



PRODUCTION PERFORMANCE OF COWS REARED ON COMPLETE FEEDS WITH VARYING LEVELS OF NEUTRAL DETERGENT FIBRE (NDF) AS AGAINST THE CONVENTIONAL GRASS – CONCENTRATE FEEDING SYSTEM IN KERALA

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Abstract

A study of six months duration was conducted in 24 lactating dairy cows, divided into four groups of six each, at the University Livestock Farm and Fodder Research and Development Scheme (ULF&FRDS), Mannuthy, to compare the efficacy of complete feeds having different levels of NDF, with the conventional grass - concentrate based feeding system on the basis of production performance and economics. Three isonitrogenous (12% CP) and isocaloric (65% TDN) complete rations, T1, T2 and T3 with 25, 30 and 35 per cent NDF respectively were formulated as per the recommendations of ICAR. The fourth ration, T4, comprised of a conventional concentrate mixture with 34 to 36 per cent NDF and green grass with 65 to 70 per cent NDF, formulated as per the above standards. The results revealed that the average daily milk (kg) in the total 180 days lactation period were 11.08 ± 0.39 , 11.81 ± 0.69 , 12.09 ± 0.70 and 8.63 ± 0.50 for the animals in the groups T1, T2, T3 and T4 respectively. The yields were significantly higher ($P < 0.05$) for T1, T2 and T3 when compared

to T4, with no significant difference ($P > 0.05$) between T1, T2 and T3. The average number of days to the first post-partum heat of the animals in the four treatment groups were 70.17 ± 8.02 , 80.33 ± 8.04 , 65.5 ± 11.76 and 118.17 ± 31.42 in the groups T1, T2 and T3 and T4 respectively indicating that the animals in the three groups fed on complete feed came into heat much earlier than the animals fed on the conventional grass-concentrate ration. The average daily income per cow, obtained over the total 180 days lactation period were Rs. 431.87 ± 14.34 , 54.64 ± 30.54 , 475.41 ± 25.22 and 345.39 ± 19.95 in the groups T1, T2 and T3 and T4, with the income in T1, T2 and T3 being significantly higher ($P < 0.05$) than T4.

Key words: complete feed, NDF, conventional feeding system, grass-concentrate, milk yield, age at first post-partum heat, economics, cows

Nearly 70 to 75 per cent of the total cost of rearing a cow is contributed by feed cost alone. This is all the more important in Kerala where the cost of inputs such as feed and

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fodder are increasing day by day. A milking cow should be fed with a ration containing at least 25 to 33 percent of NDF (NRC, 2001). However, providing even this minimum quantity of NDF is very difficult in Kerala, because the state is suffering from severe fodder shortage. Lack of affordable fodder resources have forced several dairy farmers to quit the scene and the cattle population in Kerala is decreasing day by day. The data from the nineteenth Quinquennial Livestock Census conducted in the year 2012, indicate that the total population of cattle and buffaloes, taken together, in Kerala was only 15.26 lakhs, as against 21.87 lakhs estimated from the seventeenth Quinquennial Livestock Census conducted in the year 2003, indicating a 30 per cent decline in bovine population in the state over the last nine years (Ministry of Agriculture, 2014). This has necessitated a situation, wherein, we have to explore ways of providing feed in the form of complete diets or total mixed rations (TMR), which involves processing the concentrate and roughage ingredients of cattle diets into a well-mixed blend. Mixing the diet in such a way has shown to increase daily intake, milk yield and the total solids content of milk (Owen, 1984).

This investigation was carried out with the objective of assessing the effect of various complete feeds with different NDF levels in lactating dairy cows by comparing with

the conventional grass- concentrate based feeding system on the basis of production performance and economics. The study also envisages, the formulation of a cost effective complete feed, containing the optimum amount of concentrate and roughage, for the dairy cows of Kerala.

Materials and Methods

Three complete rations, T1, T2 and T3 with 25, 30 and 35 per cent NDF respectively were formulated as per the recommendations of ICAR feeding standards (Ranjhan 1998) for the study. All the three complete rations were isonitrogenous (12% crude protein) and isocaloric (60 – 65% TDN) and were given *ad libitum* to meet the nutrient requirements for lactating dairy cows stipulated by the above standard. The fourth ration, T4, comprised of a conventional concentrate mixture and green grass, given as per the Package of Practices Recommendations of KAU (2001), so as to meet the nutrient requirements for lactating dairy cows stipulated by the ICAR feeding standards. The four rations were compared on the basis of feeding trials conducted in lactating dairy cows, yielding 10 to 15 kg milk per day, in two phases, of three months each; 1-90 days being the early lactation and 91-180 days being the mid lactation phase. The ingredient composition of the four rations in early and mid-lactation are given in tables 1 and 2 respectively.

Table 1: Ingredient composition of the four rations in early lactation

Ingredient	T1 (kg)	T2 (kg)	T3 (kg)	T4 (kg)	
Maize	37	27	16	30 kg green grass*/ animal/ day	1.5 kg concentrate mixture** for maintenance + 0.40 kg concentrate mixture** extra for every kg of milk produced/ animal/ day
Coconut cake (de-oiled)	11	12	17		
Rape seed meal	11	12	11		
De-oiled rice bran	20	19	16.5		
Paddy straw	14	21	29		
Molasses	5	5	5		
Calcite	1.5	1.5	1.5		
Salt	0.5	0.5	0.5		
Vegetable fat	-	2.0	3.5		
Total	100***	100***	100***	Concentrate: roughage ratio = 40: 60	
Cost per kg feed (Rs.)	24	24	24	3	19

*Hybrid Napier

** Kerala Feeds Plus

*** To every 100 kg of complete feed, 10g of Vitamin AD₃E supplement containing 10,00,000 I.U of Vitamin A, 2,00,000I.U of Vitamin D₃ and 1,00,000I.U of Vitamin E, 50g of trace mineral mixture (KERAMIN FORTE) and 50g of toxin binder (CURATOX) and were added

Table 2: Ingredient composition of the four rations in mid lactation

Ingredient	T1 (kg)	T2(kg)	T3(kg)	T4 (kg)	
Maize	38	30	21	30 kg green grass*/ animal per day	1.5 kg concentrate mixture** for maintenance + 0.4 kg concentrate mixture** extra for every kg of milk produced/ animal per day
Coconut cake (de-oiled)	5	8	12		
Rape seed meal	10	10	10		
De-oiled rice bran	26	23	21		
Paddy straw	14	22	29		
Molasses	5	5	5		
Calcite	1.5	1.5	1.5		
Salt	0.5	0.5	0.5		
Total	100***	100***	100***	Concentrate: roughage ratio = 40: 60	
Cost per kg feed (Rs.)	18	18	18	3	19

* Hybrid Napier

** Kerala Feeds Plus

*** To every 100 kg of complete feed, 10g of Vitamin AD₃E supplement containing 10,00,000 I.U of Vitamin A, 2,00,000 I.U of Vitamin D₃ and 1,00,000I.U of Vitamin E, 50g of trace mineral mixture (KERAMIN FORTE) and 50g of toxin binder (CURATOX) and were added

Twenty four crossbred dairy cows, yielding approximately 10 kg of milk per day, in the early stage of lactation (within two weeks of calving) were selected from the University Livestock Farm and Fodder Research and Development Scheme, Mannuthy. They were divided into four groups of six each, as uniformly as possible with regard to age, parity, milk yield and body weight and allotted randomly to the four dietary treatments.

The animals were maintained under uniform management conditions prevailing in the farm. Data on daily feed intake and daily milk production was recorded. Samples of feed and green grass were analysed for proximate principles (AOAC 1990) and fibre fractions (Van Soest *et al.* 1991). The animals were observed for signs of oestrus and those that showed signs were inseminated. Pregnancy diagnosis was conducted within three months of insemination. Days to first post-partum heat and conception rate were recorded. The economics of the study was also worked out in terms of feed cost per kg milk produced. Data gathered on the various parameters, in the two phases were analysed statistically as per Snedecor and Cochran (1994) by analysis of variance (ANOVA) technique, using the software, statistical product and service solutions (SPSS) version 21.0.

Results and discussion

The proximate composition of the experimental rations in early and mid-lactation are given in Tables 3 and 4, respectively. The data on dry matter intake of animals given

below in table 5, reveal that the daily dry matter intake of cows during early, mid and total lactation, in the groups T2 and T3 as well as in the mid and total lactation in group T1, were significantly higher ($P<0.05$) than that of T4. However, in early lactation, the intake in T1 was similar ($P<0.05$) to that of T2, T3 and T4. The higher dry matter intakes observed in the three complete feed fed groups in comparison to the conventional grass- concentrate ration, is in accordance with the findings of Hundal *et al.* (2004) who reported that cross bred milking cows in early lactation, fed on a TMR had a significantly higher milk yield than those fed on a conventional hay-concentrate feed and Girdhar and Balaraman (2005) who reported that mid lactation cows fed on berseem based TMRs, had a significantly higher dry matter intake than those fed on a conventional feed.

The data on milk yield of the animals fed on the four experimental rations, given in Table 6 reveal that the average daily milk yield of cows fed on the three complete rations, T1, T2 and T3 were significantly higher ($P<0.05$) than the conventional ration, T4, in both early and mid-lactation as well as the total experiment, which is in agreement with the work of Hundal *et al.* (2004) who reported that cross bred milking cows in early lactation, fed on a TMR had a significantly higher milk yield than those fed on a conventional hay-concentrate feed. Similar results of significantly higher milk yield were observed by Girdhar and Balaraman (2005) in mid lactation cows fed on berseem based TMRs, as against a conventional feed.

The values of average daily milk yield obtained in the three complete rations, T1, T2 and T3, in the present study are comparable to those reported by Girdhar and Balaraman (2005), where the values ranged from 11.08 to 11.46 kg in lactating cross bred cows fed on TMRs, but lower than those of Hundal *et al.* (2004) who reported values of 15.02 and 15.43 kg in cross bred milking cows fed on oat and berseem hay based TMRs, respectively. The values in the three complete feed fed groups, T1, T2 and T3 are higher than those reported by Ally (2003) who obtained values in the range of 8.81 to 9.87 kg, Mohan (2003) who reported values ranging from 9.08 to 10.00 and Dominic (2013) who reported values ranging from 7.71 to 8.85 kg, in cross bred cows, fed on conventional grass-concentrate rations, whereas the values are comparable to T4 in the present study.

The data on income generated from

the sale of milk of animals fed on the four rations, given in Table 7 reveal that the average daily income per cow, obtained over the total 180 days of experiment was significantly higher ($P<0.05$) in the groups T1, T2 and T3, than T4, with no significant difference ($P<0.05$) among T1, T2 and T3. These results are in agreement with that of Khan *et al.* (2010) who reported that the average income generated from milk was significantly higher in cows fed on wheat straw based complete feeds in mash and pellet form as against a conventional ration consisting of concentrate mixture and wheat straw, given separately. Significant increase in income generated was also observed by Marston *et al.* (2011) who reported that the income generated and the profits were significantly higher in the group of cows fed on TMRs containing various forage sources than those fed on a conventional commercial feed.

Table 3. Chemical composition of the four rations fed to the experimental animals in early lactation, % on DM basis

Ingredient	T1	T2	T3	T4	
				Grass	Concentrate mixture
Dry matter	87.25	86.30	85.80	18.08	92.80
Crude Protein	12.23	12.94	12.18	8.98	22.49
Crude Fibre	10.73	12.68	15.01	36.69	6.89
Ether extract	4.00	3.60	3.80	2.07	4.02
Total Ash	14.00	12.90	12.90	10.75	9.65
Nitrogen Free extract	59.04	57.88	56.11	40.51	56.95
Acid insoluble ash	5.30	5.60	6.00	1.86	1.06
NDF	25.88	30.03	35.59	69.37	35.06
ADF	21.60	23.10	24.80	45.87	16.84
Calcium	0.83	0.85	0.87	0.61	1.12
Phosphorus	0.54	0.52	0.48	0.30	0.94
TDN*	64.50	65.20	64.61	56.58	67.90

* Calculated value

Table 4. Chemical composition of the four rations fed to the experimental animals in mid lactation, % on DM basis

Ingredient	T1	T2	T3	T4	
				Grass	Concentrate mixture
Dry matter	88.43	87.92	87.70	20.12	90.91
Crude Protein	12.40	12.14	12.08	7.96	22.16
Crude Fibre	10.53	12.70	14.85	34.35	6.49
Ether extract	4.50	3.50	3.60	1.98	4.12
Total Ash	14.10	13.30	12.98	8.74	8.91
Nitrogen free extract	58.47	58.36	56.49	46.97	58.32
Acid insoluble ash	4.80	5.40	6.20	1.96	1.16
NDF	25.94	30.86	35.38	65.39	34.16
ADF	21.80	23.00	25.01	41.97	15.29
Calcium	0.81	0.84	0.86	0.43	1.11
Phosphorus	0.59	0.55	0.52	0.19	0.84
TDN*	65.62	62.65	59.72	56.04	66.88

* Calculated value

Table 5. Average daily dry matter intake (per animal, kg) of the animals of the animals fed on the four experimental rations

Stage of lactation	T1	T2	T3	T4		
				Concentrate	Roughage	Total
Early	12.03±0.43 ^{ab}	12.89±0.58 ^a	13.19±0.38 ^a	4.76±0.12	7.15±0.32	11.91±0.28 ^b
Mid	15.56±0.33 ^a	15.62±0.61 ^a	15.89±0.31 ^a	4.50±0.18	7.50±0.36	12.00±0.26 ^b
Total	13.93±0.37 ^a	14.36±0.58 ^a	14.64±0.30 ^a	4.63±0.16	7.33±0.34	11.96±0.27 ^b

Means with different superscripts in the same row differ significantly ($P < 0.05$)

Table 6. Average daily milk yield of cows fed on the four experimental rations (kg/cow)

Stage of lactation	T1	T2	T3	T4
Early	11.63±0.51 ^a	12.67±0.74 ^a	12.63±0.64 ^a	9.12±0.45 ^b
Mid	10.61±0.39 ^a	11.07±0.68 ^a	11.62±0.79 ^a	8.15±0.63 ^b
Total	11.08±0.39 ^a	11.81±0.69 ^a	12.09±0.70 ^a	8.63±0.50 ^b

Means with different superscripts in the same row differ significantly ($P < 0.05$)

Table 7. Average income (Rs./ animal/ day,) generated from the sale of milk from the animals fed on the four experimental rations (@ Rs.40 / kg)

Stage of lactation	T1	T2	T3	T4
Early	440.95±22.44 ^a	475.42±29.03 ^a	487.16±27.51 ^a	364.72±17.84 ^b
Mid	422.79±16.22 ^a	433.86±33.45 ^a	463.67±23.94 ^a	326.05±25.25 ^b
Total (per day)	431.87±14.34 ^a	454.64±30.54 ^a	475.41±25.22 ^a	345.39±19.95 ^b
Total (per month)	12956.11±430.20 ^a	13639.22±916.18 ^a	14262.44±756.51 ^a	10361.56±598.51 ^b

Means with different superscripts in the same row differ significantly ($P < 0.05$)

The days to first post-partum heat and conception rate of animals in the four experimental groups are given below in Table 8.

Table 8. Days to first post-partum heat and conception rate of the animals in the four experimental groups

Treatment	Days to first post-partum heat (days)	Conception rate (no. of animals confirmed as PD + ve during the experimental period of 180 days)
T1	70.17±8.02	2
T2	80.33±8.04	2
T3	65.5±11.76	2
T4	118.17±31.42	0

The above data show that animals in the group T3, first came into heat followed by those in T1, T2 and T4, indicating that the animals in the three groups fed on complete feeds came into heat much earlier than the group fed on the conventional grass – concentrate ration. The age at first post-partum heat obtained for the three complete feed fed groups, T1, T2 and T3 were better than those reported by Ally (2003) who reported values ranging from 79.40 to 122.00 days, Mohan (2003) who reported values ranging from 81.67 to 81.83 and Dominic (2013) who obtained values ranging from 74.17 to 105.17 days, all of them in lactating dairy cows fed on conventional feeding regimes. At the same time, the value obtained for the

grass–concentrate fed group, T4, in the present study was comparable to those reported by the above three workers. The data on conception rate reveal that two animals in each of the three complete feed fed groups, conceived within the experimental period of 180 days, as against none, in group T4, fed on the conventional grass–concentrate ration, indicating the better performance of cows under the complete feeding regime.

From an overall critical evaluation of the results obtained in the present study, both in early and mid-lactation as well as the total experiment, it could be found that cows in all the three complete feed fed groups performed well in comparison to the conventional grass-

concentrate ration, probably due to the fact that when the feed was provided in the form a complete feed, uniform blending of feed ingredients was ensured, without giving any choice to the animal for selection of any specific feed ingredient, so that each bite supplied the required amount of nutrients. As a result, a more balanced diet was provided to the animals, which assured a more stable rumen environment ultimately resulting in better performance (Pandya *et al.*, 2005, Gupta *et al.*, 2006; Khan *et al.*, 2010). Therefore, it can be concluded that complete feeds having NDF levels ranging from 25 to 35 per cent NDF, can be recommended for use among the dairy farmers of Kerala, especially in areas where availability of land for fodder cultivation is poor.

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