Indian J. Anim. Nutr. 2020. 37 (3): 227-234
doi: 10.5958/2231-6744.2020.00036.5

Indian Journal of
Animal Nutrition

Effect of Different Levels of Energy and Protein on Performance of Lactating Malnad Gidda Cows

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ABSTRACT

The study was conducted to determine the effect of different levels of energy and protein on performance of Malnad Gidda (MG) cows. Six lactating MG cows (Av. BW; 134 kg; milk yield 1.8 kg/day) were divided into three groups of two cows each in experiment based on switch over design comprising of three periods and allocated one of the following treatments; T_1 was fed 100 % of the requirement according to ICAR (2013), T_2 was fed 10 % more than T_1, and T_3 was fed 20 % more than T_1. The experimental cows were offered daily with 2.5 kg paddy straw, 3 kg hybrid Napier and concentrates (based on milk yield) to meet the requirement. There was a significant difference in body weight and body condition change between the groups. The total DMI in all the groups were similar and the ratio of roughage and concentrates of the diet was 52:48, 51:49 and 48:52 in groups T_1, T_2 and T_3, respectively. There was no significant difference in the nutrients intake and digestibility among the groups, however all the cows were in positive nitrogen balance and per cent of N-retention was significantly ($P<0.01$) higher in T_3 followed by T_1 and T_2 groups. The 4 % FCM yield (kg/d) was 2.26, 2.27 and 2.44 in groups T_1, T_2 and T_3, respectively and the difference was non-significant. Composition of milk was also similar among the groups. It was concluded from this study that dry matter consumption in Malnad Gidda cows ranged from 3.6 to 3.9% body weight and feeding as per ICAR (2013) is sufficient to maintain optimum milk production.

Key words: Composition, Malnad Gidda cows, Milk yield, Nutrient intake

INTRODUCTION

Malnad Gidda is a unique dwarf breed of Western Ghat regions in Karnataka which are heat and disease resistant with special quality of grazing ability in hilly regions. Presently, the population of breed is 12.81 lakh (GoK, 2007), with an average body weight of 80-120 kg and they play a major role in the rural economy by providing milk, manure and draft power with negligible inputs. Milk MG cows is known to have many medicinal properties, whereas dung and urine are extensively used for preparation of various products with medicinal values and sanitation purposes (Ramesha, 2001). Greater awareness has been created in recent past among MG cow farmers regarding system of feeding and nutrient requirement of the breed. Malnad Gidda cow's potential of milk production has not yet been fully explored as they are mostly reared solely on grazing. Although this method of rearing renders many benefits, it might not be enough to meet the nutrient requirement of the cows, and thus not fully utilizing the genetic potential of the breed. Thus, it would be of interest to see the effect feeding at different plane of nutrition on performance of Malnad Gidda cows.

MATERIALS AND METHODS

Six lactating Malnad Gidda cows (early lactation, BW 134 kg, milk yield 1.8 kg) from Malnad Gidda Research and Information Center (MGRIC), Veterinary College, Shivamogga were divided in to three groups of two cows each based on milk production and number of days in lactation in a switch over design. The cows were housed in individual stalls, in an open protected shed in a single row and were provided with uniform management and care. All the cows were dewormed individually before starting the feeding trial. The individual cows in the experiment were allocated to one of the three dietary treatments. The treatments were designated as T_1, T_2 and T_3 to provide 100, 110 and 120 per cent respectively of the CP and ME requirement as specified by the ICAR (2013). The cows were offered

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adequate amount of paddy straw (2.5 kg/cow/days) and hybrid Napier Co-4 (HN, 3 kg /cow/day). The concentrate mixture was fed at the time of milking at 6.30 am and 3.30 PM in two portions. A metabolic trial of 5-day collection period was conducted during which an accurate account of feed offered, residues, feces voided and urine excreted were maintained. During the experiment period daily feed intake, milk yield, weekly body weight and body condition score were recorded. Samples of feed, fodder and dung were subjected to proximate analysis (AOAC, 2016) and fiber fraction analysis (Van Soest, *et al.,* 1991). Nitrogen in urine and CP in milk samples were analysed (AOAC, 2016). Milk samples were analyzed for minerals (Atomic Absorption Spectrometry) and milk composition (% SNF, protein, fat and lactose, total ash and total solid) by using electronic milk analyser (Ksheeraa 270 A). Experimental data on DMI, nutrient intake, body weight gain, digestibility, body condition score, milk yield, milk composition and milk composition yield were analysed by statistical analysis system (Graph pad Prism, 2007. version 5.01).

RESULTS AND DISCUSSION

Data pertaining to the nutrient composition of different feed ingredients are presented in Table1. The chemical composition of paddy straw, hybrid Napier and concentrate mixture were similar to the values reported in various earlier studies (Ramachandra and Sampath, 1995; Dohnani *et al.,* 2001; Rahman *et al.,* 2010; Imran *et al.,* 2017).

The Malnad Gidda cows (between 3 to 4 lactation) gained body mass at 85.7, 139.3 and 135.7 g/day in groups T_1, T_2 and T_3, respectively. Even though per cent of increase in body weight was 62 % in T_2 and 58.3 % in T_3 as compared to T_1, the difference between the group was non-significant. Body condition score recorded initially and at the end of each period was significantly ($P<0.05$) higher in group T_2 followed

Table 1. Chemical and mineral composition on % dry matter basis) of paddy straw (PS), hybrid Napier (HN) and concentrate mixture

Parameter	Paddy straw	Hybrid Napier	Concentrates
Organic matter	86.48	87.29	93.63
Crude protein	4.09	4.65	18.25
Crude fibre	32.08	28.69	5.67
Ether extract	1.00	1.83	2.48
Nitrogen free extract	49.32	52.13	67.24
Total ash	13.52	12.71	6.37
Acid insoluble ash	11.67	6.43	2.72
Neutral detergent fibre	68.36	66.41	37.64
Acid detergent fibre	40.95	34.68	8.20
Acid detergent lignin	1.95	1.54	0.60
Minerals			
Calcium, g/kg	3.98	5.67	6.88
Phosphorus, g/kg	1.42	1.69	2.14
Magnesium, g/kg	1.17	4.12	3.12
Potassium, g/kg	7.42	9.53	2.62
Sodium, g/kg	3.26	9.28	1.64
Zinc, mg/kg	62.82	25.83	42.44
Manganese, mg/kg	238.43	32.63	52.21
Iron, mg/kg	330.81	143.41	144.40

by groups T_3 and T_1.This indicated that 10% additional nutrient supplied over the normal requirement improved body condition score and 20 % above the normal requirement (T_3) had not shown any further improvement than T_2 (Table 2).

Dry matter intake (kg/d) from the roughage sources, paddy straw and hybrid Napier ranged from 1.59 to 1.66; and 0.94 to 0.98, respectively, similarly on *per cent* of body weight basis, the corresponding values were 1.2 and 0.7, respectively. The difference

Table 2. Mean body weight gain, body condition score, dry matter and nutrients intake in lactating Malnad Gidda cows

Parameter	Groups				P value
	T_1	T_2	T_3	SEM	
Body weight (kg)					
Initial	139.5	137.0	137.3	6.29	0.986
Final	141.9	140.9	141.1	6.27	0.998
Gain (g/d)*	85.7[a]	139.3[b]	135.7[b]	60.69	0.036
Body condition score					
Initial	2.81	2.72	2.99	0.092	0.504
Final	2.90	3.21	3.16	0.085	0.293
Difference*	0.09[a]	0.49[b]	0.17[c]	0.072	0.045
Dry matter intake (kg/d)					
Paddy straw	1.66	1.59	1.60	0.055	0.869
Hybrid Napier	0.95	0.98	0.94	0.146	0.856
Concentrates	2.42	2.45	2.81	0.108	0.269
Total	5.03	5.02	5.36	0.146	0.591
% of body weight					
Paddy straw	1.19	1.16	1.17	0.035	0.941
Hybrid Napier	0.70	0.74	0.71	0.040	0.918
CFM*	1.72a	1.79[ab]	2.04[b]	0.054	0.028
Total	3.61	3.69	3.91	0.097	0.439
Nutrients intake, kg/d					
OM	4.30	4.60	4.71	0.19	0.311
CP*	0.52[a]	0.57[b]	0.64[b]	0.03	0.054
EE	0.09	0.10	0.11	0.01	0.267
NFE	2.77	2.98	3.09	0.13	0.221
CF	0.91	0.95	0.87	0.04	0.403
NDF	2.55	2.67	2.63	0.12	0.761
Mineral intake					
Calcium, g/d	28.66	28.72	31.07	0.881	0.469
Phosphorus, g/d	9.17	9.18	9.92	0.282	0.491
Magnesium, g/d	13.48	13.61	14.6	0.380	0.444
Potassium, g/d	27.73	27.58	28.26	0.639	0.913
Sodium, g/d	5.91	5.688	5.785	0.189	0.903
Zinc, mg/d	231.5	228.9	244.2	7.126	0.669
Manganese, mg/d	553.2	538.6	559.6	16.920	0.887
Iron, mg/d	1035	1020	1071	29.870	0.791

*P≤0.05, Means bearing different superscripts within a row differ significantly

between the groups in the roughages intake was non-significant as intake was restricted to 2.5 to 3 kg based on maximum intake limit of Malnad Gidda cows determined in the pilot study. Similarly the amount of hybrid Napier fed to each cow was also restricted so as to meet 50 % of dry matter requirement from the roughage sources. The ratio between Hybrid Napier: paddy straw among all the groups was 37:63. Amount of concentrates offered to Malnad Gidda cows in each groups adjusted so as to supply 10 and 20 % more nutrients as compared to ICAR (2013). Hence, the variation concentrate intake was in the expected line and was as per the experimental protocol.

The ratio of roughages to concentrate mixture (CM) in groups T_1, T_2 and T_3 were 52:48, 51:49 and 48:52, respectively. The ratio of HN: PS: CM were in groups T_1, T_2 and T_3 were 19:38:48, 20:31:49 and 18:30:52, respectively. Avergae daily dry matter intake (DMI) was similar among the groups. Similar results were obtained by Venakataramana (1996) in Punganur cows, where supply of different levels of nutrients did not change dry matter intake. On the contrary, Patel and Mudgal (1976) observed significantly higher DMI due to higher plane energy nutrition (135 % of NRC 1966).

The OM intake in T_1, T_2 and T_3 groups was similar, whereas CP intake in the corresponding groups were 0.52, 0.57 and 0.64 (kg/d) which was statistically

Table 3. Digestibility of nutrients, nitrogen balance and density of nutrients in lactating Malnad Gidda cows

Parameter	Groups				P value
	T_1	T_2	T_3	SEM	
Digestibility of nutrients, %					
Dry matter	58.40	60.47	61.75	2.02	0.51
Organic matter	61.79	63.86	64.92	1.80	0.48
Crude protein	60.45	61.59	63.68	1.63	0.39
Ether extract	58.00	52.74	55.64	3.44	0.34
Nitrogen free extract	62.69	65.85	66.13	1.94	0.40
Crude fibre	59.88	60.00	62.55	2.03	0.66
Neutral detergent fibre	52.86	55.22	57.24	2.32	0.43
Acid detergent fibre	44.64	47.01	48.56	3.26	0.70
N-balance, g/day					
Intake*	82.75^{a}	91.02^{ab}	101.55^{b}	0.495	0.042
Out go					
Faeces	41.24	44.44	41.87	2.55	0.651
Urine	20.77	19.24	22.13	3.88	0.872
Milk	12.14	12.36	11.81	0.822	0.893
Retained, g/d**	8.60^{a}	14.97^{a}	25.73^{b}	2.451	0.001
Nutrient density					
TDN, %	56.95	58.96	60.39	1.81	0.424
Intake, kg/d	2.72	3.01	3.12	0.09	0.145
DCP*, %	6.58^{a}	6.91^{ab}	7.76^{c}	0.32	0.054
Intake, kg/d	0.315	0.353	0.407	0.25	0.065
ME, MJ/kg diet	8.61	8.92	9.16	0.27	0.423
Intake, MJ/d	41.14	45.39	47.25	1.29	0.144

*P≤0.05, **P≤0.01, Means bearing different superscripts in a row differ significantly

significant (P<0.05) and higher intake was noticed in T_3 group due to additional supply of concentrates. Not much variation between groups was observed with respect to EE, NFE, CF, TA and minerals intake (Tables 4, 5). Intake of NDF and ADF were similar among the groups, additional nutrient supply could not bring any significant change fibre intake because of lesser variation of NDF and ADF content in the feed stuffs offered to Malnad Gidda cows. Similarly, Mrudhula (2008) and Nagesh (2009) observed similar response pertaining to NDF, ADF and CP intake at different levels of energy supplementation in crossbred cows. On the contrary, Umesh (2011) noticed significantly higher NDF intake in cross bred cows (HF x Jersey) fed higher levels of energy.

Digestibility of DM, OM, CP, NFE, CF, NDF and ADF was not significantly different among the groups (Table 3). Venkataramana (1996) noticed similar digestibility values in Punganur cows for DM, OM, CF, NFE, NDF and ADF. The digestibility values obtained for all the nutrients in Malnad Gidda cows were lower than the digestibility of nutrients in cross bred cows and high producing Holstein cows, but similar to dwarf breed like Punganur. All the cows were on positive nitrogen balance and nitrogen retained was significantly higher (P<0.01) in groups T_2 and T_3 when compared to T_1 to

Table 4. Milk yield and composition

Parameter	Groups				P value
	T_1	T_2	T_3	SEM	
Milk yield, kg/d	2.21	2.26	2.30	0.14	0.906
4% FCM yield, kg/d	2.26	2.27	2.44	0.16	0.698
Milk energy, MJ/kg milk[#]	3.20	3.17	3.29	0.078	0.874
Milk composition and yield					
TS, %	13.10	13.00	13.35	0.36	0.783
TS yield, kg/day	0.29	0.29	0.31	0.02	0.729
SNF, %	8.96	8.91	8.96	0.11	0.945
SNF yield, kg/day	0.20	0.20	0.21	0.01	0.593
Fat, %	4.14	4.10	4.39	0.38	0.847
Fat yield, kg/day	0.09	0.09	0.10	0.01	0.633
CP, %	3.29	3.27	3.29	0.04	0.160
CP yield, kg/day	0.07	0.07	0.08	0.05	0.972
Lactose, %	4.93	4.90	4.92	0.06	0.954
Lactose yield, kg/day	0.11	0.11	0.11	0.07	0.855
Ash, %	0.76	0.76	0.76	0.14	0.945
Ash yield, kg/day	0.02	0.02	0.02	0.09	0.126
Mineral composition					
Calcium, g/kg	1.92	1.91	1.92	0.01	0.906
Phosphorus, g/kg	0.79	0.78	0.79	0.01	0.804
Magnesium, g/kg	0.20	0.22	0.20	0.02	0.766
Potassium, g/kg	0.65	0.65	0.66	0.01	0.804
Sodium, g/kg	0.48	0.48	0.48	0.00	0.922
Zinc, mg/kg	5.91	5.96	6.02	0.05	0.734
Manganese, mg/kg	0.62	0.62	0.63	0.01	0.750
Iron, mg/kg	14.81	14.87	14.94	0.11	0.905

[#]Milk energy (MJ/ kg of milk) = [41.63(% fat) + 24.13(% protein) + 21.6(% lactose) – 11.72] × 2.2/239 (NRC, 2001)

due to higher intake of CP.

The nitrogen retention might have supported weight gain and improved body condition score (Table.3). TDN and DCP content (%) of diets fed to Malnad Gidda cows of T_1, T_2 and T_3 groups were 56.95 and 6.58; 58.96 and 6.91; 60.39 and 7.76, respectively. Both these values increased as the level of energy and protein increased in the diet. The ME content of diets (MJ/kg diet) of groups T_1, T_2 and T_3 were 8.61, 8.92 and 9.16, respectively. ME intake increased as the energy value of the diet increased. Malnad Gidda cows consumed ME in the range of 41.14 to 47.25 ME, MJ/day. The total requirement was almost similar to the maintenance energy requirement of any cross bred cows (ARC, 1984).

Milk yield (MY) and 4 % fat corrected milk yield (FCM, kg/day) in groups T_1, T_2 and T_3 were 2.21, 2.26; 2.26, 2.27 and 2.30, 2.44, respectively. Differences among the groups were not significant (Table 4). However, milk yield (kg/day) increased from 1.8 in Malnad Gidda cows before the start of the experiment to 2.2 to 2.3 after the start of experiment where animals were fed according to standard requirement, and 10 and 20 % more than the standard requirement. Providing optimum nutrients to the Malnad Gidda cows could only marginally increase the production by an average of 0.5 kg/day, when compared to Malnad Gidda cows raised in unorganized system (Hegde *et al.,* 1978). The milk energy of Malnad Gidda cows' milk (MJ/kg milk) calculated according to NRC (2001) was 3.20, 3.17 and 3.29 in groups T_1, T_2 and T_3, respectively. The milk energy content of MG cows was lower than the values obtained for the pure and cross bred cows which were reported to be 5.2 MJ/kg milk (Mcdonald, 1999). The total solids, fat, CP, lactose, ash and SNF content and yield were statistically non-significant among the groups.

Out of total energy output, around 77 % of the net energy was diverted for maintenance, 18 to 19 % for milk production and 1.9, 4.5 and 3.9 MJ of net energy were diverted for weight gain in groups T_1, T_2 and T_3, respectively (5). The amount of energy utilized for weight gain was higher in groups T_2 and T_3 than in T_1 because the weight gain in T_2 and T_3 of Malnad Gidda cows were 62 and 58 % more than cows in group T_1. Hence, the energy diverted for the gain was more in T_2 and T_3 than in T_1. However, the efficiency of ME was more in T_1 followed by T_2 and T_3 and it was observed that efficiency was more at lower intake of nutrients. The difference between the groups in partitioning of net energy and efficiency of utilization of ME were not significantly different among the groups. Thus, rearing MG cows at higher plane of nutrition may not be advisable with respect to energy utilization efficiency. Similar findings were also reported in HF × Sahiwal cows supplemented with higher level of energy (Mrudhula, 2008; Nagesh, 2009).

Table 5. Partition of net energy[#] in lactating Malnad Gidda cows

Attribute	Groups			SEM
	T_1	T_2	T_3	
Total, net energy (MJ)	17.1	17.4	17.6	6.77
Maintenance (MJ)	13.6	13.5	13.6	0.46
Milk production (MJ)	3.2	3.2	3.3	0.08
Weight gain / loss (MJ)	0.3	0.8	0.7	0.21
% of net energy				
Maintenance	79.1	77.1	77.2	1.25
Milk production	19.0	18.4	19.0	0.79
Weight gain / loss	1.9	4.5	3.9	1.15
Efficiency of ME	41.94	38.45	37.51	1.09

Efficiency of ME = (NE output / ME intake) x100, [#]Calculated; NRC (1989) and Tyrrell and Reid (1965)

Table 6. Economics of milk production in lactating Malnad Gidda cows

Parameter	Groups				P value
	T_1	T_2	T_3	SEM	
Feed consumed (kg/d)					
Paddy straw	1.8	1.8	1.8	0.049	0.872
Hybrid Napier	2.8	3.0	2.8	0.120	0.794
CFM**	2.5a	2.7ab	3.2ab	0.114	0.020
Total cost (₹)					
Cost of labour (milking, cleaning of shed and animals)	-	-	-	-	-
Paddy straw	2	2	2	0.044	0.830
Hybrid Napier	3	3	3	0.122	0.812
Concentrate mixture	55[a]	59[ab]	70b	2.725	0.020
Total cost (₹)	60[a]	64[ab]	75b	2.755	0.022
Milk yield per day (kg)	2.2	2.3	2.3	0.075	0.848
Cost per kg milk production* (₹)	27a	28ab	33b	0.861	0.006

*P≤0.05, **P≤0.01, Means bearing different superscripts in a row differ significantly; Cost: Paddy straw (₹) 0.90/kg, Hybrid Napier (₹) 1.0/kg and CFM (₹) 22/kg

The total cost incurred towards feeding of Malnad Gidda cows in groups T_1, T_2 and T_3 was worked out to be Rs60, 64 and 75 respectively. Cost of production of 1 kg of milk was ₹ 27, 28 and 33 in groups T_1, T_2 and T_3, respectively (Table 6) higher cost per kg of milk production was observed in group T_3 followed by T_2 because amount of concentrates fed to the MG cows of these two groups were 10 and 20% higher than control. production when compared to T_1. In addition, there is a demand for urine for preparations of medicines and sanitary solutions and dung is extensively used for organic manure purpose both were excluded for economics calculation. If these two components are included with milk, the margin of the profit would have further been increased.

CONCLUSIONS

It was concluded that Malnad Gidda cows with an average body weight of 134 kg could consume maximum dry matter at 3.6 to 3.9 % of its body weight. The DCP and TDN intake (kg/day) of 0.315 and 2.72 was sufficient to support for maintenance, maximum milk yield and marginal weight gain (86 g/d) in Malnad Gidda cows. No significant difference was observed in milk yield and composition due to higher nutrient supply (10 and 20 % more than the actual requirement. Supply of nutrients at exact requirement was sufficient enough to obtain optimum milk yield Malnad Gidda cows. Out of total net energy output in the form of maintenance, milk production and weight gain, the net energy diverted for maintenance was higher (79%) than milk production (19%) and weight gain (1.9%). The cost per kg milk production was ₹ 27 with margin of profit of 50% from the sale of milk alone. Thus, the feeding standard of ICAR (2013) can be safely followed for economic milk production in Malnad Gidda cows.

ACKNOWLEDGMENTS

The authors are thankful to Dept. of Social Welfare, Govt. of Karnataka for funding the project under Tribal Sub Plan grant.

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Received on 10-10-2020 and accepted on 16-10-2020