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Nutritional status of dairy animals in different regions of Punjab State in India

M P S BAKSHI[1] and M WADHWA[2]

Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab141 004 India

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ABSTRACT

The objective of this study was to assess the nutritional status of animals with respect to macro nutrients in different regions of Punjab state. The Punjab State is divided into 6 agro climatic zones — the sub mountain undulating zone (SMUZ), undulating plain zone (UPZ), central plain zone (CPZ), western plain zone (WPZ), western zone (WZ) and flood prone bet zone (FPBZ). Two districts were selected from each region; from each district 2 tehsils/blocks were selected. From each tehsil, 2 villages and from each village at least 10 farmers of different socio-economic status were selected.

The animals of WZ had highest body weight (518 kg) produced highest milk (6.9 kg/d), while that of SMUZ had the lowest body weight (467 kg) and animals of UPZ produced only 5.1 kg/d. The daily DM intake expressed as per cent of body weight varied between 2.35 (UPZ) and 2.84% (WPZ). The animals of all the zones, except that of CPZ (protein) and WPZ (EE) were offered either protein and fat deficient diets, or the diet offered was not able to meet the requirement of these nutrients, as also indicated by the milk urea-N (MUN), which varied between 4.67 (WPZ) and 9.45 mg/dl (CPZ). The NDF content in the complete feed was much higher in all the zones than the recommended level. The proportion of roughage in the complete feed was highest in UPZ (86.9%) followed by that in FPBZ (83.69%) and lowest proportion was used in the diet of animals of WZ (71.41%), where relatively high proportion of concentrate was used (28.59%), which was clear from the health and productive performance of the animals of WZ.

The purine derivatives excreted in urine revealed that allantoin concentration was highest in animals of WZ indicating highest microbial protein synthesis in the rumen for meeting the protein requirements. The results revealed that animals of WZ utilized the nutrients more efficiently compared to animals of any other zone, as indicated by higher milk production. The animals of WPZ though consumed higher amount of DM and CP, the absorption of purines and microbial nitrogen synthesis was low, indicating inefficient utilization of dietary nutrients.

Only 19.7% of the farmers offered mineral mixture (MM) in CPZ, followed by that of FPBZ and lowest (2.5%) in SMUZ. With regards to salt supplementation in the diet, the situation was better than that for MM, as 48% of the farmers of CPZ and only 19.68% of the farmers of WZ supplemented the diet with salt. The deficiency of minerals and salt was reflected in reproductive problems faced at farm houses. The highest cases of repeat breeding/anoestrus were recorded in CPZ and WPZ (52.0–51.5%) and the lowest number (28–34%) of cases was recorded in WZ and FPBZ. It was concluded that feeding of the balanced diet (with respect to energy, protein and minerals) must be advocated under field conditions.

Key words: Dairy animals, Macro nutrient status, Milk urea nitrogen, Mineral supplement, Urinary purine derivatives

Punjab is one of the smallest states of India, covering an area of 50 362 km^2, representing 1.54% of country's total geographical area and is often known as the bread basket of India. The Punjab State is divided into 6 different agro-climatic zones and contributes 10% of milk to the national grid, from about 3% of the total milch population of the country. To improve upon the current status, the animals must be fed quality feedstuffs as per their physiological status and production potential. But, majority of the animals under field conditions are fed as per the feedstuffs available with the farmer, without giving much significance to the productivity and reproductive performance of animals. However, the progressive dairy farmers are really concerned about the health and productivity of their animals. It is imperative to know the nutritional status of dairy animals in different zones, so as to feed them as per their physiological status to improve the productive and reproductive performance of dairy animals and to reduce nutrient losses to the environment. Therefore, the study was taken up to assess the nutritional status of the dairy animals in different zones of Punjab.

Present address: [1]Senior Nutritionist cum Head (e-mail: bakshimps@yahoo.com), [2]Senior Biochemist, Department of Animal Nutrition.

MATERIALS AND METHODS

The Punjab State is divided into 6 agro-climatic zones, viz. sub-mountainous undulating zone (SMUZ: Covering Pathankot, Ropar, Nawanshehar, part of Hoshiarpur districts), undulating Plain zone (UPZ: Covering Gurdaspur, part of Hoshiarpur districts), Central Plain zone (CPZ: Covering Jalandhar, Kapurthala, part of Amritsar, Ludhiana, part of Sangrur, Malerkotla, Patiala, Fatehgarh Sahib districts), Western plain zone (WPZ: Covering Ferozepur, Moga, part of Sangrur districts), Western zone (WZ: Covering Ferozepur, Faridkot, Muktsar, Mansa, Bathinda, Moga districts) and Flood prone, bet zone (FPBZ: Covering parts of Kapurthala, Taran Taran, Jallandhar, Ludhiana and parts of Patiala districts). Two districts were selected from each region; from each district 2 tehsils/blocks were selected. From each tehsil, 2 villages and from each village at least 10 farmers of different socio-economic status were selected (Table 1). The socio-economic status of the farmers was assessed by land holdings i.e. small and marginal farmers having <4 ha, medium 4–10 ha and landlords >10 ha land. Information

Table 1. Districts, tehsils/blocks and villages selected from different agro-climatic regions

Sub-mountainous undulating zone (SMUZ)							
Nawanshahr[1]				Hoshiarpur			
Balachaur[2]		Saroya		Bhunga		Hoshiarpur	
Paniali Kalan[3]	Sobhuwal	Mukhupur	Teehra	Patiari	Panj Bhayan	Khankan	Jian
Undulating plain zone (UPZ)							
Hoshiarpur				Gurdaspur			
Garhshankar		Dasua		Dera Baba Nanak		Gurdaspur	
Simbhi	Chak Phullu	Randhawa	Panwa	Kalen Wali	Dera Baba Nanak	Pasiyal	Magrala
Central plain zone (CPZ)							
Ludhiana				Kapurthala			
Samrala		Jagraon		Dhilwan		Sultanpur Lodhi	
Todarpur	Mukabad	Gurey	Agead Loppe Dhilwan	Gajji gudaha		Georgepur	Sherpur Sadda
Western zone (WZ)							
Bathinda				Mansa			
Bathinda		Talwandi Sabo		Sardulgarh		Bhikhi	
Jangi Rana	Ghudda	Gurusar Jagah	Jagah Ram Tirath	Sangha	Khera Khurd	Kotra Kalan	Moola Singh Wala
Western plain zone (WPZ)							
Ferozepur				Moga			
Zeera		Jallalabad		Dharma kot		Baghapurana	
Mihan Singh Wala	Kohala	Saide Ke Mohan	Chak Swah wala	Dharma Kot	Fategarh Krotan	Smallsar	Rajoana
Flood prone bet zone (FPBZ)							
Tarantaran				Jallandhar			
Khadur sahib		Patti		Nakodar		Shahkot	
Dhunda	Munda	Vada Sabhra	Kot Bhudhe	Chote Billey	Kayam Wala	Dhandowal	Kanian Khurd

[1]District, [2]Tehsil, [3]Village.

about cropping pattern, livestock holdings, and feeding practices was collected by filling up a comprehensive questionnaire duly approved by the ICAR. The different categories of animals kept by the farmers were converted into adult cattle units i.e. adult lactating buffalo, cow, bullock or adult male buffalo as 1 unit, heifer as 0.75 units and calves as 0.35 units. The heart girth and body length of animals were measured to calculate body weight of animals by using the Shaeffered's formula (Sastry *et al*. 1994).

The feed and fodder samples (1 315), on the spot milk and urine samples (1 920) were collected from at least 2 lactating animals selected at random from each house-hold. The samples of different feedstuffs were dried in a hot air oven at 80° C and ground to pass through 1 mm sieve and analyzed for CP, EE (AOAC 1995) and NDF content (Robertson and Van Soest 1981). The milk samples were preserved with sodium azide tablet. The milk samples were centrifuged at 2 800 g for 15 min at 4°C to separate the fat layer. The defatted milk was de-proteinized by equal volumes of 3% TCA. Samples were mixed and centrifuged at 21 000 g for 20 min at 4°C. The supernatant was used for the estimation of urea. The urine sample (10 ml) stored in a vial containing 0.5 ml of 20% H_2SO_4 was analyzed for allantoin (Young and Conway 1942), uric acid (Trivedi *et a1*. 1978) and creatinine (Folin and Wu 1919). Purines absorbed were calculated from the daily urinary PD excreted (IAEA 1997). The data were analyzed by simple ANOVA (Snedecor and Cochran 1994) by using the software package SPSS version 12 (SPSS 1996) and differences in mean were assessed by using Tukey's b.

RESULTS AND DISCUSSION

On average the relative per cent of landlords was highest in FPBZ followed by that in WZ. Majority (42%) of medium farmers were localized in CPZ (Fig. 1). The percentage of poor/landless farmers varied from 10% (CPZ) to 25% (WZ).

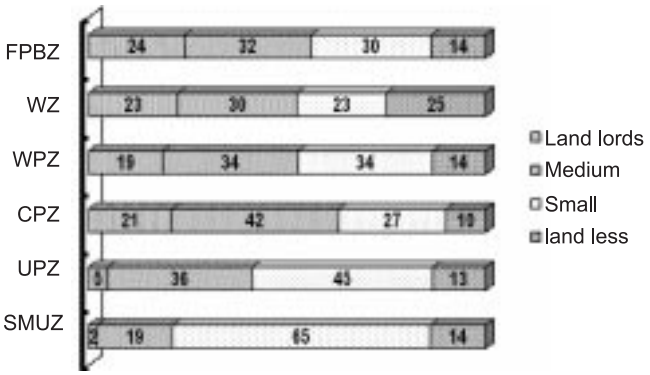

Fig 1. Relative proportion of farmers based on land holdings in different zones,% .

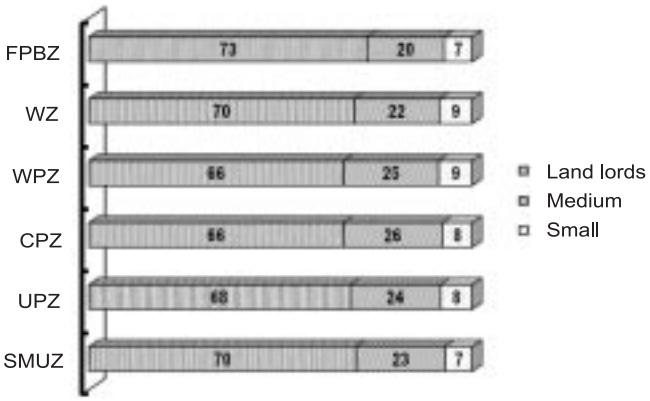

Fig 2. Relative per cent of land holdings by different category of farmers.

The land holdings (Table 2) of land lords ranged between 16 (SMUZ)–25 ha (FPBZ), medium farmers between 5.3 (SMUZ) and 7.2 ha (WPZ) and that of small farmers between 1.6 (SMUZ) to 2.6 ha (FPBZ). The relative per cent of land holdings (Fig. 2) of big, medium and small farmers was in the proportion of 70: 23: 7, 68: 24: 8, 66: 26: 8, 66: 25: 9, 69:

Table 2. Land holdings and cropping pattern

Particulars	SMUZ	UPZ	CPZ	WPZ	WZ	FPBZ	PSE
			Land holding, ha				
Landlord	16.0	16.5	16.3	19.1	19.5	25.1	
Medium	5.3	5.7	6.4	7.1	6.3	6.9	
Small	1.6	2.0	1.9	2.5	2.4	2.6	
			Irrespective of socio-economic status				
Landholding, ha	2.99^{a}	4.32^{ab}	7.67^{bc}	7.20^{bc}	7.20^{bc}	9.60^{c}	0.38
			Cropping pattern,% of landholding				
Cereals	32.3^{b}	68.4^{c}	73.2^{c}	83.7^{d}	20.6^{a}	75.1^{cd}	1.63
Fodder	47.01^{b}	16.46^{a}	18.36^{a}	13.25^{a}	14.38^{a}	14.41^{a}	1.07
Vegetables	8.21^{b}	1.29^{a}	4.96^{a}	0.14^{a}	Nil	1.09^{a}	0.54
Sugarcane	1.67^{a}	11.49^{b}	3.27^{a}	0.79^{a}	0.15^{a}	2.36^{a}	0.50
Oilseeds	0.53^{a}	3.83^{a}	0.10^{a}	2.96^{a}	60.29^{b*}	4.79^{a}	1.25
Fallow land	10.31^{c}	0.69^{ab}	Nil	Nil	5.0^{b}	0.86^{ab}	0.54

Figures with different superscript in a row differ significantly, P<0.01; * Cotton crop.

Table 3. Livestock inventory, body weight, milk yield and milk urea N in animals

Particulars	SMUZ	UPZ	CPZ	WPZ	WZ	FPBZ	PSE
			Livestock inventory				
Adult cattle units, ACU	6.3[a]	5.4[a]	16.0[b]	8.4[a]	6.1[a]	7.5[a]	0.42
Cattle,%	28.7	22.2	28.0	32.2	23.7	21.7	1.15
Buffalo,%	71.3	77.8	72.0	67.8	76.3	78.3	1.14
LA,% of ACUs	51.9[ab]	55.6[b]	46.6[a]	44.9[a]	49.0[ab]	45.1[a]	0.84
			Body measurements and body weight				
Heart girth	6.07[a]	6.18[ab]	ND	6.14[ab]	6.33[b]	6.16[ab]	0.02
Body length	4.61[a]	4.75[b]	ND	4.72[ab]	4.66[ab]	4.71[ab]	0.02
Body weight,kg	466.6[a]	492.9[ab]	ND	480.3[a]	518.45[b]	481.6[a]	3.72
			Milk yield and milk urea nitrogen				
Milk yield, kg/d	5.4[ab]	5.1[a]	6.4[bc]	6.0[abc]	6.9[c]	5.6[ab]	0.11
MUN, mg/dl	7.1[b]	9.2[c]	9.5[c]	4.7[a]	4.8[a]	5.5[a]	

LA Lactating animals; MUN, Milk urea nitrogen; Figures with different superscript in a row differ significantly; ND, Not determined.

Table 4. Urinary excretion of purine derivatives and microbial protein synthesis in animals

Particulars	SMUZ	UPZ	CPZ	WPZ	WZ	FPBZ	PSE
Allantoin, mM/l**	4.69[ab]	3.80[ab]	4.40[ab]	4.88[ab]	5.75[b]	3.51[a]	0.21
Uric acid, mM/l**	0.79[b]	1.02[b]	0.31[a]	1.16[b]	0.91[b]	0.77[b]	0.05
Creatinine, mM/l	5.96[c]	5.92[bc]	2.7[a]	5.60[bc]	5.97[bc]	4.86[b]	0.12
Purine derivatives, mM/l**	4.98[ab]	4.82[ab]	4.71[ab]	6.04[ab]	6.66[b]	4.28[a]	0.24
Purines absorbed, g/d*	456.9[a]	501.1[a]	ND	430.2[a]	735.3[b]	498.1[a]	21.46
Microbial N supply, g/d*	287.6[a]	315.39[a]	ND	273.5[a]	462.8[b]	313.5[a]	13.49
Allantoin,%*	85.1[a]	82.2[a]	92.0[b]	83.0[a]	86.2[a]	85.1[a]	0.42
Uric acid,%*	14.9[b]	17.8[b]	8.0[a]	17.0[b]	13.8[b]	14.9[b]	0.41

Figures with different superscript in a row differ significantly, *P<0.05; **P<0.01; ND, not determined.

22: 9, and 73: 20: 7% in SMUZ, UPZ, CPZ, WPZ, WZ and FPBZ, respectively. Irrespective of the socioeconomic status of the farmer the average land holding was 2.99, 4.32, 7.67, 7.20, 7.20 and 9.60 ha respectively. The survey revealed a very clear picture about socio-economic status of farmers; the farmers of CPZ, WPZ, WZ and that of FPBZ were better off than that of UPZ or SMUZ.

In Punjab, only 4% of area is uncultivated, and most of this is in Hoshiarpur and Nawanshehar districts where, considerable land is covered by Shivalik hills and the beds of seasonal streams that cannot be brought under cultivation. The cropping pattern revealed that 84% total irrigated area (P<0.05) was under cereal production in WPZ as compared to 21 and 32% in WZ and SMUZ, respectively (Table 2). In WZ 60% of irrigated area was under cotton crop. In SMUZ about 47% of irrigated area was under fodder production, unmatched with any other zone. But in spite of this, there is shortage of green fodder, mainly because of very low soil water table especially in the semi-hilly arid region of Hoshiarpur district. The animals of this area are mainly dependent on forest tree leaves and wild grasses. Some of these leaves (Bakshi and Wadhwa 2004, Rana *et al.* 2006, Bakshi *et al.* 2006, Bakshi and Wadhwa 2007, Bakshi *et al.* 2009) and grasses (Bakshi *et al.* 2005) have great potential as livestock feed.

The farmers of CPZ has highest (P<0.05) number of ACUs (16) followed by that in WPZ and FPBZ (Table 3). The farmers of UPZ had the lowest number of ACUs. The number of lactating animals as per cent of ACUs was highest (P<0.05) in UPZ (56%) followed by that in SMUZ (52%) and lowest in FPBZ (45%). In all the zones, buffaloes were the favorite (71–78%) animal as compared to crossbred or indigenous cows (22–29%). However, in Gurey village under the Jagraon Tehsil of Ludhiana District in CPZ crossbred cows predominated (71.7%) as compared to only 28.3% buffaloes. The body measurements of the animals revealed that the animals of WZ had the highest (P<0.05) heart girth and that of UPZ had the highest (P<0.05) body length, both these parameters were lowest in the animals of SMUZ, which were responsible for lowest (P<0.05) body weight of animals in this region as compared to those of WZ, which had the highest. The animals of this zone produced the highest (P<0.05) milk as compared to those of UPZ. On the basis of the production status animals of CPZ occupied the second position. The milk urea-N (MUN), an indicator of nutritional status of animal, especially with respect to protein was highly variable in animals. The average MUN concentration in the different zones revealed that it was highest (P<0.05) in the

milk of animals of CPZ (9.5 mg/dl), which was statistically comparable to that in UPZ, lowest in milk of animals of WPZ and WZ. But in all the cases the MUN was less than that recommended level (11–16 mg/dl) for well fed animals, indicating that most of the animals were under fed especially with respect to protein (Wadhwa e*t al*. 2005 and 2006).

The purine derivatives (PD) excreted in urine has been used as tool to assess the microbial protein synthesized in the rumen. The urinary excretion of allantoin and total PD was highest (P<0.05) in animals of WZ as compared to those of FPBZ, but comparable to the animals in rest of the zones (Table 4). Allantoin constituted the major proportion of total PD excreted in urine. The ratio of allantoin to uric acid in urine varied from 82: 18 to 95: 5. In both the districts of CPZ, the ratio of allantoin to uric acid was significantly different i.e. 95: 5 and 90: 10, while in all other zones, the difference between the districts was not significant. On an average the absorption of purines and supply of microbial nitrogen was lowest (P<0.05) in the animals of WPZ followed by that in animals of SMUZ, while in animals of WZ highest (P<0.05) amount of purines were absorbed resulting in highest amount of microbial nitrogen synthesis, revealing that animals of WZ utilized the nutrients more efficiently compared to animals of any other zone, as indicated by higher milk production.

The chemical composition of different feed stuffs revealed that the total ash content in commercial feeds was much higher than the home made concentrate mixture resulting in low OM content in the former than latter (Table 5). The CP content in homemade mash was much lower than commercial. The quality of commercial mash, mustard and undecorticated cotton seed cake was highly variable with regards to ISI (1976) specifications.

The CP content of the complete diet was the highest (P<0.05) in CPZ followed by in UPZ and lowest (9.3%) in SMUZ (Table 6), while EE content was highest (P<0.05) in WPZ as compared to the lowest in UPZ. As per NRC feedings standards (NRC 1989) the diet of the animal producing 7 litre milk should have 13% CP and 3% EE, accordingly it was observed that most of animals under different agro-climatic zones were underfed, especially in terms of protein. The NDF content of the diet was lowest (P<0.05) in CPZ (63.9%) and highest in WPZ (68.9%). The NRC has recommended that the diet of the lactating animals must have minimum of 28% NDF. Animals of WPZ consumed highest (P<0.05) amount of DM, followed by that of WZ and FPBZ and lowest in UPZ. The daily DMI as per cent of body weight was highest in animals kept in WPZ and lowest in animals in UPZ of the state. The daily DM consumption by the animals in most of the zones was less than the requirements, except that of WPZ, where reverse trend was observed. The CP intake was highest (P<0.05) in the animals of CPZ, and lowest in the animals of SMUZ, while that of EE was highest (P<0.05) in WPZ and lowest in UPZ. In all the zones, except WPZ, the animals consumed EE less than the requirement. The roughage to concentrate ratio in the diet has direct impact on the performance of animals. The proportion of roughage used in diet was highest (P<0.05) in UPZ (86.9%) followed by that in FPBZ and lowest (P<0.05) in WZ (71.4%). The proportion of green and straw in roughage portion also varied between the districts within each zone. The proportion of green fodder used was the highest (P<0.05) in SMUZ followed by that in FPBZ and lowest in WZ, reverse but significant trend was observed in the proportion of straw in roughage, which plays a significant role in modifying rumen microbial population, leading to changes in the secretion of

Table 5. Chemical composition of feedstuffs

Ingredient	Total ash	OM	CP	EE	NDF
Pelleted feed	10.65 (1.3–21.5)	89.35 (78.5–98.7)	18.29 (10.51–26.19)	2.36 (1–4)	50.08 (22–60)
Commercial mash	10.06 (1.8–13.5)	89.94 (86.5–98.2)	17.51 (16.35–26.56)	2.87 (1–7)	48.54 (24–64)
Conc (Homemade)	6.30 (2–14.99)	93.70 (85.01–98)	15.95 (9.56–27.35)	2.95 (1–12)	39.91 (24–56)
Mustard cake	6.69 (5–11)	93.71 (89–95)	36.61 (35.01–40.45)	8.04 (6–11.5)	35.30 (20–46)
Cottonseed cake	4.34 (3.25–9)	95.66 (91–96.75)	24.45 (17.88–27.36)	7.26 (6–9.66)	45.32 (38–56)
Cottonseed	4.0	96	20.71	6.33	48.0
Chapattis (Wheat)	2.5	97.5	14.09	1.33	36
Wheat flour	2.22 (1.5–8.25)	97.78 (91.75–98.5)	13.02 (10.24–16.63)	1.88 (1.5–3.0)	24.73 (20–32)
Rice *kani*	2.0	98.0	12.58	1.5	40
Tara-meera	5.24 (4.5–10)	94.76 (90–95.5)	27.83 (23.30–32.77)	26.24 (18.5–29.5)	37.21 (36–44)
Mah *churi*	11.5	88.5	14.96	3.0	42
Green fodder	11.12 (4–17.5)	88.88 (82.5–96)	12.46 (6.01–24.33)	2.47 (0.5–4.6)	66.50 (47–80)
Wild grass	9.62 (5–23.25)	90.38 (95–96.75)	4.98 (3.58–5.71)	2.3 (0.5–3)	70.5 (57–80)
Wheat bran	5.8 (5–7.5)	94.2 (92.5–95)	14.87 (13.09–16.95)	3.02 (1.5–4)	42.21 (38–48)
Gram husk	2.75	97.25	11.38	0.5	52
Wheat straw	8.15 (2.5–11.5)	91.85 (88.5–97.5)	3.35 (3.01–3.99)	1.06 (1–1.5)	83.99 (78–89)
Paddy straw	16.0	84.0	4.44 (4.05–5.01)	1.0	79.25 (74–83)

Figures in parenthesis indicate the range.

Table 6. Nutrients in complete feed and nutrient intake by animals

Particulars	SMUZ	UPZ	CPZ	WPZ	WZ	FPBZ	PSE
			Chemical composition,% DM basis				
CP	9.3^{a}	10.7^{b}	12.6^{c}	10.2^{ab}	10.2^{ab}	9.6^{ab}	0.12
NDF	67.6^{bc}	68.1^{bc}	63.9^{a}	68.9^{c}	65.9^{ab}	68.5^{c}	0.25
EE	2.58^{b}	1.94^{a}	2.41^{b}	2.70^{b}	2.51^{b}	2.42^{b}	0.03
			Nutrient intake and requirement				
DM intake, kg/d	11.64^{a}	11.59^{a}	11.96^{a}	13.65^{b}	12.83^{ab}	12.87^{a}	0.14
DM required, kg/d	11.87^{a}	11.95^{a}	-	12.28^{a}	13.02^{b}	12.18^{a}	0.07
CP intake, kg/d	1.08^{a}	1.26^{abc}	1.54^{d}	1.40^{cd}	1.32^{bc}	1.18^{ab}	0.02
CP required, kg/d	1.19^{a}	1.18^{a}	-	1.25^{a}	1.34^{b}	1.22^{a}	0.01
EE intake, kg/d	0.30^{b}	0.22^{a}	0.29^{b}	0.37^{c}	0.32^{b}	0.30^{b}	0.01
EE required, kg/d	0.36^{a}	0.36^{a}	-	0.37^{a}	0.39^{b}	0.36^{a}	-
			Conc: Roughage				
Conc. as % DMI	17.81^{b}	13.11^{a}	24.26^{c}	19.65^{b}	28.59^{d}	16.31^{ab}	0.52
Roughage as % DMI	82.19^{c}	86.89^{d}	75.74^{b}	80.35^{c}	71.41^{a}	83.69^{c}	0.52
Green as % roughage	99.14^{d}	41.88^{a}	51.76^{b}	84.17^{c}	37.28^{a}	85.25^{c}	0.92
Straw as % roughage	0.86^{a}	58.12^{d}	48.24^{c}	15.83^{b}	62.72^{b}	14.75^{b}	0.92
			Mineral supplements used at farm houses (%) and reproductive problems				
Mineral mixture	2.5^{a}	13.64^{abc}	19.66^{b}	6.02^{ab}	6.53^{ab}	16.88^{ab}	5.88
Salt	28.46^{ab}	44.32^{b}	47.98^{b}	30.57^{ab}	19.68^{a}	25.29^{ab}	8.24
Reproductive problems	44.60^{ab}	37.61^{ab}	52.02^{b}	51.48^{b}	33.85^{a}	28.26^{a}	6.09

Figures with different superscript in a row differ significantly, P<0.01.

microbial enzyme responsible for digestibility of nutrients which in turn may affect productivity of animals (Bakshi *et al.* 2004).

Only 20% of the farmers of CPZ offered mineral mixture, followed by farmers of FPBZ and UPZ (Table 6) as compared to only 2.5% in SMUZ. The situation is quite bleak as majority of the farmers were not aware of the mineral supplement. As far as salt supplementation in the diet of animals was concerned, the situation was slightly better as 48% of farmhouses of CPZ supplemented salt in the diet of animals followed by that of UPZ as compared (P<0.05) to only 20% in WZ. The lack of mineral mixture and common salt in diet lead to various reproductive problems/failures, like repeat breeding and anoestrus. The reproductive problems faced by the farmers were highest (P<0.05) in CPZ (52.0%) followed by that in WPZ and lowest (28.3%) in FPBZ.

Feeding practices followed: The majority of the farmers preferred to feed homemade cereal mixture (wheat and paddy or wheat and maize), a few fed commercial concentrate mixture (pelleted or mash) supplemented with green fodder and wheat straw depending upon the production status of the animal. The most popular feeding practice followed was to feed only mustard cake or undecorticated cotton seed cake supplemented with wheat, wheat straw with or without green fodder. In WZ 2–5% farmers offered commercial feed, 65–67% home made concentrate, 20–22% mixture of commercial and home made and 5–7% did not offer any concentrate feed (Wadhwa *et al*. 2009). In SMUZ 14–61% farmers offered commercial pelleted feed, 21–24% homemade concentrate, 5–63% mixture of pellets and home made and 1–3% were not offered any concentrate (Hundal *et al*. 2009). Some farmers in WPZ supplemented commercial feed either with mustard cake, cotton seed cake or wheat flour, while others preferred to feed only green fodder or green fodder and wheat straw or green fodder and grass and wheat/paddy straw (Bakshi *et al*. 2009). In FPZ 23–42% offered commercial feed, 25–48% homemade concentrate, 16–18% mixture of commercial and homemade and 12–15% were not offered any concentrate (Wadhwa *et al*. 2010). The animals in UPZ were offered 1–4 kg commercial feed/home made concentrate mixture, supplemented with 5–50 kg chaffed green fodder mixed with 2–11 kg wheat straw (Kaushal *et al*. 2010). Most of the progressive farmers in CPZ made their own balanced concentrate mixture duly supplemented with mineral mixture and common salt (Kaur *et al*. 2010). Some of the farmers in CPZ offered *Phalaris minor* seeds (a weed prevalent in wheat-rice system in northern India) as a part of concentrate to the lactating animals. In winter, berseem was the main fodder crop offered either with wheat straw, rye grass, green oats or with chaffed whole sugarcane. The berseem-sugarcane in equal proportion boosted milk production. During *kharif* season non leguminous forages were offered predominantly, with or without straw. Some of the commercial dairy farmers offered dried *chapattis*, which were soaked in water overnight and fed; waste bread, maize bran, a byproduct of starch industry or spent brewer's grains to their animals as the only concentrate ingredient supplemented with green fodder and straw. These byproducts/wastes also boosted milk production. In all the zones, the concentrate mixture was offered only to

lactating animals or to those, which were in advanced stage of pregnancy. Immediately after parturition the animals were offered boiled crushed wheat supplemented with jaggary for 3–4 days. Landless and marginal farmers, now-a-days medium farmers also offer rice straw to their animals. Only a few farmers supplemented the diet of their animals with mineral mixture.

It was concluded that feeding of the balanced diet (with respect to energy, protein and minerals) must be advocated under field conditions.

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