

Effect of replacing wheat bran with rice polishings on the lactation performance of crossbred cows

NARAYAN DUTTA¹, K SHARMA², AVIJIT DEY³, M SINGH⁴ and A SINGH⁵

Indian Veterinary Research Institute, Izatnagar, Uttar Pradesh 243 122 India

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Ruminant production in mixed farming has lagged behind in productivity because of factors like low genetic potential, poor health management and imbalanced feeding. Supplementation with other feeds that provide additional protein, energy and minerals (Dutta *et al.* 2009) may be recommended for improving nutrient utilization. Rice polish is freely available in predominantly paddy-cultivated areas at a 40–50% cheaper rate as compared to wheat bran but usually not favoured by the farmers as a supplement in the diet of lactating animals, especially during winter (Dutta and Sharma 2004). Since chemical composition of rice polish is approximately comparable to that of wheat bran (Dutta and Sharma 2004, Dubey *et al.* 2010), farmers may be encouraged to use rice polish as a substitute of wheat bran in the diet of lactating cows to reduce the cost of milk production. Keeping this in view, comparative performance of lactating cows given wheat bran or rice polish as a constituent of concentrate mixture was ascertained.

Animals and diets: Lactating crossbred (12) cows, weighing on an average 393.75 ± 10.9 kg, at their second and mid lactation (average milk yield 7.04 ± 0.44 kg/d) were randomly divided into two groups of six each in a completely randomized block design to receive either a conventional concentrate mixture (control) or experimental concentrate mixture (treatment) containing rice polish replacing wheat bran in the supplement, respectively (Table 1). All the cows had a common nutritional and managerial exposure prior to the experiment. The amount of concentrate mixture was adjusted fortnightly as per the milk yield of each animal.

Present address: ¹Senior scientist (e mail: dutta65@gmail.com);

⁵Senior Research Fellow (e mail: anandsingh26651@gmail.com).

²ADG, HRD, ICAR, New Delhi (e mail: ksharma52@gmail.com).

^{3,4}Subject Matter Specialists, Malda KVK, UBKV, Ratua, Malda 732 205 (e mail: avijit76@rediffmail.com).

⁴KVK, Dhamora, Rampur 243 701 (e mail: singhmanoj_21@rediffmail.com).

Table 1. Ingredients and chemical composition of feeds (%DM)

Attributes	Concentrate mixture		Oats green
	Control	Treatment	
Ingredients composition			
Maize	30	30	-
Deoiled groundnut cake	30	30	-
Wheat bran	37.5	-	-
Rice polish	-	37.5	-
Mineral mixture*	1.5	1.5	-
Salt	1.0	1.0	-
Chemical composition			
OM	91.9	91.7	89.7
CP	21.5	20.4	6.8
EE	2.3	5.9	1.7
Total ash	8.1	8.3	10.3
NDF	35.4	26.5	67.3
ADF	17.2	18.4	42.8

*Mineral mixture contained (g/ kg): calcium 215, phosphorus 95, sodium chloride 285, potassium iodide 2.5, iron 5.0, copper 0.8, cobalt 1.0, manganese 1.0; and sulphur 1.0.

Experimental procedure

All the cows were penned individually with free access to fresh water in ventilated sheds allowed exercise out-doors in an adjacent dry paddock daily. All the animals were adapted to their respective diets for 15 days. During the experiment, the animals were offered a weighed quantity of respective test concentrate mixture as 2 equal meals in the morning at 7:00 AM and in the afternoon at 4:00 PM during the time of milking and daily milk yield of individual cows were recorded. Green oats (*Avena sativa*) were offered *ad lib.* at 11:00 AM, after ensuring complete consumption of concentrate mixture. Daily DM intake and fortnightly body weights of all the cows were recorded before feeding in the morning. Milk samples from each cow was drawn once a week during the 60-days feeding trial for analysis of milk composition and then daily during the 6 days of metabolism trial for determination of nitrogen balance. Milk samples were

stored at 4°C after adding 2–3 drops of potassium dichromate as a preservative, until further analysis. A metabolism trial of 6 days collection and measurement period was conducted towards the end of feeding trial. Individual cows were accustomed to urine collection by manual stimulation of the vulva. The daily feed intake, faecal and urinary outputs from individual cows were recorded. Daily urine output from each cow was collected quantitatively in plastic bottles containing known quantity of sulphuric acid (10%) to bring pH around 3.0 and a sub-sample was collected and stored at –20°C for purine derivatives estimation. Suitable sub-samples of faeces and urine were collected daily from each cow and preserved with 25% and 10% (v/v) sulphuric acid, respectively for nitrogen estimation. Another sub-sample of the daily faecal output was dried at $80 \pm 2^\circ\text{C}$ for 24 h in a forced-draft oven for dry matter estimation. Samples of the dried feeds, refusals and faeces were pooled over 6 days and preserved in airtight polythene bags for further chemical analysis.

Chemical and statistical analyses: Samples of feeds, faeces and residues were milled to pass through a 1.0 mm sieve and analysed for their proximate constituents (AOAC 1995). The fibre fractions, NDF and ADF were estimated as per Van Soest *et al.* (1991). Milk samples were analysed for total solids, total ash, total protein and fat content (ISI 1961). Urinary purine derivatives (allantoin and uric acid) and creatinine were determined by HPLC. The results obtained were subjected to t-test to compare the difference between the treatment means (Snedecor and Cochran 1994).

Table 2. Effect of replacing wheat bran with rice polish on nutrient intake and utilization by lactating cows

Attributes	Dietary treatments		SEM
	Control	Treatment	
Body weight, kg	383.3	405.0	10.95
Metabolic body size ($\text{kgW}^{0.75}$)	86.6	90.28	2.12
Intake ($\text{g/kgW}^{0.75}$)			
Concentrate	36.99	37.56	1.94
Green oat	72.32	80.32	3.97
DM	109.32	117.99	4.30
OM	98.86	106.96	3.80
DM, % B. W.	2.47	2.63	0.11
Nutrient digestibility %			
DM	58.79	63.93	1.71
OM	62.61	67.49	1.57
CP	65.79	60.27	2.78
NDF	52.17	55.01	1.95
ADF	40.19	47.47	2.38
Nutrient intake ($\text{g/kgW}^{0.75}$)			
DCP	8.09	8.02	0.47
TDN	64.71	72.97	3.98
Nutrient density %			
DCP	4.73	6.63	0.38
TDN	59.35	61.36	2.02

*TDN calculated from DOM (1kg DOM = 1.05 kg TDN)

Chemical composition of diet: The chemical composition of concentrate mixtures, and green oats (*Avena sativa*) fodder (Table 1) was within the normal range for Indian feeds and fodder (Ranjhan 2004). Though the experimental concentrate mixtures were isonitrogenous, the ether extract content was significantly higher in rice polish based concentrate mixture, which was due to higher level of fat inherent in rice polish used in the experimental diet (Dutta and Sharma 2004, Dutta *et al.* 2006).

Intake and utilization of nutrients: The daily nutrient intake by crossbred cows during metabolism trial is shown in Table 2. Daily intake ($\text{g/kg W}^{0.75}$) of dry matter, concentrate and green oats was statistically similar ($P>0.05$) between the dietary treatments. The DMI of lactating cows ranges from 81 to 121 $\text{g/kg W}^{0.75}$ (Kearl 1982, Dey *et al.* 2009). In the present study the cows had DM intake of 109–118 $\text{g/kg W}^{0.75}$, which clearly indicates that both the concentrate mixtures were equally palatable. Present results are in agreement with the earlier reports (Dutta and Sharma 2004, Dutta *et al.* 2006), who reported that inclusion of rice polish @ 25 and 63% in concentrate mixtures of lactating goats and buffaloes, respectively, did not affect the dry matter intake. Rice polish has been reported to improve dry matter intake, stimulate VFA concentration, microbial counts and efficiency of rumen synthesis (Preston *et al.* 1976, Elliot *et al.* 1978, Garcia *et al.* 1992). The digestibility coefficient of DM, OM, CP, NDF and ADF was comparable irrespective of dietary treatments given to lactating cows. This is in concurrence to earlier observations that inclusion of rice polish in concentrate mixtures did not make any significant change in nutrients digestibility (Dutta and Sharma 2004, Dutta *et al.* 2006). Daily intake ($\text{g/kg W}^{0.75}$) of DCP and TDN was also comparable between dietary treatments. Similarly, DCP and TDN content of the composite diets did not differ significantly. Comparative study of plane of nutrition revealed that all the experimental animals met their nutritional requirement for maintenance and milk production.

Nitrogen balance: The intake (g/d) and excretion of nitrogen (N) in faeces, urine and milk were comparable between the dietary treatments (Table 3). Similarly, net balance (g/d) and N-retention (as percentage intake or absorption) were not affected by replacing wheat bran with rice polish and cows showed a positive N-balance. Present results are in conformity with the finding of Dutta *et al.* (2006) who also reported a positive N-balance fed a diet containing rice polish at 25–50% level in concentrate mixtures of lactating goats.

Urinary excretion of purine derivatives and microbial nitrogen supply: The replacement of wheat barn by rice polish did not exert any significant ($P>0.05$) effect on excretion and absorption of PD (Table 3). Allantoin excretion through urine accounted for more than 90% of total urinary PD excretion and is in concurrence with earlier report (Shingfield and Offer 1998). Similarly, creatinine (C) excretion and PD:

Table 3. Effect of replacing wheat bran with rice polish on N-balance, microbial-N synthesis, milk yield and composition in lactating cows

Attributes	Dietary treatments		SEM
	Control	Treatment	
N-intake, g/d			
Concentrate	108.90	110.28	4.99
Green	68.53	79.58	4.64
Total	177.51	189.86	6.31
N-intake, g/kgW ^{0.75}	2.06	2.12	4.64
N-excretion, g/d			
Faeces	68.35	70.14	3.60
Urine	48.43	49.35	2.98
Milk	36.67	40.99	2.05
Total	152.92	160.47	3.79
N- balance, g/d	24.58	29.38	2.40
N-retention			
as % intake	13.78	15.19	1.06
as % of absorption	22.61	23.78	1.56
Urine-N (% N absorption)	43.89	41.45	1.86
Milk-N (% N absorption)	33.48	34.75	1.34
Urinary excretion of PD (m moles/d)			
Allantoin	125.34	128.73	4.86
Uric acid	17.34	18.04	0.98
Total	142.47	146.74	3.25
Creatinine	105.46	99.10	3.27
PD: C	1.39	1.69	0.11
PD absorption	128.40	133.41	4.63
Microbial N supply, g/d	93.35	97.05	3.50
Efficiency of microbial N synthesis			
g/kg DOMI	17.69	15.04	1.20
g/kg DOMR	27.21	20.06	1.97
Milk yield			
Kg/d	7.4	7.99	0.24
4% FCM (kg/d)	7.38	8.19	0.33
ECM (kg/d)	8.15	8.9	0.35
Milk composition (%)			
Fat	3.99	4.1	0.11
Protein	3.57	3.61	0.03
Total ash	0.77	0.76	0.01
SNF	9.04	8.8	0.07
Total solids	13.04	12.98	0.08

PD, Purine derivatives; DOMI, digestible organic matter intake; DOMR, organic matter digested in rumen; DOMR = 0.75 × DOMI (Osuji *et al.* 1993). ECM, Energy corrected milk.

C ratio was comparable between the dietary treatments and was within the range (1.31–2.02) in lactating dairy cows maintained at different feeding regimes (Shingfield and Offer 1998, Dey *et al.* 2009). The microbial nitrogen synthesis (g/d) and efficiency of microbial nitrogen (g/kg DOMI or DOMR) was comparable between dietary treatments. The efficiency of microbial N synthesis (g/kg DOMR) was within the range (10–70 g) (Van Nevel and Demeyer 1977, Dey *et al.* 2009). This suggests that inclusion of rice police in concentrate mixture did not exert any deleterious effect on

microbial protein synthesis. Lack of any depressing effect of rice police inclusion on rumen microbial protein synthesis agrees with the observations recorded earlier in steers (Elliot *et al.* 1978).

Milk yield and composition: The effect of replacing wheat bran with rice polish on daily milk yield (kg), 4% FCM (fat corrected milk), ECM (energy corrected milk) and milk composition are presented in table 3. The average milk yield (kg/d), 4%FCM, ECM and milk composition was similar between the treatment groups. The comparable milk yield and composition recorded in the present study are in concurrence with the earlier reports (Patle and Tripathi 1978, Dutta and Sharma 2004), indicating no significant effect by lactating buffaloes given rice polish or wheat bran containing supplements on milk yield and quality.

Economic implications: The cost of wheat bran and rice polish containing concentrate mixture was (₹/quintal) 698 and 586, respectively. The cost-benefit analysis of substitution effect of rice polish revealed that cost of concentrate for lactating cows could be reduced ₹ 112.0/quintal, if wheat bran is fully replaced by rice polish.

Replacement of wheat bran with rice polish significantly reduced the feed cost of lactating cows' ration without any adverse effect on their intake, nutrient utilization, microbial protein synthesis and milk yield and composition. Substitution of commercial rice polish (38%) in the concentrate mixtures for crossbred lactating cows may be an economical and socially acceptable proposition.

SUMMARY

Comparative performance of crossbred lactating cows given wheat bran or rice polish in the concentrate mixtures was ascertained during mid lactation. Replacement of wheat bran through rice polish did not exert any adverse effect on intake and digestibility coefficient of various nutrients in lactating cows. N-retention (g/d) and efficiency microbial protein synthesis did not differ significantly between treatment groups. The average daily milk yield (kg/d), 4% FCM, ECM and milk composition was similar between treatment groups. For crossbred lactating cows substitution of commercial rice polish (38%) in the concentrate mixtures may be an economical and socially acceptable proposition.

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