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Effect of roughage to concentrate ratio on performance and RFI of lactating crossbred cows

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RFI;
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Abstract

Residual feed intake (RFI) is defined as actual feed intake minus the expected feed intake of individual animal and it was first proposed as an alternate measure of feed efficiency by (Koch et al 1963). RFI is a heritable character and heritability of RFI as 0.14. selection for traits associated with feed conversion efficiency should lead to greater profitability of dairying. Residual feed intake is a useful selection criterion for greater feed efficiency. The experiment was conducted at Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana . The two roughage: concentrate diets, namely 50:50 (50% roughage: 50% concentrate), 60:40 (60% roughage: 40% concentrate) were made. Twenty four lactating crossbred cows with average milk yield and week of lactation were taken. Twelve cows were divided in to two groups of six animals each and fed ration with 60:40 roughage: concentrate ratio (R_{LC}). The intake of OM and CP were significantly ($p < 0.05$) high in R_{HC} whereas intake of ADF and NDF were significantly ($p < 0.05$) high in R_{LC}. The roughage to concentrate ration has non-significant effect on the intakes of CHO, EE, NE, and ME. The RFI calculated based on DMI were statistical in both the groups. The digestibility of CP and EE were significantly ($p < 0.05$) high in R_{HC} compared to R_{LC} ration but that of ADF was significantly ($p < 0.05$) high in R_{LC} compared to R_{HC} ration. The RFI of R_{HC} had significantly negative ($p<0.05$) effect on milk protein % but had no effect on milk production, milk energy yield, metabolic body wt., change/kg m.wt, and fat %, fat yield, protein yield and FCM . Nutrient digestibility of R_{HC} is significantly ($p < 0.05$) higher for CP, EE as compared to R_{LC} and that of ADF had significantly ($p < 0.05$) higher in $R_{LC.}$ The milk yield and protein yield of R_{HC} was significantly ($p < 0.05$) higher than R_{LC}. Nutrient digestibility of R_{HC} is significantly ($p < 0.05$) higher for CP, EE as compared to R_{LC} and that of ADF had significantly ($p < 0.05$) higher in $R_{LC.}$ The correlation of RFI with m.b.wt, fat yield, protein yield, FCM was positively significant ($p < 0.05$). RFI with milk yield was significantly ($p < 0.05$) and negatively correlated.

Introduction

The feed costs account for about 80% of total variable costs associated with milk production and utilization of feed with higher efficiency is the basis of profitable dairy farming. There is variation of feed efficiency at the individual level having genetic and metabolic basis for it. There is wide variation of nutrient requirements among individual animals having similar production levels. Measuring gross efficiency of milk production can be erroneous due to fat that dairy animals has substantial body reserves which masks the short term nutrient deficiencies.

An efficient RFI animal will eat less than what is estimated for them, resulting in a negative or lower number. An inefficient RFI animal's calculation will be high because the animal consumes more than what is expected. Selection for DMI amount doesn't necessarily identify an efficient animal because it does not account for the output of the animal.

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Residual feed intake can be calculated by measuring an animal's actual feed intake minus estimated intake [1]. RFI is a method of choice for determining feed efficiency because it takes into the account the production of the animals when determining the estimate of what an animal should eat. By selecting for animal that has a negative RFI value or is efficient, then you are selecting for animals that eat less but gain or produce the same. This would help the producer to get similar output with lower inputs in terms of feed. RFI has been estimated to be moderately heritable character.

Keeping all this in view the present study was undertaken with the objective of estimating residual feed intake in lactating crossbred cows as affected by some animal and dietary factors.

Materials and Methods

Animals and Experimental Design

The experiment was conducted at Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. The two roughage: concentrate diets, namely 50:50 (50% roughage: 50% concentrate), 60:40 (60% roughage: 40% concentrate) were made.

Twenty four lactating crossbred cows with average milk yield and week of lactation were taken. Twelve cows were divided in to two groups of six animals each and fed ration with 60:40 roughage: concentrate ratio (R_{LC}).

The sample of feed and refusal were taken twice weekly for analysis for proximate principles [2] and cell wall fractions [3]. The body weight of animals was recorded fortnightly. The milk was measured daily and milk composition was estimated at weekly intervals. The blood samples will be taken before start of experiment and at the end of experiment and was analyzed for biochemical constituents like total protein, glucose, BUN, albumin, cholesterol using Micro lab - 300 kit (Merck).

Residual feed intake estimation was measured by the method given by [1]. The estimated intakes was calculated from regression of actual intake on energy yielded in milk MJ/d (LE) and the fitted values taken as estimated intakes [4]. The actual ME intake and predicted ME intake were also estimated. The correlations of RFI with various animal and dietary parameters were calculated.

A digestion trial was conducted for 7 days on all experimental cows after 50 days of feeding trial. Collection of fasces was done on 24 hourly basis. Simultaneously daily feed offered and residue left was recorded. The representative samples of feed offered, residue left and fasces voided were collected and analyzed for proximate principles by the methods of [5] in order to determine the digestibility of different nutrients viz. dry matter, crude protein, ether extract, total ash, ADF and NDF.

Result and Discission

The chemical composition of rations is given in Table 2. The rations were iso-nitrogenous. The EE value for treatment R_{HC} was numerically higher than treatment R_{LC}. Variations like these are likely to occur where TMR's are analyzed for nutritional parameters. The DM, OM, NDF, ADF and ASH contents are higher in R_{LC} treatment.

The comparison of nutrient intake of R_{LC} and R_{HC} rations is given in Table 3. The perusal of data showed that the intake of OM and CP were significantly ($p < 0.05$) high in R_{HC} whereas intake of ADF and NDF were significantly ($p < 0.05$) high in R_{LC}. The roughage to concentrate ration has non-significant effect on the intakes of CHO, EE, NE, and ME. The RFI calculated based on DMI were statistical in both the groups.

Table 1: Ration composition of rations

Ingredient	60:40(R_{LC})	50:50(R_{HC})
Concentrate	7	8.5
Wheat Straw	2	2
Silage	36 (Adjusted on DM basis, fortnightly)	28 (Adjusted on DM basis, ortnightly)

*R_{LC}=low concentrate ration, R_{HC}=high concentrate ration

Table 2: Chemical composition of rations

Composition, % DM	R_{LC}	R_{HC}
DM	92.55	92.16
OM	91.47	92.10
CP	15.34	15.29
NDF	42.61	37.10
ADF	25.86	24.35
EE	3.06	4.32
Ash	8.53	7.9

The comparison of digestibility of R_{LC} and R_{HC} is given in Table 4. The data showed that digestibility of CP and EE were significantly ($p < 0.05$) high in R_{HC} compared to R_{LC} ration but that of ADF was significantly ($p < 0.05$) high in R_{LC} compared to R_{HC} ration. The varying roughage to concentrate ratio had no significant effect on digestibility of DM, OM, NDF, CHO, and TDN in both rations. These results are not in agreement with [6,7,8]who reported decreased apparent digestibility of DM and OM in the total tract as a result of increase in the proportion of roughage in

diet from 35 to 65%. The narrow difference between the groups in terms of roughage level in present study might be the reason for similar DM and OM digestibility among the groups. They also reported digestibility of NDF fractions of the diets in treatments that tended to be lower when the roughage proportion was increased in the diet, though the differences was not significant.

The milk yield and protein yield and milk/kg m.wt was significantly ($p < 0.05$) higher in R_{HC} (Table 5). As the animals were of high genetic merit HF crossbred cows, therefore, they responded well to increasing the concentrate in the ration. R_{LC} and R_{HC} had no significant effect on milk energy, fat %, fat yield, protein %, and FCM yield although the FCM was about 13% higher in R_{HC} as compared to R_{LC}. Numerically lower fat% in R_{HC} resulted in non-significant effect on FCM yield among the groups.

The correlation of milk production and composition with RFI is given in Table 6. The data revealed that the correlation of RFI with milk yield was significantly negative where as correlation of RFI with metabolic body weight, fat yield and FCM was significantly positive. The increased milk production tends to lower the RFI of the animal indicating desirable character of efficient milk production.

The RFI of R_{LC} was positively correlated ($p<0.05$) with metabolic body weight, fat yield, protein %, protein yield, FCM and week of lactation (WOL) whereas RFI was negatively correlated with milk yield. Also, RFI of R_{LC} had no significant effect on milk energy yield, change/kg metabolic body weight and fat % .

In this study, the RFI of R_{HC} had significantly negative ($p<0.05$) effect on milk protein % but had no effect on milk production, milk energy yield, metabolic body weight., change/kg m.wt, and fat %, fat yield, protein yield and FCM .

Table 3: Effect of R:C ratio on nutrient intake of animals

Parameter	R_{LC}	R_{HC}	SE	p value
DMI, kg/day	17.47	17.41	0.04	0.17
OMI, kg/day	15.75	15.78	0.01	0.04
CPI, kg/day	2.60	2.68	0.01	0.001
ADFI, kg/day	4.77	4.62	0.04	0.01
NDFI, kg/day	9.30	8.90	0.07	0.001
CHOI, kg/day	12.22	12.07	0.09	0.14
EEI, kg/day	0.64	0.65	0.01	0.11
NEI, Mcal/day	24.01	24.21	0.47	0.39
MEI, Mcal/day	41.11	40.32	1.02	0.30
RFI, kg /day(DM)	-0.80	-2.81	0.01	0.09

Table 4: Effect of R:C ratio on nutrient digestibility of animals

Digestibility coefficient %	R_{LC}	R_{HC}	SE	p valve
DM	63.82	63.20	0.86	0.33
OM	65.38	65.40	0.35	0.96
CP	68.18	71.35	1.10	0.02
EE	79.38	81.26	0.83	0.05
ADF	64.77	63.14	0.58	0.02
NDF	56.54	55.34	1.79	0.32
CHO	62.18	61.83	0.99	0.40
TDN %	63.32	63.81	0.73	0.32

Table 5: Effect of R:C ratio on Milk production and composition

Parameter	R_{LC}	R_{HC}	SE	p valve
Milk yield kg/day	13.41	15.51	0.87	0.04
Milk/kg m. wt	0.31	0.51	0.01	0.001
Milk energy yield, MJ/day	43.33	46.44	1.31	0.07
Fat %	3.83	3.72	0.14	0.34
Fat yield kg/day	0.51	0.57	0.03	0.06
Protein %	3.05	3.00	0.05	0.26
Protein yield kg/day	0.41	0.46	0.03	0.001
FCM kg/day	13.16	14.86	0.93	0.10

Table 6: Correlation of RFI with milk parameters

Parameter	Correlation	p valve
Milk energy yield MJ/day	-0.01	0.97
Metabolic body wt kg/day	0.32	<0.001
Milk energy/kg m.wt	-0.03	0.70
Change/kg m.b.wt	-0.08	0.42
Milk yield kg/day	-0.28	<0.001
Fat %	0.01	0.85
Fat yield kg/day	0.23	<0.001
Protein %	0.10	0.32
Protein yield kg/day	0.30	<0.001
FCM kg/day	0.27	<0.001
Week of lactation (WOL)	0.02	0.83

Conclusion

The intake of OM, ADF, and NDF was significantly ($p<0.05$) higher in R_{LC} whereas CPI was significantly ($p <0.05$) high in R_{HC}. Nutrient digestibility of R_{HC} is significantly ($p <0.05$) higher for CP, EE as compared to R_{LC} and that of ADF had significantly ($p <0.05$) higher in $R_{LC.}$ The milk yield and protein yield of R_{HC} was significantly ($p <0.05$) higher than $R_{LC.}$ The correlation of RFI with metabolic body weight, fat yield, protein yield, FCM was positively significant ($p <0.05$). RFI with milk yield was significantly ($p <0.05$) and negatively correlated.

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