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Research Article

RESIDUAL FEED INTAKE AND ITS RELATIONSHIP WITH BLOOD BIOCHEMICALS IN GROWING BUFFALO CALVES

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ABSTRACT

An experiment of 90 days was conducted to study the relationship of residual feed intake with blood biochemicals in growing healthy twelve buffalo calves in the age group of seven to nine months. During the experimental period, the animals were given green fodder and concentrates mixture as to meet their protein and energy need for growth. 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. Blood samples were collected thrice, once at the beginning, in the middle and at the end of trial and estimation of blood biochemicals in plasma *viz.* glucose (mg/dl), total protein (g/dl), albumin (g/dl), globulin (g/dl) and blood urea nitrogen (BUN) (mg/dl) was carried out. Variation in mean values of blood glucose levels in high and low RFI groups was non-significant while a negative non-significant correlation was observed between RFI and blood glucose. The average blood total protein levels values were high in low RFI group throughout the experimental period but not differing significantly with high RFI group. A negative but non-significant correlation (r = -0.175) was observed between RFI and total protein. Mean value of plasma albumin was significantly (P= 0.01) higher in high RFI group and highly significant (P=0.01) positive correlation (r = 0.56) was found with RFI (P 0.01). A non-significant positive correlation (r = 0.356) was observed between RFI value and BUN concentration.

Keywords: Residual feed intake, Glucose, Total protein, Albumin and Blood urea nitrogen (BUN)

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). The concept of residual feed intake was first used by Koch *et al*. (1963), who 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 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 RFI 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. The physiological parameters such as blood indicators predictive of RFI may became useful as a means for early indirect selection in large herds. This can lead to better understanding of the possible physiological variation in the efficiency of diet use among individuals.

MATERIALS AND METHODS

An experiment of 90 days was conducted to study the relationship of residual feed intake with blood biochemicals in growing healthy twelve buffalo calves in the age group of seven to nine months at Buffalo farm of Department of Livestock Production Management, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar. The experimental animals were kept individually under loose housing system. All standard managemental practices and biosecurity measures were followed throughout the experiment. Prior approval was taken to conduct the present investigation by the Institutional Animal Ethics Committee held on February 6, 2017. During the experimental period, the animals were offered green fodder and concentrates mixture as to meet their protein and energy need for growth as per ICAR (2013). Daily residual feed intake was recorded for each animal and body weight was recorded at fortnightly interval. Average dry matter intake (DMI) for the 90 days feeding period was regressed on mid-test metabolic body weight average daily gain (ADG) (Kelly *et al.,* 2010). 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. During experimental period, blood samples were collected thrice, once at the beginning, in the middle (45th day) and at the end of trial, from all the animals by jugular vein puncture in heparinized vacutainer, mixed well by rotating tubes between palms to ensure proper mixing of blood and anticoagulant and brought to the laboratory after placing in ice box. Then, the samples were centrifuged at 3000 rpm 15 minutes to separate the plasma. The plasma samples were stored at -20°C for further analysis.

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Estimation of blood biochemicals in plasma *viz.* glucose (mg/dl), total protein (g/dl), albumin (g/dl), globulin (g/dl) and blood urea nitrogen (BUN) (mg/dl) was carried out with semi-automated Random Access Clinical Chemistry Analyzer following standard procedure. The data obtained during this study were statistically analyzed by using software package SPSS 20. The two way ANOVA with repeated measures was used to determine the significant ($P < 0.05$) difference between treatments (high and low RFI groups) and time groups (day 0, 45 and 90). Further, Pearson's correlation coefficient was employed to find significant ($P < 0.05$) association between residual feed intake and blood biochemical parameters.

RESULTS AND DISCUSSION

Measurement of residual feed intake

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) (Figure1). After that, animals were divided into low and high RFI groups (Table 1).

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, and a less efficient animal has a high RFI. 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 1).

Low RFI animals

The dots below line indicates (Figure 1) the low RFI animals which means dry matter (DM) consumption of the animals is less than their actual requirement (ICAR, 2013) and 6 animals were considered as low RFI animals.

Table 1
List of animals in high and low RFI groups

Animal No.	+ RFI value	- RFI value
1	0.26	-0.11
2	0.30	-0.28
3	0.20	-0.41
4	0.04	-0.10
5	0.33	-0.11
6	0.28	-0.40
Overall mean ± SE	0.235 ± 0.04	-0.235 ± 0.06

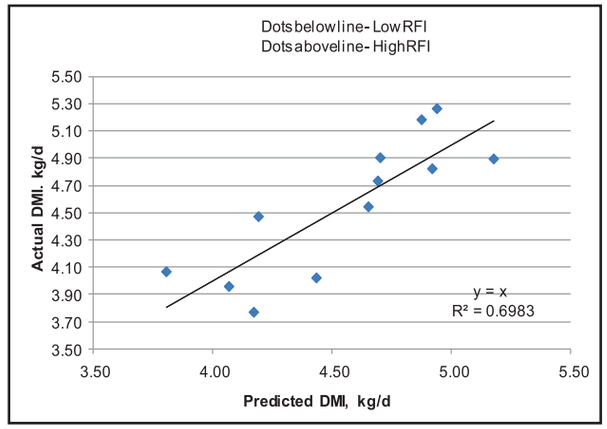

Fig.1: Actual v/s predicted dry matter intake (DMI) of growing buffalo calves

High RFI animals

The dots above the line indicates (Figure 1) high RFI animals which means animals consumed more DM than their actual requirement (ICAR, 2013) and 6 animals were considered as high RFI animals.

Blood biochemicals in high and low RFI Groups.

The level of various blood biochemicals have been presented in Table 2. Result revealed that blood biochemical parameters were not significantly differing between high and low RFI groups.

Correlation of residual feed intake with blood biochemicals

Pearson correlation value between RFI and blood biochemical has been presented in Table 3.

Mean value of blood glucose levels in high and low RFI groups was found to be 68.77, 68.75, 70.45 and 70.95, 72.18, 71.71 (mg/dl), respectively. These values were not differing significantly while a negative non-significant correlation was observed between RFI and blood glucose. Similar results have been reported by Baban (2013) and Sharma (2013). They reported a negative non-significant correlation of RFI with blood glucose concentration. Similarly, Kelly *et al*, (2010) observed blood glucose was not associated with RFI while Kolath *et al.* (2006) observed that high RFI steers had greater concentration of glucose. However, Richardson *et al,* (2004) found that at the beginning of the RFI test period, plasma glucose concentration was positively correlated with RFI in Angus steers.

Average blood total protein levels in high and low RFI groups were found to be 7.54, 7.72, 7.78 and 7.84, 7.70, 7.86 (mg/dl), respectively. These values were high in low RFI group throughout the experimental period but not differing significantly. A negative but non-significant correlation (r = -0.175) was observed between RFI and

Table 2
Blood biochemicals in high and low RFI Groups (Mean± S.E.)

S. No	Parameter	Group	DAY 0	DAY 45	DAY 90	P VALUE		
						TIME	T_X	$T \times T_X$
1.	Glucose (mg/dl)	H-RFI	68.77±1.63	68.75±1.72	70.45±1.04	0.258	0.159	0.321
		L-RFI	70.95±.50	72.18±0.66	71.71±1.19			
2.	Total Protein (g/dl)	H-RFI	7.54±0.15	7.72±0.11	7.78±0.08	0.415	0.275	0.342
		L-RFI	7.84±0.15	7.7±0.12	7.86±0.07			
3.	Albumin (g/dl)	H-RFI	2.84±0.05	2.61±0.08	2.64±0.06	0.364	0.010	0.316
		L-RFI	2.53±0.09	2.54±0.08	2.52±0.10			
4.	Globulin (g/dl)	H-RFI	4.70 ±0.19	5.1±0.16	5.14±0.11	0.288	0.075	0.342
		L-RFI	5.31 ±0.16	5.16±0.19	5.34±0.11			
5.	BUN (mg/dl)	H-RFI	26.58±0.79	25.33±0.58	26.34±1.50	0.055	0.209	0.333
		L-RFI	26.55±1.01	23.48±0.96	24.16±0.55			

TIME = Time effect, T_X = Treatment effect and $T \times T_X$ = Time × Treatment effect

Table 3
Correlation of residual feed intake with blood biochemicals

S. No.	Parameter	Correlation	P Value
1.	Glucose (mg/dl)	- 0.235	0.452
2.	Total Protein (g/dl)	- 0.175	0.583
3.	Albumin (g/dl)	0.561	0.058
4.	Globulin (g/dl)	- 0.355	0.258
5.	BUN (mg/dl)	0.356	0.256

total protein. Protein turnover is an energetically expensive process within the body, with energy costs of protein turnover accounts for 15-20% of basal metabolic rate across a range of species (Waterlow, 1998). There is genetic variation in the rate of protein degradation in cattle (Oddy *et al*., 1998). There is difference in the rate of protein breakdown in cattle divergently selected for RFI (McDonagh *et. al*, 2001).

Mean value of plasma albumin was significantly (P = 0.01) higher in high RFI group and highly significant (P 0.01) positive correlation (r = 0.56) was found with RFI. Paula *et al*. (2013) reported a significant difference (P = 0.04) in serum albumin level among the RFI efficiency classes and lowest concentrations was observed in most efficient animals.

Mean values of blood urea nitrogen in high and low RFI groups were found to be 26.58, 25.33, 26.34 and 26.55, 23.48, 24.16 (mg/dl), respectively. A non-significant positive correlation (r = 0.0.35) was observed between RFI value and BUN concentration. Baban (2013) and Sharma (2013) however, observed a significantly (P<0.05) higher mean values of BUN in high RFI group than low RFI groups in growing male Sahiwal calves. Urea is a product of protein degradation (Cameron, 1992) and a positive correlation between blood urea and RFI indicating a positive association between urea and dietary nitrogen intake. There is evidence that high RFI steers have a higher rate of protein degradation than low-RFI steers (Richardson *et al.,* 1996). There are three mechanisms that could contribute to the association between blood urea concentration and RFI *viz.* Body composition, protein breakdown and feed intake. Richardson *et al*. (1996, 2004) found greater blood concentration of urea in less efficient genotypes which could be attributed to a greater protein intake in high RFI animals, a greater rate of body protein degradation or deviation in the supply of amino acids due in part to variation in the efficiency of microbial protein production in the rumen (Lush *et al*., 1991; Kahn *et al*., 2000).

Blood glucose and total protein were negatively but non-significant correlated with RFI. Plasma albumin concentration was significantly positively correlated (r = 0.56) with RFI (P<0.01). BUN concentration was non-significantly positively correlated (r = 0.35) with RFI.

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