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Effect of rice gluten meal on nutrient intake and economics of feeding in beetal goat kids

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Abstract
The present study was conducted to evaluate the effect of inclusion of rice gluten meal (RGM) as an alternate protein source in the diet of beetal goat kids on nutrient intake and economics of feeding. Conventional concentrate mixture was prepared (maize 38, SBM 25, wheat bran 15, deoiled rice bran 11.50, rice polish 7.50, mineral mixture 2.0 and common salt 1.0 part per 100 parts). Soybean meal (SBM) in the concentrate mixture was replaced by rice gluten meal (RGM) at 50 and 75% and 100% level on N basis. Four dietary treatments [control (0% RGM), T1 (25% RGM), T2 (50% RGM) and T3 (100% RGM) replacing SBM] were fed to sixteen beetal kids divided into four groups of 4 animals each for 60 days. The mean DM and OM intake was similar in all groups (C, T1, T2 and T3) and no significant difference was observed during 60 day study period. The mean EE intake was higher (P<0.05) in group T3 than other groups. The mean NDF and ADF intake in treatment groups was similar to that of control group. SBM replacement by RGM reduced the cost of concentrate mixtures fed to T1 (50% RGM), T2 (75% RGM) and T3 (100% RGM) groups by 4.52%, 7.75% and 8.90%, respectively as compared to concentrate mixture fed to control (0% RGM) group. RGM inclusion at 18.75% level (75% replacement of SBM) in the diet of beetal goat kids in T2 group over 60 days resulted in saving of Rs. 55.63 per kg body weight gain as compared to control group. It was concluded that RGM can economically replace SBM upto 75% in the concentrate mixture of beetal goat kids (inclusion level 18.75%) without any adverse effect on nutrient intake.

Keywords: rice gluten meal, beetal goat kids, nutrient intake, economics

1. Introduction
India has maximum livestock population in the whole world. In most recent census i.e. 20th Livestock Census (2019) [12], 535.78 million population of livestock is existing in the country including 35.94% of cattles, 27.80% of goats, 20.45% of buffaloes, 13.87% of sheeps and 1.69% of pigs which indicated an intensification of 4.6% over preceding livestock census, 2012. Other livestock species like mithun, yaks, horses, ponies, mules, donkeys and camels collectively contributes about 0.23% of the entire livestock. Among other countries, India ranks second in the population of goats. In 2007, the proportion of goats was 140.5 million, which descends up to 135.1 million in 2012, but afterwards in 2018, it again elevated to 148.8 million. There was an increase of 10.1% in the population of goats in 2019 in comparison with the last census of 2012. Because of multifunctional benefits like availability of meat, milk, skin, fiber, manner etc. goat farming has become very famous in whole world. Goat farming has huge contribution in rural economy. For poor farmers, women, ex-serviceman and unemployed youth, goat is the animal of choice due to its smaller size, easy handling, wide range of vegetation, great adaptability of climatic change and also lower input requirements in the goat production.
Rice gluten meal (RGM) is a starch industry byproduct and has greater content of limiting amino acid, lysine than that of other cereal proteins. It is hypoallergenic, so it is good substitute for livestock having corn and wheat allergies. Amylase content is low in rice gluten meal. RGM has a higher biological value than wheat gluten and corn gluten because of its low cost and better results. There is shortage of conventional feedstuffs for livestock in the country and the cost of conventional ingredients is also high. Thus, the present study was taken up with the objective to evaluate an alternate feed stuff RGM in the diet of goat kids and to work out the comparative cost of feeding of RGM and soybean meal.

2. Material and Methods

2.1 Chemical analysis

The finely ground feed ingredients (Rice gluten meal, soybean meal and green fodder) were analyzed for proximate principles as per AOAC (2007) [1], total carbohydrates as per Sniffen *et al.* (1992) [15] and cell wall constituents as per Van Soest *et al.* (1991) [12]. Estimation of nitrogen fractions (acid detergent insoluble nitrogen and neutral detergent insoluble nitrogen) was done according to Licitra *et al.* (1996) [8].

2.2 Selection, distribution and maintenance of animals

Conventional concentrate mixture was prepared (maize 38, SBM 25, wheat bran 15, deoiled rice bran 11.50, rice polish 7.50, mineral mixture 2.0 and common salt 1.0 part per 100 parts). Soybean meal (SBM) in the concentrate mixture was partially replaced by rice gluten meal (RGM) at 50 and 75% and 100% level on N basis. Sixteen beetal goat kids were randomly distributed into four groups of four animals each. A 60-day growth trial was conducted on 6-7 month old beetal goat kids (average initial body weight 11.30 ± 2.80). The goat kids were fed [as per ICAR (2013) feeding standard] total mixed ration with roughage to concentrate ratio 50:50 on DM basis. All the TMRs contained bajra fodder. The animals in control group were fed with basal diet consisting of bajra fodder and SBM based conventional concentrate mixture. The animals in experimental groups (T1, T2 and T3) were fed green fodder and concentrate mixtures in which crude protein of soybean meal was replaced with RGM at 50%, 75% and 100% levels, respectively. The daily record of feed intake and orts was maintained. The animals were housed in a concrete shed and were stall fed individually at 9:00 AM daily. The animals had free access to water twice daily.

2.3 Economic evaluation

Cost of feeding RGM in experimental groups was calculated by taking into account dry matter intake, cost of concentrate, cost of fodder and cost of RGM. Net profit per kg body weight gain was calculated for all groups.

2.4 Statistical analysis

Data were analyzed by simple ANOVA, as described by Snedecor and Cochran (1994) [14], by using SPSS (2012) [16] version 21. The differences in means were tested by Tukey's b.

3. Results and Discussion

3.1 Chemical composition of RGM, SBM and green fodder used in the experiment

The OM content in RGM was 97.50% which was higher than OM present in SBM (89.63%) (Table-1). Green fodder (bajra) was having 88.37% OM. CP content in RGM was almost similar to that of SBM. The CP content of RGM was 48.20% while CP content of SBM was 47.20%. Dinani *et al.* (2018) [3], Ongmoo *et al.* (2018) [11] and Mahesh and Thakur (2018) [9] reported that rice gluten meal contained 49.94%, 49.97% and 47.5% CP, respectively, which is almost identical to that obtained in present study. The EE of SBM (0.95%) was less as compared to RGM (8.84%). Green fodder (bajra) used in this experiment contained 12.11% CP and 2.16% EE. Das *et al.* (2015) [2] reported that OM, CP and EE content in bajra fodder and napier bajra was 91.00% and 88.80%, 8.10% and 10.90%, 3.10% and 1.50%, respectively. EE content in RGM in the present study was higher than that reported by Wani *et al.* (2018) [17]. The total ash, ADF, HCL, ADL and TCHO content of RGM was 2.50, 17.30, 28.0, 1.90 and 40.46%, respectively. Durga *et al.* (2018) [6] reported higher total ash content (5.80%) in rice gluten meal than that reported in present study. SBM was having lower NDF content than RGM and bajra. Mahesh and Thakur (2018) [9] reported 40.00% NDF and 44.80% TCHO content in rice gluten meal. Dinani *et al.* (2018) [3] reported 16.24% ADF in rice gluten meal which was almost similar to present study. Kumar *et al.* (2016) [7] and Malik *et al.* (2017) [10] reported 23.10% hemicellulose in rice gluten meal which is lower than that calculated in present study. The ADICP and NDICP content in rice gluten meal was 25.14% and 63.43% and in SBM was 8.52% and 22.90%, respectively.

Table 1: Chemical composition of RGM, SBM and green fodder used in the experiment, % DM basis

Parameter	RGM	SBM	Green fodder (Bajra)
OM	97.50	89.63	88.37
CP	48.20	47.20	12.11
EE	8.84	0.95	2.16
Total ash	2.50	10.38	11.63
NDF	45.30	22.85	64.05
ADF	17.30	15.00	35.28
Hemicellulose	28	7.85	28.77
ADL	1.90	1.00	4.78
ADICP	25.14	8.52	-
NDICP	63.43	22.90	-
TCHO	40.46	41.47	74.10

OM- organic matter, CP- crude protein, EE- ether extract, NDF- neutral detergent fibre, ADF- acid detergent fibre, ADL- acid detergent lignin, TCHO- total carbohydrates, ADICP- acid detergent insoluble crude protein, NDICP- Neutral detergent insoluble crude protein

3.2 Chemical composition of feedstuffs offered during trial, %DM basis

The DM was 90.00, 91.00, 90.50 and 91.00% in control, T1, T2 and T3 concentrate mixtures, respectively (Table-2). The value of DM in green fodder had 24.50%. The OM content of concentrate mixtures increased from control to T3 concentrate mixture. Green fodder fed during metabolic trial had 91.02% OM. The CP content was 22.30%, 22.37%, 22.81% and 23.18% in control, T1, T2 and T3 concentrate mixtures, respectively, indicating that concentrate mixtures were iso-nitrogenous. EE content increased with increase in RGM level in concentrate mixtures which might be due to high EE content of RGM. With increase in RGM level, total ash content decreased in concentrate mixtures. NDF content varied from 33.70% to 39.80% in concentrate mixtures and showed increasing trend with graded increase in level of RGM. ADF content was 11.50%, 10.20%, 10.45% and 10.25% in control, T1, T2 and T3 concentrate mixtures, respectively. CP and EE content was 10.82% and 2.01% in green fodder, respectively. Green fodder had 36.40% ADF.

Table 2: Chemical composition of feedstuffs offered during trial, %DM basis

Parameter	C (0% RGM)	T1 (12.5% RGM)	T2 (18.75% RGM)	T3 (25% RGM)	Green fodder (Bajra)
DM	90.00	91.00	90.50	91.00	24.50
OM	91.65	93.15	93.20	93.40	91.02
CP	22.30	22.37	22.81	23.18	10.82
EE	4.70	4.75	4.90	5.10	2.01
Total ash	8.35	6.85	6.80	6.60	8.99
NDF	33.70	35.40	37.00	39.80	59.47
ADF	11.50	10.20	10.45	10.25	36.40
Cellulose	8.30	7.10	6.00	6.70	30.00
Hemicellulose	22.20	25.20	26.55	29.55	23.07
TCHO	67.42	68.28	67.79	67.34	78.19

DM- Dry matter, OM- organic matter, CP- crude protein, EE- ether extract, NDF- neutral detergent fibre, ADF- acid detergent fibre, TCHO- total carbohydrates

3.3 Effect of dietary level of RGM on nutrient intake in beetal goat kids

The mean DM and OM intake was similar in all groups (C, T1, T2 and T3) and no significant difference was observed during 60 day study period (Table-3). The results are in agreement with those of Mahesh and Thakur (2018) [9] where no effect on DMI was seen in Murrah buffaloes when they replaced peanut cake with 50% rice gluten meal and corn gluten meal (on N- basis). Our results are also in tune with the results of Kumar *et al.* (2016) [7] where DMI was similar in crossbred calves fed GNC, 50% RGM and 75% RGM (replacing GNC). The mean CP intake was lower (P<0.05) in group T1 than control group (Table-3). However, CP intake in T2 and T3 groups was similar to that of control group. The lower mean CP intake in group T1 may be due to slightly lower DM intake in this group. Kumar *et al.* (2016) [7] reported that CP intake was similar in crossbred calves fed 50% and 75% RGM replacing GNC. Similarly, Mahesh and Thakur (2018) [9] observed no effect on CP intake in Murrah buffaloes fed RGM and corn gluten meal replacing peanut cake (PNC) on N- basis.

The mean EE intake in 60 days experimental period was higher (P<0.05) in group T3 than other groups (Table-3 and Fig-1). The EE intake was higher (P<0.05) in treatment groups than control group.

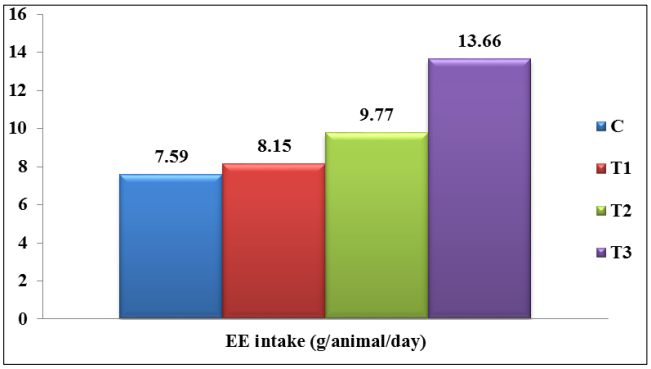

Fig 1: Effect of dietary level of rice gluten meal on fortnightly EEI (g/animal/day) in beetal goat kids

The mean NDF and ADF intake in treatment groups was similar to that of control group (Table-3). The mean cellulose intake (CLI) was lowest (P<0.05) in group T1. The cellulose intake in groups T2 and T3 was similar to that of control group. HC intake was higher (P<0.05) in group T3 than control group.

Table 3: Effect of dietary level of RGM on nutrient intake (kg/100 kg BW) in beetal goat kids

Parameter	C (0% RGM)	T1 (50% RGM)	T2 (75% RGM)	T3 (100% RGM)	SEM
DMI	3.48	3.40	3.51	3.48	0.03
OMI	3.14	3.11	3.21	3.19	0.02
CPI	0.697^{ab}	0.677^{a}	0.712^{ab}	0.736^{b}	0.007
EEI	0.060^{a}	0.068^{b}	0.079^{c}	0.111^{d}	0.001
NDFI	1.73	1.71	1.79	1.77	0.013
ADFI	0.75	0.72	0.75	0.73	0.007
CLI	0.58^{b}	0.55^{a}	0.56^{ab}	0.56^{ab}	0.006
HCLI	0.98^{a}	0.99^{ab}	1.03^{ab}	1.04^{b}	0.008

DMI- Dry matter intake, OMI- organic matter intake, CPI- crude protein intake, EEI- ether extract intake, NDFI- neutral detergent fibre intake, ADFI- acid detergent fibre intake, CLI- cellulose intake, HCLI-hemicellulose intake; Means bearing different superscripts in a row differ significantly (P<0.05)

3.4 Economics of feeding

The economics of feeding rice gluten meal (RGM) replacing soybean meal at graded levels in the diet of beetal goat kids during 60 days given in Table-4. At the time of experiment, the cost of RGM and SBM was Rs. 3200/Q and Rs. 3600/Q, respectively. The cost of concentrate mixtures fed to beetal goat kids was worked out to be Rs. 21.69/kg, Rs. 20.71/kg, Rs. 20.01/kg and Rs. 19.76/kg for control, T1, T2 and T3 groups, respectively. Replacement of SBM by RGM reduced the cost of concentrate mixtures fed to T1, T2 and T3 groups by 4.52%, 7.75% and 8.90%, respectively as compared to concentrate mixture fed to control group. RGM inclusion at 18.75% level in the diet of beetal goat kids in T2 group over 60 days resulted in saving of Rs. 55.63 per kg body weight gain as compared to control group. Dinani *et al.* (2019) [4] also reported less cost of production of rations having 12.5% rice distiller dried grains (rDDGS) and 15% RGM as compared to other treatment groups fed 10% rice distiller dried grains (rDDGS) and 15% RGM to broiler chickens. Durga *et al.* (2018) [5] reported net gain of Rs. 36.25 in pigs fed with 10% wet brewer spent grains over control group fed conventional concentrate diet and loss of Rs. 48.74 and Rs. 227.89 in pigs

fed 5% RGM and 10% MOL, respectively. Wani *et al.* (2018) observed gradual decrease in the cost of feed with the rising level of RGM in the broiler chicken diets. Mahesh and Thakur (2018) [9] reported decrease in the cost of milk production in Murrah buffaloes by 4% on RGM inclusion at 50% level replacing PNC. Kumar *et al.* (2016) [7] observed feed cost (US$) per kg live weight gain for GP-1 (fed GNC), GP-2 (fed 50% RGM) and GP-3 (fed 75% RGM) were 2.19, 2.06 and 1.97, respectively which was reduced to 5.1% in GP-1 and 10% in GP-2. Sherazi *et al.* (1995) [13] showed that ration containing 10% rice protein meal was most economical when compared with other rations containing 0%, 2.5%, 5% and 7.5% rice protein meal in the diet of broiler chicks. The results of the present study indicated that RGM inclusion at 18.75% in the concentrate mixture (replacing 75% SBM) presented more economical results.

Table 4: Comparative cost of feeding graded levels of RGM as a replacement of soybean meal to beetal goat kids over 60 days experimental period

Parameter	C (0% RGM)	T1 (12.50% RGM)	T2 (18.75% RGM)	T3 (25% RGM)
Amount of fresh feed given, kg				
Concentrate mixture	62.92	60.27	61.97	61.80
Green fodder	247.88	237.77	244.80	242.92
Feed cost (Rs/kg)				
Concentrate mixture	21.69	20.71	20.01	19.76
Green fodder	1.00	1.00	1.00	1.00
Total feed cost for 60 days (Rs)	1612.68	1486.03	1484.74	1464.09
Total BW gain in 60 days/ group (Kg)	7.80	6.94	9.82	7.31
Feed cost (Rs/kg BW gain)	206.78	214.16	151.15	200.23

4. Conclusion

The present study in beetal goat kids revealed that DMI and OMI was not affected by replacing SBM with RGM in concentrate mixtures upto 100% level. The CPI, NDFI and ADFI (kg/100kg BW) in experimental groups was similar to that of control group. EEI was higher ($P<0.05$) in experimental groups than control group. Therefore, from the present study, it was concluded that RGM can economically replace SBM upto 75% in the concentrate mixture of beetal goat kids (inclusion level 18.75%) without any adverse effect on nutrient intake of animals.

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