGS incorporation in goat, but contrary to present findings they reported significant (P<0.05) improvement in serum cholesterol of goats fed with DDGS. These results of serum creatinine in present study were in agreement with the findings of Etman *et al.* (2014) who also observed no significant effect of DDGS incorporation in lamb ration.

These results are also in accordance with the findings of Mohi E L Din *et al.* (2008), Lopez *et al.* (2010) and Etman *et al.* (2011). The findings for serum glucose corroborate well with the results reported by Obediat (2018).

Antioxidant and liver enzymes: The present study revealed that there was significant difference in total immunoglobulin, catalase, TBARS and ALT (Table 4). Mean values of total immunoglobulin were highly significant with a mean of 36.01, 38.44, 41.43 and 42.39 in control, T1, T2 and T3 groups, respectively. The catalase was found significantly higher in T2 (112.84) group as compared to control. TBARS in the groups fed with rDDGS was significantly lower than control (1.30) group goats. Overall plasma FRAP value was found to be similar in dietary groups. ALT values were found significantly

affected in all the groups fed with rDDGS at different inclusion levels with a mean of 32.24, 27.88, 25.97 and 25.60 in Control, T1, T2 and T3 groups, respectively.

From the results of the present study, it was concluded that rice dried distillers grains soluble (rDDGS) up to the level of 20% can be included in diet without affecting health status in Barbari goats.

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