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RESEARCH ARTICLE

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EFFECT OF WHEAT STRAW BASED TOTAL MIXED RATION WITH *PROSOPIS JULIFLORA* PODS (MESQUITE PODS) ON PERFORMANCE OF LACTATING COWS

PR PANDYA, GR PATEL, RS GUPTA, DC PATEL, MB PANDE AND MC DESAI

Animal Nutrition Research Department, Anand Agriculture University, Anand – 388 110, Gujarat, India
E-mail: prp_anand@yahoo.co.in

ABSTRACT

A lactation study of 25 weeks duration was carried out to explore the effect of wheat straw based total mixed rations on performance of crossbred (Jersey x Kankrej and Holstein Friesian x Kankrej) cows. Sixteen crossbred cows were randomly divided in to four dietary treatments viz. T1: TMR with 30 % wheat straw and without *Prosopis juliflora* pods, T2: TMR with 30 % wheat straw and 10 % *Prosopis juliflora* pods replacing rice polish w/w, T3: TMR. with 30 % wheat straw and 20 % *Prosopis juliflora* pods replacing rice polish w/w and T4 (Control): Conventional system of feeding roughage and concentrates separately. Wheat straw was used as roughage in T4 without processing. The TMRs were prepared by mixing wheat straw ground through 8 mm sieve with concentrates. The values for modulus of uniformity were 2:6:2, 1:6:3 and 2:7:1 for T1, T2 and T3, respectively. The NDF content in TMRs ranged from 42.97 to 46.74 %. The average daily DMI was 7.92, 7.78, 8.92 and 5.62 kg in T1, T2, T3 and T4, respectively with significant treatment differences ($P<0.01$). The percent DMI and DMI per kg metabolic body weight also followed the similar trend ($P<0.05$). The DMI through wheat straw was 33 to 41 % higher in TMRs than control. Intake of CP, DCP and TDN (Kg/d) revealed values in the range of 1.03 to 1.61; 0.66 to 1.08 and 3.14 to 4.96, respectively with higher DCP ($P<0.01$) and TDN ($P<0.05$) intake in all the TMRs than control group. The efficiency of feed and nutrient utilization was not affected by dietary treatments, however, it was found better under conventional system of feeding. Similar trend was also observed for gross and net protein and energy efficiency. The average daily milk production recorded was 7.54, 6.78, 7.82 and 6.20 kg with corresponding values of 3.82, 4.01, 4.05 and 4.31 for milk fat content in T1, T2, T3 and T4, respectively. Total mixed rations improved milk yield and it was the highest in T4 with 26 % improvement over control group. The milk constituents like TS, SNF, Protein, Phosphorus and calcium were not affected by dietary treatments. Digestibility of nutrients was on par in all the groups. The average daily feed cost was recorded higher in TMR groups but the feed cost per kg milk and kg FCM yield were more or less similar among the treatments. It was concluded that feeding TMR instead of feeding concentrates and roughage (wheat straw) separately increased feed intake and milk production in crossbred cows. Poor quality crop residues like wheat straw can be better utilized through TMR instead of feeding alone. Use of *Prosopis juliflora* pods as an unconventional energy rich feed can replace rice polish successfully with reduction in cost of feed formulation.

KEYWORDS: Total Mixed Ration, Feeding system, *Prosopis juliflora* pods, dairy cattle, lactation

INTRODUCTION

India ranks first in the world with 299.08 million cattle, which is 15.88 % of the world population (FAO, 1997). For such a huge population, the feeds and fodder are in short supply to the tune of 36 to 40 %. In developing countries like India, ruminants mainly sustain on crop residues and agro industrial byproducts, which are poor in nutritive value and digestibility. Limitation of practical application of methods suggested to improve their nutritive value in field conditions has compelled nutritionist to improve feeding systems. Total mixed ration or complete feed refers to system of feeding roughages and concentrates together after blending. Total mixed ration has been used with a great interest by farmers because of its expected benefits in nutrition, management and production of ruminants (Sirohi et al.,

2001). Nock et al. (1985) reported that TMR system helps to maintain rumen pH and A/P ratio because TMR could provide more balanced ration with a uniform rate of roughage and concentrate and increased intake. For the high yielding dairy cattle which require high concentrate feeds, TMR has been known to give benefits by increased meal frequency and feed intake, enhanced fiber digestibility and nutrients utilization and increased milk production and milk fat production (Owens, 1984). Wheat straw is the chief crop residue available in Gujarat State but not used efficiently. *Prosopis juliflora* pods (Mesquite pods) are the most promising energy rich unconventional feed available to the tune of 0.2 and 1 million ton annually in Gujarat and India, respectively (Anonymous, 1989). These pods contain about 13% Crude Protein, 75% TDN and 20% soluble sugars and hence are sweet in taste and increase palatability of feed (Talpada et al., 2003). Inclusion of *Prosopis juliflora* pods at 30 % level in compounded cattle feed has been recommended without any adverse effect on feed intake, digestibility, rumen fermentation, milk production, composition and flavour in dairy cows (Talpada, 1985). It also supplies readily fermentable carbohydrate in rumen and thus improves utilization of ammonia by microbes and ensures better supply of protein and energy for production. Three total mixed rations were prepared based on wheat straw with different levels of *Prosopis juliflora* pods and evaluated as ration of lactating cows.

MATERIALS AND METHODS

Experimental animals

Sixteen cross bred (Jersey x Kankrej and HF x Kankrej) cows were randomly allotted to 4 treatments with four cows in each following completely randomized design.

Experimental feeds and feeding animals

Three total mixed rations were prepared by mixing ground (8 mm) wheat straw with concentrates as follows: **T1:** TMR prepared by mixing ground (8mm) wheat straw (30 %) and concentrates (70 %) without *Prosopis juliflora* pods, **T2:** TMR prepared by mixing ground (8mm) wheat straw (30 %) and concentrates (70 %) with 10 % *Prosopis juliflora* pods replacing rice polish w/w, **T3:** TMR prepared by mixing ground (8mm) wheat straw (30 %) and concentrates (70 %) with 20 % *Prosopis juliflora* pods replacing rice polish w/w and T4: Conventional system of feeding roughage and concentrates separately (Control). All the TMRs were isonitrogenous and isocaloric in nature. In T4, the wheat straw was fed as such without chaffing. The ratio of roughage to concentrate in TMR was 30:70. The cows were offered respective TMR ad lib. (10% refusal). The cows under control group were offered concentrate mixture as per ICAR (1985) feeding standards for lactating cows. Green NB 21 was offered daily @ of 5 kg to each animal to meet vitamin A requirement. The feeding protocol for TMR groups involved once daily feeding of TMR at 10.00 h. The cows in control groups were offered half the concentrate mixture during morning milking (06.00 h) and half during evening milking (18.00 h). The wheat straw was offered ad lib. (10% refusal) at 10 a.m. to cows under T4. Cows were housed in a stall and received feed individually. The cows were let loose daily for 2 hours in the morning and 2 hours in the evening during which they had free access to fresh drinking water. The animals were weighed at weekly intervals for 3 consecutive days before feeding and watering. The daily milk yield and feed intake were recorded. A metabolism trial of 7 days collection period was conducted on all the animals by conventional method. The samples of feeds, fodder and feces were collected and pooled samples were analyzed for proximate composition (AOAC, 1990). Representative samples of morning and evening milk were analyzed for fat (ISI, 1970), total solids (ISI, 1962), nitrogen, ash, phosphorus (AOAC, 1990) and calcium (ISI, 1962) fortnightly. Feed efficiency and economics were workout. The differences between dietary treatments with respect to feed intake and digestibility results, performance data and economics were analyzed as per Snedecor and Cochran (1989). The experiment was conducted for 25 weeks.

RESULTS AND DISCUSSION

Feeds and TMR

The wheat straw was ground through 8 mm sieve for preparation of total mixed rations. The particle size of 8 mm of wheat straw was considered to be above the threshold of 6.4 mm that is reported to decrease rumination time and cause milk fat depression when dairy cows were fed chopped alfalfa hay as forage (Beauchemin et. al., 1994). The modulus of uniformity of total mixed rations was determined as per standard procedure using standard sieves. The values of MU (distribution of course: medium: fine particles in ration) were 2:6:2, 1:6:3 and 2:7:1 in TMR groups T1, T2 and T3, respectively. The particle size of wheat straw in control group was 2 to 3 cm. The chemical composition and composition of various fiber fractions are given in Table 1. Replacement of rice polish with *Prosopis juliflora* pods in T2 and T3 reduced fed cost by 5 and 10 %, respectively. The NDF content ranged from 42.97 to 46.74% and ADF content ranged from 33.53 to 33.86% in total mixed rations. The lignin content ranged from 5.37 to 7.20%. All the total mixed rations contained sufficient total NDF content according to NRC (2001) recommendations.

Feed intake and plane of nutrition

Intakes of dry matter and nutrients are shown in Table 2. The average daily dry matter intake was found significantly (P<0.01) higher in all TMR groups over the conventional system of feeding indicating that total mixed rations were more palatable and the particle size reduction resulted in increased DM intake. Among the TMR groups, DMI gradually increased with increase in the level of *Prosopis juliflora* pods in the ration. This suggested that inclusion of *Prosopis juliflora* pods helped in increasing DM intake by increasing palatability, which might be due to higher sugar content in it.

The DMI from wheat straw was 2.24, 2.20, 2.54 and 1.49 kg/day, respectively in T1, T2, T3 and T4. It was 33% higher in T1 and T2 and 41% higher in T3 than T4, which indicated that wheat straw can be better consumed in form of TMR as compared to fed as such. Higher DMI in total mixed rations may be due to inclusion of *Prosopis juliflora* pods along with processing and blending of roughage with concentrates resulting in to faster passage rate through digestive tract. This is consistent with the earlier reports where particle size reduction of poor quality forages significantly increased dry matter intake (Moore et al., 1964). The level of forage in complete feed also plays an important role on DMI. Coppock et al. (1974) reported that high DMI can be observed in TMR with forage level between 30-45 per cent. Reddy et al. (1996) observed higher (P<0.05) DMI in lactating crossbred cows maintained on complete feed regimen than the cows under conventional system of feeding. Villavicencio et al. (1970) reported that cows on a complete feed containing cottonseed hulls at 30:70 roughage to concentrate ratio consumed significantly higher DM than cows on conventional system of feeding. The intake of nutrients (CP, DCP and TDN) is delineated in Table 2. Intakes of all the nutrients were observed higher in all the TMR groups than control. The differences were significant for DCP (P<0.05) and TDN (P<0.01) intake. Reduction in particle size of forage in TMR groups increased DMI, which resulted in increase in nutrients intake. In control group, the wheat straw was not processed and hence was consumed less. However, since the concentrate mixture was fed as per the ICAR (1985) feeding standards to meet the protein requirement of cows in T4, though the intake of crude protein was lower, was on par with other treatments. But insufficient forage intake could not meet the energy requirement of cows. The results are in agreement with the earlier report of Kawalkar and Patle (1978) where in they reported significantly (P<0.01) higher DCP and TDN intake by lactating cows fed TMR with 40% sorghum straw or local hay than cows fed roughage and concentrate separately. Villavicencio et al. (1970) and Reddy et al. (1996) had also reported similar nutrients intake by cows fed either complete diet or the cows under conventional system of feeding.

However, the comparative plane of nutrition of cows with the average requirement of DCP and TDN in each group as per ICAR (1985) feeding standards for lactating primiparous cows (figures given in parenthesis in Table 2) revealed that cows under all the groups consumed more DCP than the requirement and in TMR groups it was 72 to 75% higher. This was because of high concentrate content in all the TMR groups and high digestibility of crude protein. But the intake of TDN was less by about 22%, 16%, 14% and 35%, respectively in T1, T2, T3 and T4 than recommended by ICAR (1985). This indicated that even with high concentrate level in all the TMRs, the desired energy level could not be achieved due to use of fibrous crop residues and even with high DMI, the cows were not able to meet their energy requirements. Further, the high CP level in all the groups resulted in excess protein intake and elimination of excess protein in form of urea might have kept the cows under more energy crisis. But the results of TDN intake and requirement also suggest that energy deficit is more likely to occur under conventional system of feeding with crop residues as basal fodder than with TMR system as the feed intake increased in later. The increase in TDN intake with increase in the level of *Prosopis juliflora* pods suggested that it can be used as energy source for lactating cows instead of rice polish since later is costlier. Talpada et al. (2002) also reported linear increase in TDN intake by calves with increase in the level of *Prosopis juliflora* pods in complete feeds.

Feed and nutrient utilization efficiency

The results on efficiency of feed and nutrient utilization (intake of DM, CP, DCP and TDN per kg milk and FCM yield) revealed non-significant treatment differences with comparatively better-feed efficiency in control group than experimental groups. This was because against 38 to 58 % higher DM intake in TMR groups over control, the corresponding increase in milk yield was in the range of 9 to 26 % only. Thus the particle size reduction of forage though improved the feed intake, the response in terms of milk production was comparatively less. Anonymous (2001) observed non significant treatment differences for nutrient utilization efficiency in lactating cows fed either complete feed with 45% wheat straw or conventional ration. The efficiency of utilization of DE and protein for milk production also followed the similar trend with values in the range of 15.3 to 18.6, 20.94 to 29.03 and 26.63 to 33.66 per cent, respectively for Gross Protein (GPE), Net Protein (NPE) and Gross Energy (GEE) efficiency. The GPE, NPE and GEE were also recorded higher (P>0.05) in control than TMR groups by 12-18 %, 21 –

28 % and 10 – 21 %, respectively. This indicated that 20 to 30 % more of digested nutrients (Protein and Energy) got secreted in milk under conventional system of feeding than total mixed rations. Kawalkar and Patle (1978) observed non significant treatment differences for gross protein (15.78 to 17.39) and energy (18.54 to 20.11) efficiency in lactating cows reared on complete feed or conventional system of feeding and the values are in agreement with present findings for protein efficiency but the energy efficiency in present study has been observed higher. Bhatnagar *et al.* (1975) reported 23.2 % GEE in indigenous as well as crossbred cows which is lower than observed in this study.

Milk yield and Composition

The average daily milk yield was 7.54, 6.78, 7.82 and 6.20 kg, respectively in T1, T2, T3 and T4 (Table 3). 21.61, 9.35 and 26.12% in T1, T2 and T3 recorded it higher, respectively over T4. However, the treatment differences were non significant. The increase in milk yield under TMR groups was due to high dry matter and nutrients intake. Increase in milk production with decrease in forage particle size in TMR has been reported earlier (Krause and Combs, 2003; Clark and Armentano. 1998). However, Krause et al. (2002) and Fischer et al. (1994) did not observe increase in milk yield with forage particle size reduction in TMR. Coppock et al. (1974) observed increase in milk yield with decrease in forage: concentrate ratio in TMR. Earlier, Ronning (1960) also reported significant increase in milk production as the concentrate intake was increased up to 30% of ration in total mixed pelleted diets but decreased at 45% level of concentrates. Reddy et al. (1988) observed 39% increase in FCM yield in cows on sunflower straw and head (35%) based complete feed.

The average milk fat content was 3.82, 4.01, 4.05 and 4.31%, respectively in T1, T2, T3 and T4 with non-significant treatment differences. Decrease in particle size of forage reduced milk fat content to some extent in T1 but in T2 and T3, the milk fat content improved over T1. Though there is no apparent reason for this, it may be due to *Prosopis juliflora* pods being rich in energy, fibre and sugar content than rice polish. It also indicates that supplementation of *Prosopis juliflora* pods in TMR can help prevent drop in milk fat content. Rakes (1969) reported that 30% roughage level seems to be optimum below which definite drop in milk fat content can be expected. However, no depression in milk fat content had been noted on complete feed with 25% roughage (Putnam and Davis, 1961). Cows fed TMR containing long hay opposed to short alfalfa silage produced milk containing more fat (Fischer et al. 1994) which is in contrast with the results of Krause et al. (2002) where forage particle size has not shown effect on milk fat percentage despite the smaller particle size of finely chopped silage in TMR even up to 3.7 mm. Milk fat depression is the animal response that often is associated with effective NDF content of ration (Mertens, 1997). Based on milk fat percentage observed in this study and the lack of diet effect on milk fat percentage, it can be concluded that all the diets provided adequate amounts of effective NDF to sustain milk fat percentage. Similar findings have been reported on complete feeds based on 45% ground cotton straw (Reddy and Reddy, 1985) and 28.5% wheat straw + 10% sunhamp hay (Reddy et al., 1996).

The values of other milk constituents like SNF, TS, Protein, Calcium and Phosphorus were more or less similar under all the treatments and revealed non significant treatment differences. The FCM production was lower in control group as compared to total milk rations, which was due to high milk production recorded in later. Significant increase in FCM yield has also been recorded by Reddy et al. (1988) in cross bred cows fed complete feed with 35% sunflower straw compared to cows under conventional system of feeding.

Digestibility and balances of nutrients

The results for digestibility coefficients of nutrients are given in Table 4. The treatment differences were non significant for all the nutrients. The results suggested that particle size reduction of forage did not decrease digestibility of nutrients especially that of crude fiber. On the contrary, the DM and OM digestibility was observed little higher in TMRs. The results are supported by the findings of Li et al. (2003) who also observed higher nutrient digestibility in steers fed TMR than the steers under conventional system of feeding. Donald et al. (1985) suggested that improvement in digestibility in TMR feeding system was due to more stabilized ruminal condition and improved ruminal function. Effect of TMR on nutrient digestibility in the literature is conflicting. No difference in digestibility of nutrients has been reported (Reddy and Reddy, 1985; Anonymous, 2001) in contrast to improved digestibility with TMR compared to separate feeding (Yang and Verga, 1989) and lower digestibility in complete feed than conventional system of feeding in lactating cows (Reddy et al., 1988). The balances of N, P and Ca were positive in all TMR groups except negative P balance in T2, where as in T4, the balance of all the nutrients were recorded negative. This was the reflection of low feed and nutrients intake in T4. The TMRs contained 13.51, 13.59 and 12.41 per cent DCP and 53.49, 55.61 and 54.27 per cent TDN in T1, T2 and T3, respectively.

Economics of feeding

The economics of feeding total mixed ration

Table 1: Ingredient and chemical composition of experimental rations.

	Complete feeds			Con. Mix.	Wheat straw	'NB 21'	Prosopis juliflora pods
	T_1	T_2	T_3	T_4			
Ingredient composition (%)							
Deoiled groundnut cake	26	26	26	35			
Rice polish	25	15	5	26.5			
Wheat bran	6.5	6.5	6.5	25			
Prosopis juliflora pods	-	10	20	-			
Molasses	10	10	10	10			
Mineral Mixture	1	1	1	2			
Salt	1	1	1	1			
Urea	0.5	0.5	0.5	0.5			
Wheat straw	30	30	30	-			
Cost (Rs./100 kg.)	334	320	306	498			
Chemical composition (% on DM basis)							
Crude protein	18.28	18.16	18.39	24.77	3.96	12.90	13.50
Ether extract	3.95	3.51	3.38	3.28	1.96	3.60	4.00
Crude fiber	21.48	22.81	21.24	13.59	40.62	27.65	20.90
NFE	43.39	42.30	44.84	45.73	41.76	42.19	54.70
Ash	12.90	13.22	12.15	12.63	11.70	13.66	6.90
Silica	5.77	5.42	4.38	3.91	7.94	4.95	1.00
Phosphorus	0.87	0.82	0.76	1.21	0.40	0.77	0.64
Calcium	1.00	1.18	1.22	1.31	0.08	0.84	0.25
NDF	46.74	45.59	42.97	–	–	–	–
ADF	33.86	33.54	33.53	–	–	–	–
Lignin	7.20	5.58	5.37	–	–	–	–

Table 2: Feed and nutrients intake and feed efficiency of experimental animals.

Particulars	T_1	T_2	T_3	T_4
Av. DMI (kg/d)	7.92 ± 0.39^{a}	7.78 ± 0.66^{a}	8.92 ± 0.78^{a}	$5.62\pm0.35^{b**}$
Av. DMI (% of B.wt.)	2.51 ± 0.09^{a}	2.51 ± 0.20^{a}	2.63 ± 0.24^{a}	$1.95\pm0.11^{b*}$
Av. DMI (g/Kg $w^{0.75}$)	102.34 ± 2.54^{a}	105.20 ± 8.24^{a}	112.70 ± 9.81^{a}	$80.36\pm4.52^{b*}$
Av. CP intake (kg/d)	1.42±0.07	1.39±0.13	1.61±0.14	1.03±0.04
Av. DCP intake (kg/d)	1.04 ± 0.05^{a} (0.602)	1.02 ± 0.09^{a} (0.559)	1.08 ± 0.09^{a} (0.628)	$0.66\pm0.03^{b*}$ (0.519)
Av. TDN intake (kg/d)	4.26 ± 0.21^{a} (5.46)	4.34 ± 0.37^{a} (5.15)	4.96 ± 0.43^{a} (5.75)	$3.14\pm0.11^{b*}$ (4.83)
Feed efficiency				
Av. DMI(kg/kg milk)	1.07±0.08	1.19±0.08	1.20±0.15	0.92±0.06
Av. DMI(kg/kg FCM)	1.10±0.09	1.19±0.08	1.19±0.15	0.88±0.06
Av. CPI (kg/kg milk)	0.191± 0.01	0.211±0.01	0.216±0.03	0.171±0.02
Av. CPI (kg/kg FCM)	0.197±0.02	0.211±0.01	0.215±0.03	0.163±0.02
DCPI (kg/kg milk)	0.139±0.01	0.155±0.01	0.145±0.19	0.109±0.01
TDNI (kg/kg milk)	0.574±0.04	0.640±0.19	0.667±0.09	0.516±0.04
TDNI (kg/kg FCM)	0.589±0.05	0.662±0.05	0.662±0.05	0.493±0.06
GPE (%)	16.33±0.75	15.36±0.62	15.30±0.18	18.60±0.09
NPE (%)	22.62±0.81	20.94±0.73	22.81±0.039	29.03±0.18
GEE (%)	30.17±0.40	26.63±0.51	26.87±0.45	33.66±0.25

** P<0.01, a,b =Values with different superscripts within a row differ significantly (P<0.01)

Table 3: Milk production and milk composition of cows under experiment.

Particulars	T_1	T_2	T_3	T_4
Av. milk yield (kg/day)	7.54±0.64	6.78±16.50	7.82±1.10	6.20±0.53
Av. milk fat (%)	3.82±0.64	4.01±1.04	4.05±0.23	4.31±0.03
Av. FCM (kg/day)	7.34±0.61	6.79±1.05	7.88±0.99	6.49±0.55
Av. Total solids (%)	13.02±0.36	13.71±0.25	13.01±0.60	13.99±0.39
Av. SNF (%)	9.20±0.26	9.70±0.18	8.95±0.39	9.68±0.40
Av. CP (%)	3.12±0.16	3.15±0.15	3.15±0.15	3.09±0.24
Av. Phosphorus (%)	0.11±0.003	0.11±0.001	0.11±0.01	0.11±0.001
Av. Calcium (%)	0.13±0.06	0.14±0.08	0.12±0.08	0.14±0.08

Table 4: Digestibility and balances of nutrients and economics of feeding.

DM	56.05±1.31	59.13±4.03	57.06±1.91	50.71±4.27
OM	58.95±1.11	59.13±4.03	57.06±1.01	50.71±4.27
CP	73.94±0.73	74.87±0.70	67.50±0.70	69.11±2.61
EE	64.46±7.25	63.22±9.77	73.89±4.21	63.69±8.94
CF	47.79±2.98	48.99±10.62	43.91±4.01	49.43±3.07
NFE	55.29±5.32	61.11±4.96	60.02±2.12	55.62±4.00
Average balances of nutrients (during metabolism trial)				
Nitrogen (g/d/h)	+33.2±25.98	+36.6±39.23	+6.17±23.76	-22.43±6.68
Phosphorus (g/d/h)	+24.97±19.1	+17.95±11.22	-17.69±5.25	-14.43±11.22
Calcium (g/d/h)	+18.31±9.40	+26.22±19.56	+20.91±18.84	-11.21±5.13
Nutritive value of TMRs				
DCP (%)	13.51	13.59	12.41	
TDN (%)	53.49	5.61	54.27	
Economics of feeding (Average Feed cost)				
(Rs./day)	29.34±1.34	29.02±2.01	31.15±1.96	22.75±0.96
(Rs./kg milk)	3.89±0.25	4.28±0.33	3.98±0.57	3.66±0.44
(Rs./kg FCM)	3.99±0.30	4.27±0.33	3.95±0.54	3.60±0.42

revealed higher daily feed cost than control group which was due to higher feed intake, however, the differences were non significant. But higher feed cost under TMR groups was compensated by higher milk yield as is evident from more or less similar feed cost per kg milk and FCM yield in all the groups. Reduction in feed cost per kg FCM by 27.9% (Reddy et al., 1988) and per kg milk by 36.5% (Anonymous, 2001) has been reported in cross bred cows fed complete feeds over cows under conventional system of feeding. Replacement of rice polish by cheaper *Prosopis juliflora* pods could not help reducing feed cost as it tended to increase feed intake by increasing the palatability due to their sweet taste.

From the results, it seems that TMR can be more favorable feeding system over conventional system of feeding considering better utilization of crop residues like wheat straw through increased DM an nutrients intake with rise in milk production without much fat depression. Also, replacement of rice polish in TMR by *Prosopis juliflora* pods as an unconventional energy source increases palatability of feed along with reduction in cost of feed formulation. It also helps in reducing feed shortage and provides employment to rural poor in form of collection of pods.

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