Growth of nine month old male buffalo calves as affected by different crude protein and energy concentrations

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ABSTRACT: The current study was planned to examine the response of altered dietary protein and energy concentrations on nutrients utilization, nitrogen metabolism and weight gain in growing male *Nili Ravi* buffalo calves to know optimum protein and energy requirements in comparison with those documented by Nutrient Requirement for Cattle (NRC) for calves. Thirty six calves of 6-7 month of age weighing 70±08kg were divided into 6 groups, six animals in each group, according to 3x2 factorial arrangements of treatments. Six experimental diets were formulated containing three levels of crude protein (CP; 11.85, 14.20 & 16.50%) each with two levels of metabolizable energy (ME; 1.86 & 2.23 Mcal/Kg). The animals were fed individually at *ad libitum* for 100 days; first 10 days were dietary adaptation period while last ten days of each of the remaining month served as collection period. Daily feed consumption in calves fed all the experimental diets remained unaltered. However, the intake of fiber fractions was significant ($p<0.05$) among treatment groups. The digestibility of dry matter (DM) was significant ($p<0.05$) while neutral detergent fiber (NDF) and CP digestibilities were similar among treatment groups. However, the intake of DM, CP, ME and fiber fractions indicated significant ($p<0.05$) difference among treatment means with respect to protein levels. While the intake of ME and fiber fractions were significant ($p<0.05$) with respect of ME levels of the diets. Similarly, digestibilities of DM and fiber fraction also showed significant ($p<0.05$) difference among treatment means. Weight gain, and feed conversion efficiency of buffalo calves did not show any treatment effect. The findings of the present study suggested 14.20% and 2.24 Mcal/kg ME as optimum CP and energy requirements for growing male buffalo calves with less than one year of age.

Key words: protein-energy, nutrient utilization, growth, buffalo calves.

INTRODUCTION

Adequate dietary protein and energy ensures maximum microbial proliferation and fermentation activities which gives birth to optimum energy production and post ruminal amino acid supply to contribute significantly in growth biosynthetic activities. Coupling of carbon (energy) and nitrogen (protein) units at ruminal level actually ensures the sustainable availability of structural components at ruminal level, required by the microbes for their body formation during multiplication (Sarwar et al., 1999). Better rumen fermentation and microbial activities usually lead to increased enzymes production, better degradation of dry matter, decreased nutrient escape from rumen and nutrient loss in manure, increased volatile fatty acid and enhanced amino acid supply at post ruminal level to meet diverse biosynthetic needs of muscle accretion and growth. Inadequate supply of either of these primary nutrients leads to inefficient utilization of nutrients and thereby reduced productivity (Preston, 1966; Odham, 1984). Balancing CP and ME optimized the nutrient utilization and growth of prepubertal heifers. Baruah et al. (1988) observed unaltered growth rate in growing buffalo calves when dietary CP was only 75% of recommended CP concentration by NRC (1989). Furthermore, Sengar et al. (1985) and Baruah et al. (1988) reported that male buffalo calves had lower CP requirements than those advised by NRC (1976). However, Sengar et al. (1985) reported that the ME requirement of buffalo male calves is the same as suggested by NRC (1976) for exotic calves.

Inconsistent and controversial outcome by these scanty studies necessitates executing a well planned study to know optimum CP and ME requirements for growing male buffalo calves reared in tropical region and differs in their physiology and feeding regimens than that of exotic temperate

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cattle calves. Keeping in view the limited and unauthentic scientific information regarding the energy and protein requirements of male growing buffalo calves, the present study was designed to examine the influence altering CP and ME concentrations on growth performance of *Nili-Ravi* calves to know optimum CP and energy requirements.

MATERIALS AND METHODS

Thirty six male buffalo calves of similar age (180±10days) and body weight (77±05kg) were fed six plans of nutrition with three levels of CP (11.85, 14.22 & 16.50%) each with two levels of ME (1.86& 2.23 Mcal/Kg) in a 3x2 factorial arrangement of treatments. The experimental diets low protein-low energy, low protein-high energy, medium protein-low energy, medium protein-high energy, high protein-low energy, high protein-high energy were denoted as LPLE (11.85 % CP and 1.86 Mcal/kg ME),LPHE (11.85% CP and 2.23 Mcal/Kg ME),MPLE (14.22% CP and 1.86 Mcal/Kg ME), MPHE (14.22% CP and 2.23 Mcal/Kg ME), HPLE (16.50% CP and 1.86 Mcal/Kg ME), HPHE (16.50% CP and 2.23 Mcal/Kg ME), respectively, (Table 1). Calves were weighed initially and fortnightly thereafter. The study lasted for 100 days. First 10 days were given for dietary adaptation while last 10 days of each remaining month served as collection period. During each collection period, digestibility trial was carried out to work out nutrient digestion and N-balance (Williams et al., 1984). Digestibility was determined by using total collection method (Shahzad et al.,2008a). Feed offered and orts were sampled and were analyzed for DM, CP and total ash by the methods of AOAC (1999), neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) by the methods described by Van Soest et al. (1991) and ME was estimated according to NRC (2001). The urine samples composited by calf were analyzed for N by the methods described by AOAC, (1999). Data generated during the animal trial was analyzed according to completely randomized design with 2x3 factorial arrangements of treatments for levels of CP and ME using the GLM procedure of SAS (1988).The statistical model used for all parameters was; $Y_{ijk} = \mu + \alpha_j + \beta_k + (\alpha\beta)_{jk} + \varepsilon_{ijk}$,where, μ was overall mean, α_j was effect of levels of CP (3 levels), β_k was the effect of levels of ME (2 levels), $(\alpha\beta)_{jk}$ was the interactions between CP and ME levels while, ε_{ijk} was the difference within treatment means (error term). Differences among means were tested using Duncan's Multiple Range Test (Snedecor and Cochran, 1980) and α level of $p<0.05$ was deemed significant unless noted otherwise.

RESULTS AND DISCUSSION

Nutrients Intake, Digestion and Nitrogen Balance

The DMI remained unaltered in buffalo calves fed diets containing low and medium CP concentrations however, it reduced ($p<0.05$) when fed diets containing high CP (Table 2). Higher DM intake in calves fed diets increasing CP concentration might be attributed to gradual increased in nitrogen availability at ruminal level which might have enhanced rumen fermentation leading to increased DM degradation. Improved feed digestion has been reported to enhance DM intake (Sarwar et al., 1996; Shahzad et al., 2008b). Increased nutrient digestion in calves fed high CP diets might be attributed to low DM intake. It is assumed that decreased DM intake might have enhanced rumen retention time, thereby allowing rumen microbes to act on respective substrates more efficiently leading to better degradation of DM. Similar findings have been reported by Sengar and Joshi (1986) who observed no difference in DMI by male buffalo calves fed diets containing varying CP concentrations. The probable explanation their observations might be attributed to narrow range of CP concentration in experimental diets. The decreasing trend in DMI with increasing the dietary CP level may be due to the higher rumen escape amount of dietary protein which might have reduced availability of ammonia nitrogen in rumen leading to reduced fermentation and thus feed intake (Davidson et al., 2003). Reduced rumen fermentation has been reported to decrease nutrients intake (Allen, 1997, 2000). In contrast, Brown et al. (2005) reported that DMI was not affected by protein levels. Higher crude protein intake with increasing dietary CP concentration has also been supported by (Gabler and Heinrichs, 2003 ; Akayezu et al. 1994). Variation in energy intake by *Murrah* buffaloes in an experiment executed by Sebastian et al. (1970) might be attributed to the smaller

Table 1. Ingredients and chemical composition (%) of experimental diets

	Experimental diets					
Ingredients	LPLE	LPHE	MPLE	MPHE	HPLE	HPHE
Berseem fodder	10.5	10.5	10.5	10.5	10.5	10.5
Maize fodder	24.5	24.5	24.5	24.5	24.5	24.5
Maize Broken	3.25	39.00	1.95	33.80	1.95	30.55
Wheat bran	14.95	0.00	10.40	0.00	10.53	0.00
Maize Bran	25.35	1.30	25.35	0.00	19.50	0.00
Maize oil cake	2.93	0.00	2.93	0.00	2.93	0.00
Cotton seed meal	2.60	0.00	2.60	0.00	3.90	0.00
Maize gluten Meal 30%	0.33	8.45	0.00	10.4	0.00	13.0
Maize gluten Meal 60%	0.98	0.00	4.55	1.30	6.37	6.18
Sunflower meal	4.55	1.30	4.55	1.30	4.55	0.00
Canola meal	0.66	2.60	1.63	2.60	1.63	0.98
Soybean Meal	0.33	3.25	1.95	6.50	4.55	6.50
Vegetable Oil	0.00	1.30	0.00	1.30	0.00	1.30
Cane Molasses	7.80	6.50	7.80	6.50	7.80	5.20
Mineral Mix	1.00	1.00	1.00	1.00	1.00	1.00
DCP pliner	0.29	0.29	0.29	0.29	0.29	0.29
Total	100.0	100.0	100.0	100.0	100.0	100.0
Chemical composition						
Dry matter	64.10	64.20	64.18	64.25	64.18	64.53
Crude protein	11.85	11.89	14.22	14.20	16.55	16.51
ME, Mcal/kg	1.86	2.23	1.87	2.24	1.86	2.23
Neutral detergent fiber	26.91	13.30	26.34	13.79	25.10	14.86
Acid detergent fiber	12.01	6.88	11.88	7.14	11.69	6.95
Acid detergent lignin	2.60	1.58	2.59	1.58	2.59	1.42
Cellulose	7.87	4.06	7.87	4.37	7.74	4.53
Hemicellulose	14.87	6.42	14.37	6.63	13.28	7.78
Total ash	6.73	6.86	6.68	6.79	6.69	6.52

*LPLE, LPHE, MPLE, MPHE, HPLE and HPHE stands for low protein low energy, low protein high energy, medium protein low energy, medium protein high energy, high protein low energy and high protein high energy, respectively.

Stature of this breed than cattle. As small breeds have higher metabolic rate and hence more nutrient requirements. Total tract digestibilities of DM and fiber fractions showed a curvilinear relationship with respect to increasing dietary CP levels (Table 2). The level of intake and digestion are interrelated because diets in high CP and ME were consumed less by buffalo calves which improved their digestibility (Sarwar et al., 1999). The NDF fraction, because of its low rate of digestion, is considered primarily the dietary constituent associated with the gut-fill effects (Van Soest, 1965). Feeds low in digestibility reduced DMI because of their slow clearance from the rumen and passage through the digestive tract (Allen, 1997, 2000). In the current study the increased dietary ME might have reduced DMI by buffalo calves (Allen, 1997, 2000). Basra et al. (2003) also reported similar findings. Increased N balance with increasing the CP level was because of higher dietary CP intake however, varying energy level didn't change the N balance (Table 2). Furthermore, Zinn and Owens

Table 2. Effect of different level of protein & energy, protein and energy on buffalo calves

Paramters	Protein & Energy levels									
	Low		Medium		High		Main Effects			
Nutrients	Energy Levels		Energy Levels		Energy Levels					Interaction
intake &Dig.	Low	High	Low	High	Low	High	SE	Energy	Protein	
DM, g/d	2340	2350	2350	2360	2340	2310	0.10	0.00	0.80	0.08
DM, Dig., %	63.90	64.03	63.98	64.05	63.98	64.34	0.00	0.00	0.00	0.00
CP, g/d	277.22	278.9	334.36	335.00	386.48	381.93	1.30	0.00	0.50	0.05
CP, Dig., %	70.61	70.90	70.74	71.18	71.56	71.62	0.96	0.67	0.74	0.98
NDF, g/d	629.54	312.1	619.33	325.33	586.15	343.76	1.82	0.00	0.00	0.00
NDF, Dig., %	52.55	53.77	52.76	54.19	54.25	55.94	0.30	0.00	0.00	0.75
Daily gain, kg	0.39	0.40	0.37	0.47	0.39	0.32	0.05	0.43	0.80	0.26
N balance, g/d	7.10	7.55	8.55	9.80	11.26	11.56	1.44	0.28	0.58	0.94

Protein levels

	Low	Medium	High	SE	Sig.	Linear	Quadratic
DM, g/d	2340[ab]	2360[ab]	2320[c]	0.11	0.00	0.02	0.00
DM, Dig., %	63.96[c]	64.01[b]	64.16[a]	0.00	0.00	0.00	0.00
CP, g/d	278.09[c]	334.68[b]	384.21[a]	0.92	0.00	0.00	0.00
CP, Dig., %	70.76	70.96	71.59	0.68	0.67	0.39	0.80
NDF, g/d	470.79[a]	472.33[a]	464.95[b]	1.28	0.00	0.00	0.01
NDF, Dig., %	53.16[b]	53.47[b]	55.09[a]	0.21	0.00	0.00	0.02
Daily gain, kg	0.40	0.42	0.36	0.03	0.43	0.42	0.31
N balance, g/d	7.32[b]	9.17[ab]	11.4[a]	1.02	0.28	0.01	0.88

Energy Levels

	Low	High	SE	Sig.	Linear	Quadratic
DM, g/d	2340	2340	0.01	0.80	0.80	2340
DM, Dig., %	63.95	64.14	0.00	0.00	0.00	63.95
CP, g/d	332.69	331.96	0.75	0.50	0.00	332.69
CP, Dig., %	70.97	71.23	0.55	0.74	0.74	70.97
NDF, g/d	611.67	327.04	1.05	0.00	0.00	611.67
NDF, Dig., %	53.19	54.63	0.18	0.00	0.00	53.19
Daily gain, kg	0.38	0.39	0.03	0.80	0.80	0.38
N balance, g/d	8.97	9.63	0.83	0.58	0.58	

(1993) suggested that feeding excess protein would place an additional demand on energy or arginine to run the urea cycle, diverting nutrients away from growth. Akayezu et al. (1994) performed nitrogen balance studies with starter diets ranging in CP from about 15% to about 22% of the DM and showed that increased CP content >19.4% did not result in any further increase in N retention but fecal and urinary N excretion consistently increased. But the results of N balance were similar when CP contents of starter DM ranged from 11.6 to 22.6%.

Growth Response

Increasing trend in daily weight gain of calves was observed with increasing the CP concentration, however, varying energy concentration didn't change the weight gain in calves (Table 2). Similarly, Sengar and Joshi (1986) and Baruah et al (1988) reported no differences in growth rate and feed efficiency in buffalo calves fed rations with CP levels 80 and 100% and ME level 100% of NRC

(1976). Rathee and Yadav (1970) also reported non-significant difference in the growth rate of buffalo calves fed different levels of CP content which might be attributed to narrow range of their dietary CP concentrations. In contrast, Veira et al. (1980) reported linear increase (p<.01) in live weight gain with increasing CP level. Large increase in growth was observed when dietary CP was increased from 9.9 to 11.7%. It was probably due to increase in feed intake. Akayezu et al. (1994) reported that maximum weight gains occurred in calves fed starter containing 19.6% CP.

CONCLUSION

In conclusion, the findings of present study suggest 14.20% CP and 2.24 Mcal/kg ME as optimum protein and energy requirements for growing male *Nili Ravi* buffalo calves less than one year of age.

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