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RELATIONSHIP OF RESIDUAL FEED INTAKE WITH DRY MATTER INTAKE OF GROWING BUFFALO CALVES

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ABSTRACT
The present study attempts to analyze the relationship of residual feed intake on dry matter intake (DMI) of growing healthy twelve buffalo calves in the age group of seven to nine month for 90 days. During the experimental period, the animals were given green fodder and concentrates mixture as to meet their protein and energy need for growth as per ICAR, 2013 feeding standard. Daily residual feed intake was recorded for each animal and body weight was taken fortnightly. Residual feed intake (RFI) was computed for each animal and was assumed to represent the residuals from a multiple regression model. The overall mean values of DMI (kg/day) were 4.70 and 4.21 kg/d in high and low RFI groups, respectively. The dry matter consumption was lower in low RFI group compared to high RFI group. The overall mean values of dry matter consumption (kg/100kg BW) across the fortnight was found to be 3.03 and 2.67 kg/100 kg body weight in high and low RFI groups and are highly significant (P≤0.01). The overall mean average DMI per kg metabolic body weight for high and low RFI groups were 106.92 and 94.64 (g/kg $W^{0.75}$) respectively and the difference was highly significant (P≤0.01).

KEYWORDS: residual feed intake, calves, body weight, dry matter intake.

INTRODUCTION

Feed utilization efficiency improvement is a major concern in animal production and traditional measures of feed efficiency like feed conversion ratio (FCR) are highly correlated with growth rate and confounded with the maturity patterns of animals. Considerable variation in feed intake, independent of size and growth rate, exists in animals and this trait is defined in terms of residual feed intake (Archer *et al.*, 1997). The concept of residual feed intake was first used by Koch *et al*. (1963), who examined a number of indices for calculating efficiency which recognized that differences in both weight maintained and weight gain affect feed requirements in growing cattle. They suggested that feed intake could be adjusted for body weight and weight gain effectively partitioning feed intake into two components: (1) the feed intake expected for the given level of production; and (2) a residual portion. The residual portion of feed intake can be used to identify animals which deviate from their expected feed intake, with efficient animals having lower (negative) RFI values. Residual feed intake (RFI) is the difference between the actual and expected feed intake of an animal based on its body weight and growth rate over a specific period (Basarab *et al*., 2003). This index describes the divergence in intake from that needed for maintenance and growth and is moderately heritable (Crews, 2005). The independence of RFI from production has led some authors to suggest that RFI may represent inherent variation in basic metabolic processes which determine efficiency (Brelin & Brannang, 1982; Korver, 1988).
Residual feed intake can be a promising selection tool for the selection of buffaloes for increased feed efficiency. It is independent of the level of production, lower the value the more efficient the animal is. Selection for the low RFI will result in progeny that consume less feed for the same level of production as progeny of high RFI cattle benefitting economically. Keeping in view of the above facts, the present investigation was undertaken to determine the relationship of residual feed intake with dry matter intake of growing buffalo calves.

MATERIALS & METHODS

The present investigation was conducted for 90 days to study the relationship of residual feed intake with dry matter intake of growing healthy twelve buffalo calves (seven to nine months age). During the experimental period, the animals were given green fodder and concentrates mixture as to meet their protein and energy need for growth as per ICAR, 2013 feeding standard. Before formulation of rations, the feed ingredients were analyzed (AOAC, 2005) for proximate composition. Based upon the proximate composition of feed ingredients, the ration was formulated. Daily residual feed intake was recorded for each animal and body weight was taken fortnightly.

TABLE 1: Chemical analysis of feed ingredients (on DM basis)

S. No	Ingredients	CP	CF	EE	ASH	OM	NFE
1.	Barley	9.98	7.88	1.74	4.96	95.04	75.44
2.	Maize	8.89	2.52	3.44	2.83	97.17	82.32
3.	Groundnut Cake (GNC)	39.97	9.43	7.60	8.90	91.10	34.10
4.	Soyabean Meal	44.86	4.67	1.80	7.34	92.66	41.33
5.	Deoiled Rice Polish	12.87	15.50	1.10	9.54	90.46	60.99
6.	Green Sorghum	8.42	35.38	3.65	7.70	92.30	44.85

TABLE 2: Ingredients of concentrate mixture

S. No	Ingredient	Parts
1.	Barley	15
2.	Maize	15
3.	Groundnut Cake (GNC)	30
4.	Soyabean Meal	15
5.	Deoiled Rice Polish	22
6.	Mineral Mixture	2
7.	Salt	1
	Total	100

TABLE 3: Chemical composition (% on DM basis) of concentrate mixture and green fodder

S. No	Ingredient	Concentrate Mixture	Green Fodder
1.	Dry matter (DM)	91.10	90.17
2.	Crude protein (CP)	24.51	24.88
3.	Crude fiber (CF)	7.40	6.49
4.	Ether extract (EE)	5.40	5.02
5.	Ash	7.70	7.77
6.	Organic matter (OM)	92.30	92.23
7.	NFE	55.35	55.84

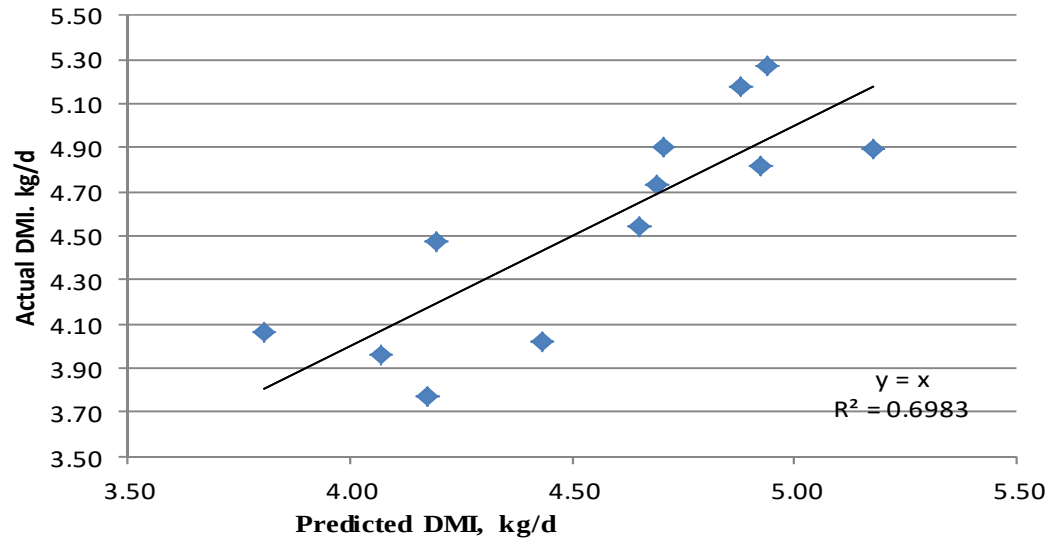

FIGURE 1: Actual v/s predicted DMI of growing buffalo calves

Average dry matter intake (DMI) for the 90 days feeding period was regressed on mid-test metabolic body weight average daily gain (ADG) (Archer *et al*., 1997, Kelly *et al.,* 2010). Residual feed intake (RFI) was computed for each animal and was assumed to represent the residuals from a multiple regression model regressing DMI on ADG and mid-test metabolic body weight. The actual DMI minus the predicted DMI corresponds to the RFI. A more efficient animal has a negative RFI (observed feed intake is less than predicted feed intake), and a less efficient animal has a positive RFI (observed feed intake is greater than predicted feed intake).

Chemical composition of the concentrate mixtures (AOAC, 2005)

Before formulation of rations, the feed ingredients were analyzed (AOAC, 2005) for proximate composition (Table 1). Based upon the proximate composition of feed ingredients, the ration was formulated. The ingredients of concentrate mixture (kg/100kg) are presented in table 2 and chemical compositions (on DM basis) of concentrate mixture and green fodder have been presented in table 3.

Statistical analysis

The results obtained during this study were analyzed by using software package SPSS.

RESULTS & DISCUSSION

Measurement of residual feed intake

Twelve buffalo calves (7-9 months age) were selected for the feeding trial. After completion of three months feeding trial, RFI value for individual animals was calculated using the formula (Archer *et al.,* 1997).

$$\mathbf{DMI = \beta 0 + \beta 1\ BW^{0.75} + \beta 2\ ADG + \varepsilon}$$

Where β0 is the intercept, β1 and β2 are the coefficients of the equation, and ε is the residual (i.e., RFI). After that, animals were divided into low and high RFI groups. Where β0 is the intercept, β1 and β2 are the coefficients of the equation, and ε is the residual (*i.e*., RFI). It is given in figure1. After that, animals were divided into low and high RFI groups.

Division of animals in high and low RFI groups

The actual DMI minus the predicted DMI corresponds to the RFI. This means that a more efficient animal has a low RFI (observed feed intake is less than predicted feed intake), and a less efficient animal has a high RFI (observed feed intake is greater than predicted feed intake). On the basis of the methodology mentioned in the materials and methods, twelve growing buffalo calves were divided into two groups i.e. low and high RFI (Table 4)

Low RFI animals

The dots below line indicates (Figure1) the low RFI animals means dry matter (DM) consumption of the animals less than their actual requirement (ICAR, 2013) and 6 animals were considered as low RFI animals.

High RFI animals

The dots above the line indicates (Figure1) high RFI animal's means animals consumed more DM than their actual requirement (ICAR, 2013) and 6 animals were considered as high RFI animals.

TABLE 4: List of animals in high and low RFI groups

Animal No.	+ RFI value	Animal No.	- RFI value
1	0.26	1	-0.11
2	0.3	2	-0.28
3	0.2	3	-0.41
4	0.04	4	-0.1
5	0.33	5	-0.11
6	0.28	6	-0.4
Overall mean± SE	0.235 ±0.04	Overall mean ± SE	-0.235 ±0.06

Fortnight DM intake (kg/day, kg/100kg BW and g/kgW$^{0.75}$) of animals in high and low RFI groups.

The values of DM intake recorded at fortnight intervals have been presented in table 5: and Fig. 2, 3 and 4 respectively.

Dry matter intake per day (kg/d)

Overall mean DMI (kg/d) values were 4.70 and 4.21 kg/day for high and low RFI groups, respectively. Statistical analysis of data revealed that there was no significant difference (P<0.05) in the dry matter intake between high and low RFI groups but it showed a trend (P<0.1) that revealed high DMI by high RFI group i.e.10.48% more DMI. Similar results have been reported by Lancaster *et al.* (2009) that more efficient animals consumed 16% less feed than the less efficient ones. Similarly, Hafla *et al*., 2013 reported that Heifers classified as efficient (low RFI) consumed 20% less feed while maintaining same body weight. Gomez *et al*. (2007) and Ribeiro *et al*. (2007) in their trial observed that low RFI steers consumed 19.1% and 17% less dry matter intake than high RFI steers While Basarab *et al*. (2003) found low RFI steers consumed 10.4% less and had a 9.4% lower FCR with no differences in BW or ADG. Herd *et al*. (2002), in their study observed that Angus cattle divergently selected for RFI currently attain the same growth rates but differ by approximately 15% in their voluntary feed intake. Arthur *et al*. (1999) and Richardson *et al*. (1998) reported that females with lower RFI at weaning required less feed intake as cows with same level of performance. Therefore, RFI could be used to improve feed efficiency without influencing growth and mature size of beef cattle. Herd *et al*. (1997) in their study observed that progeny of parents selected for reduced RFI consumed less feed during the test period without influencing growth.

Dry matter intake (kg/100 kg BW)

Overall mean DMI values were 3.03 and 2.67 (kg/100kg BW) for high and low RFI groups, respectively. A significant higher DMI was observed in (P <0.01) high RFI groups as compared to low RFI group. Sharma, (2014) reported that low RFI group consumed less DM (2.24 kg/100kg of BW) as compared to high RFI group (2.53 kg/100kg BW). Similarly, Sharma, (2013) in his study conducted on growing Sahiwal calves observed a significant difference (P ≤0.05) between low and high RFI groups.

Dry matter intake per kg metabolic body weight per day (g/kgW$^{0.75}$)

Overall mean DMI values were 106.92 and 94.64 g/kgW$^{0.75}$ for high and low RFI groups, respectively. DMI was significantly higher in high RFI group as compared to low RFI group. Sharma, (2014) reported that mean DMI (g/kgW$^{0.75}$) was significantly higher (P≤0.05) in high RFI group than low RFI group during the feeding trial on male Murrah buffalo calves.

TABLE 5: Fortnight DM intake (kg/day, kg/100kg BW and g/kgW$^{0.75}$) of animals in high and low RFI groups (Mean± S.E.)

DMI (kg/d)				
FORNIGHT	HIGH RFI	LOW RFI	SEM	P-VALUE
1st	3.69 ± 0.11	3.35 ± 0.17	0.15	0.11
2nd	4.00 ± 0.17	3.43 ± 0.19	0.18	0.05
3rd	4.66 ± 0.23	3.94 ± 0.22	0.23	0.05
4th	5.00 ± 0.23	4.36 ± 0.30	0.27	0.12
5th	5.18 ± 0.24	4.79 ± 0.27	0.26	0.32
6th	5.68 ± 0.17	5.38 ± 0.16	0.17	0.25
Overall mean± SEM	4.70±0.184	4.21±0.21	0.20	0.11
DMI (kg/100 kg BW)				
1st	2.84±.008	2.53±.04	0.068	0.01
2nd	2.88±.055	2.45±.055	0.054	0
3rd	3.15±.044	2.65±.042	0.042	0
4th	3.17±.09	2.74±0.087	0.089	0.007
5th	3.06±.084	2.82±0.073	0.079	0.061
6th	3.16±.084	2.98±0.072	0.08	0.157
Overall mean± SEM	3.03±.055	2.67±1.053	0.054	0.001
DMI (g/kgW$^{0.75}$)				
1st	95.9±1.5	85.99±1.70	1.76	0.002
2nd	98.87±1.04	84.36±2.16	1.7	0
3rd	109.85±1.64	92.64±2.02	1.84	0
4th	112.25±2.47	97.44±3.68	3.14	0.007
5th	110.25±2.48	101.85±3.02	2.76	0.057
6th	115.62±2.21	109.3±1.45	1.87	0.039
Overall mean± SEM	106.92±1.33	94.64±1.97	1.68	0

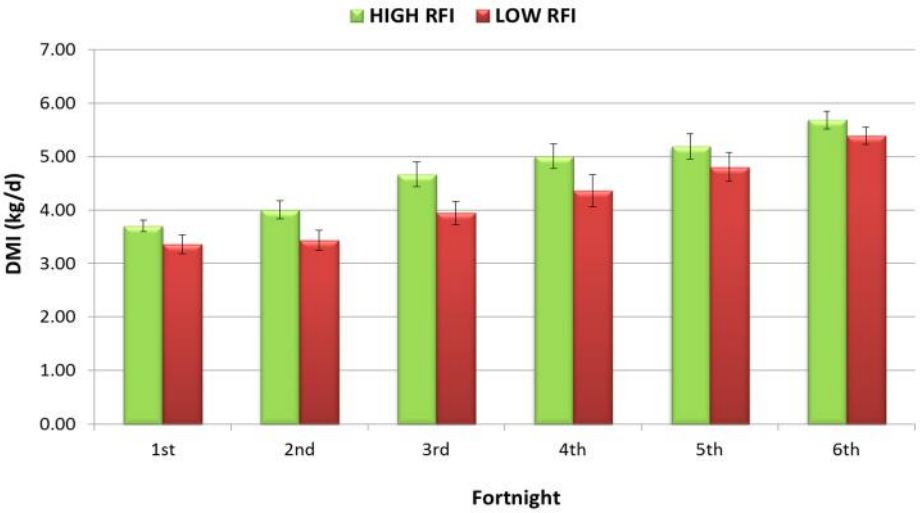

FIGURE 2: Fortnight DMI (kg/d) of animals in high and low RFI groups

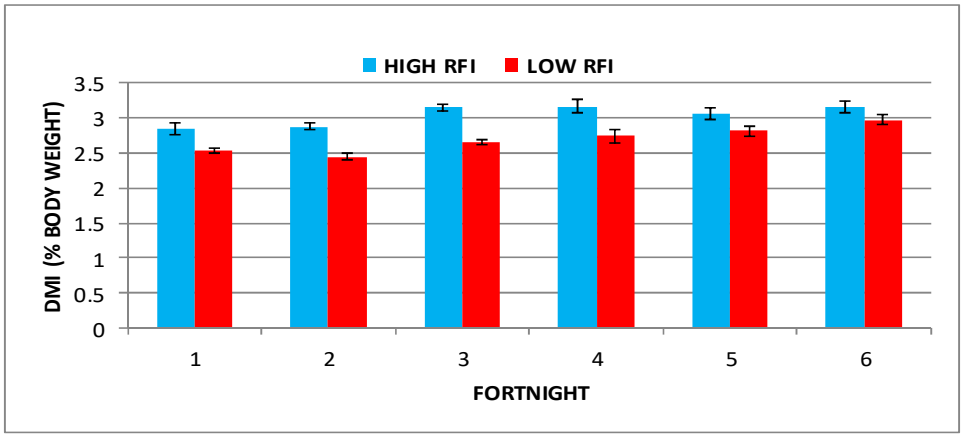

FIGURE 3: Fortnight DMI (kg/100 kg BW) of animals in high and low RFI group

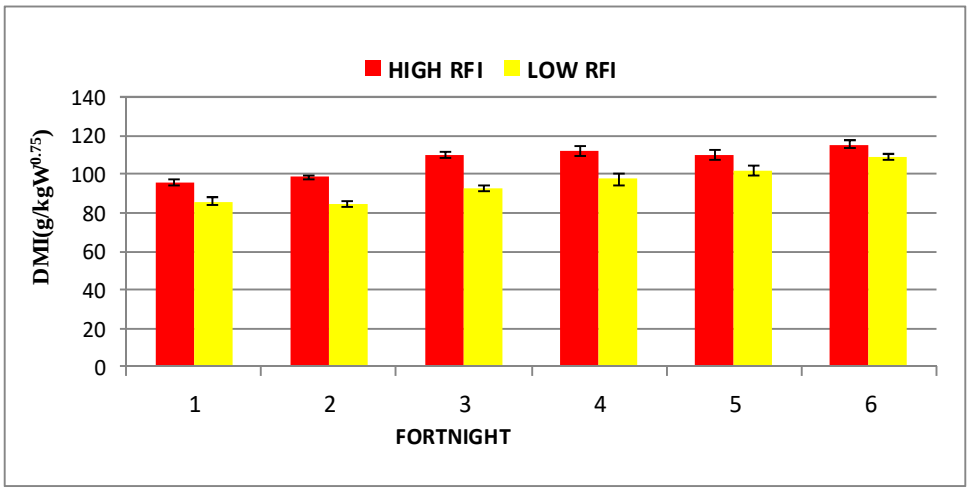

FIGURE 4: Fortnight DMI (g/kgW$^{0.75}$) of animals in high and low RFI groups

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