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EVALUATING VARYING LEVELS OF CONCENTRATE ON PRODUCTIVE AND METABOLIC PERFORMANCE OF NILI-RAVI BUFFALO HEIFER CALVES

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ABSTRACT

A study was conducted with an aim to investigate the effect of varying levels of concentrate for optimum growth and metabolic parameters on Nili Ravi buffalo heifers (n=30) of similar age (5±1 months) and weight (93.95±5.59 kg) for a duration of 8 months. The selected heifers were randomly divided into three dietary treatments (n=10) and were offered concentrate (Metabolizable energy: 2.6 Mcal/kg and Crude Protein: 17%) at the rate of 0.5 % (low; A), 1% (medium; B) and 1.5% (high; C) of their body weight. The data were analyzed through general linear model (Proc. GLM) using statistical software SAS 9.1 and differences among treatment means were determined through LSD. As designed, the estimates for average daily protein and energy intake were higher ($P<0.001$) for high concentrate level group compare with other two groups. The differences in intake were unable to affect (P=0.258) average daily gain of heifers i.e. 497.32±17.92, 503.63±19.09 and 532.77±20.67 g/d for treatment groups A, B and C, respectively. Thus, feed efficiency estimates were better for low concentrate level group as compared with medium and high level. Dietary treatments did not affect ($P>0.05$) the blood chemistry however, serum urea concentration and digestibility parameters (dry matter, crude protein and NDF) were increased by increasing dietary concentrate level. Thus, inclusion of concentrate @ 0.5% of body weight is concluded better for rearing Nili-Ravi heifers from 6 to 14 months of age.

Key word: Heifers, concentrate levels, digestibility, protein, energy.

INTRODUCTION

Production potential of buffaloes has not been exploited because of being neglected animals all over the world. Buffalo heifers are mostly raised on forages and wheat straw and some farmers offer limited amount of concentrate feed as well (Bhatti *et al.*, 2007). Now the preference of buffalo over cattle is increasing due to its superior milk quality (high fat content) and better efficiency in utilizing poor quality fibrous tropical feed (Paul and Patil, 2007). Reduced weight gain of buffalo heifers is attributed to poor, improper and imbalanced nutrition. The main reason for their stunted growth may be that farmers don’t want to leave the traditional system. In traditional system animals graze on seasonal fodder and low quality pastures having low protein, energy and greater fiber contents (Sarwar *et al.*, 2002). Farmers should follow research based scientific nutritional program which will not only eradicate the risk of surplus or shortage of any nutrient (energy & protein) but will also ensure the enhanced rumen microbial production and fermentation ability which will ultimately produce energy and post ruminal amino acid for the development of muscle protein and different body functions. Energy and protein are two important primary nutrients of ruminant’s diet (Basra *et al.*, 2003), which govern animal’s growth performance. The deficient supply of either of these nutrients leads to ineffective consumption of nutrients and reduce productivity. A lot of scientific literature is existing regarding ME & CP needs of exotic dairy cattle of moderate countries but it cannot be applied directly to buffalo in tropical countries due to variation in physiology and feeding regime. Wynn *et al.* (2009) reported low milk yield, poor productive and reproductive performance in buffaloes due to lack of quality feed. In Asia, especially in Pakistan and India the protein and energy requirements of buffalo heifers are being met by offering agricultural crop residues, low quality roughages and industrial by-products having low level of fermentable carbohydrates and high levels of lingo-cellulosic material. However, feeding fresh green fodder though “cut and carry system” is still practiced in most parts of Pakistan (Sarwar *et al.*, 2009).

Keeping in view the above research findings about limited protein and energy requirements in female buffalo heifers, the present study was designed with an objective to examine the influence of varying levels of concentrate (CP and ME) intake on the nutrient digestion, utilization and growth performance of Nili-Ravi heifer calves.

MATERIALS AND METHODS

Nili-Ravi buffalo heifers (n=30) of similar age (5±1 months) and weight (93.95±5.59 kg) were selected from the available stock at Buffalo Research Institute

(BRI), Pattoki (31° 1' 0" North, 73° 51' 0" East) district Kasur in Punjab province of Pakistan. These animals were randomly divided into three different groups i.e. low (A), medium (B) and high (C) and were offered concentrate ration having CP =17% and ME 2.6 Mcal/Kg at the rate of 0.5%, 1.0% and 1.5% of their body weight, respectively. Furthermore, all the trial heifers were offered green fodder ad-libitum along with clean fresh water round the clock.

Table 1. Ingredients and chemical composition of experimental diet.

Sr. No.	Ingredient			Inclusion level (%)
1	Cotton seed Cake			20
2	Maize Gluten			10
3	Maize grain broken			16
4	Canola meal			16
5	Wheat Bran			9
6	Rice polishing			15
7	Molasses			12
8	Mineral Mixture			2
	Total			**100**
	Chemical composition	**Concentrate ration**	**Maize**	**Sorghum**
1	Dry matter %	90.2	23.5	20.1
2	Crude protein %	17	8.5	7.7
3	Ether extract %	3.5	2.3	1.9
4	Metabolizable energy Mcal/Kg	2.6	2.5	1.7

The study lasted for eight months excluding the adjustment period of 15 days for animal's adaptability to experimental diet. The required quantity of feed was offered twice daily and orts were measured on next day. Animals were fed individually in partitioned manger. The deworming of animals was performed before the start of experiment. The study parameters were comprised of average daily weight gain, daily protein & energy intake, body mass index [body weight (BW, kg)/wither's height (WH, m)^2(Chacur *et al.*, 2007)], blood sample analysis (Packed cell volume, PCV; mean corpuscular volume, MCV; platelets count, lymphocytes, monocytes and granulocytes) by using through blood analyzer (Abacus, Diatron), serum chemistry (blood urea & cholesterol) through serum chemistry analyzer (microlab 300), digestibility and urine pH estimation by pH meter (Model=Bante 920 Benchtop precision pH). Feed intake was recorded on daily basis and representative feed samples were taken monthly basis for proximate analysis. The BW and WH was measured on fortnightly basis while blood & serum analysis was performed on monthly basis.

Chemical Analysis: Respective sample of feed and fecal were collected and subjected to chemical analysis for the estimation of dry matter (DM), crude protein (CP), ether extract (EE), fat, ash contents (AOAC, 2000), NDF and ADF (Van Soest *et al.*, 1991).

Statistical Analysis: The data were analyzed through general linear model (Proc. GLM) using statistical software SAS 9.1. The differences among treatment means were determined through LSD (Steel *et al.*, 1997).

RESULTS AND DISCUSSION

Protein and energy intake: Green fodder and concentrate were remained the two sources of nutrients intake during the whole trial. The animals of all the three group "low, medium and high" have taken same (P>0.65) amount of nutrients (protein and energy) from green fodder however variable intake (P<0.001) was noted for concentrate among all the three groups (table 2). These results showed that the nutrient (protein and energy) consumption increased with the increase of level of concentrate in diet. The difference in average daily total nutrient intake among all the three group is due to variable intake level of concentrate as animals raised on high concentrate level diet consumed more nutrients. Varying level of concentrate significantly (P<0.001) influenced the total average daily protein and energy intake. These findings are in-line with the findings of Lohakare *et al.* (2006) as they offered three different levels of protein to crossbred calves and found significant (P<0.05) difference in average daily protein intake in calves raised on low and high protein group. Tatsapong *et al.* (2010) also found the same results in growing swamp buffalo calves on varying dietary protein ration. Figure 1 & 2 show the trend of protein and energy intake on fortnightly basis.

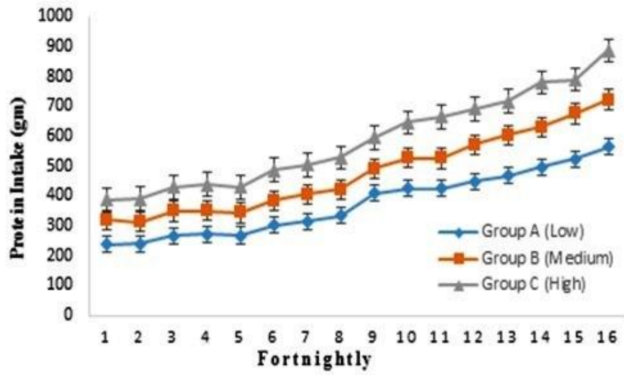

Figure 1. Trend of total protein intake (gm) fortnightly basis in Nili-Ravi buffalo heifer calves

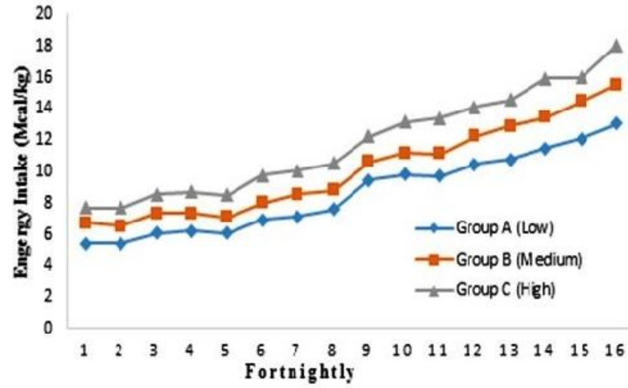

Figure 2. Trend of total energy intake on fortnightly basis in Nili-Ravi buffalo heifer calves

Average daily gain: The effect of feeding varying concentrate levels (low, medium and high) on the production performance of buffalo heifer calves is presented in table 2. The average initial body weight at the start of experiment was 93.95±5.59 kg. The corresponding average final body weight was 205.10 ± 9.66[a], 206.80 ± 10.14[a] and 211.80 ± 13.62[a] kg for all the three treatment groups. Dietary supplementation of concentrate 0.5, 1.0 and 1.5% of body weight had no effect (P=0.258) on average daily weight gain among all the three treatments (table 2). Prusty *et al.* (2016) offered three different levels of protein (low medium and high) having similar energy to thirty Murrah buffalo calves for 150 days and reported similar average daily gain (594±27.45, 564±20.83 and 585±12.25) among all the three treatment calves, respectively. Tomar *et al.* (2014) raised Murrah buffalo male calves on various energy levels and found no difference in the average daily gain of calves. The reason for same results in both studies may be the same geographical position and environmental condition in both regions (Pakistan and India). Singh *et al.* (2009) found the same results in Bhadawari buffalo calves on different dietary energy levels. The better body weight gain in buffalo heifers belonging to low concentrate diet might be due to their efficiency in utilizing nutrients from poor quality feed (Sarwar *et al.*, 2009) and their capacity to adjust the metabolism in response to low energy diet (Campanile *et al.*, 2010). Monthly trend of average daily gain is shown figure 3. Current experiment was started in April and after three months decline in weight gain (figure 3) might be due to high environmental temperature in June. After that shed was furnished with showers to reduce heat stress. The 2nd decline in weight gain might be due to change in diet. Animals' diet was shifted from maize to sorghum.

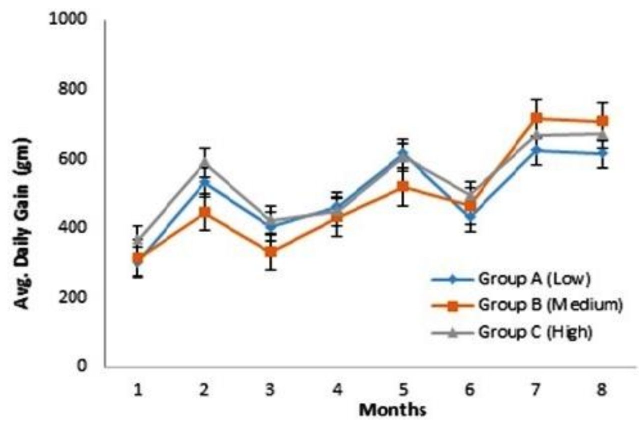

Figure 3. Trend of average daily gain in Nili-Ravi buffalo heifer calves on monthly basis

Feed efficiency: Feed efficiency on varying levels of protein and energy intake has been shown in table 2. It was noted that feed efficiency was significantly ($P<0.0001$) affected. Optimum performance was observed on low protein and energy diet. These findings are in accordance with the results of Basra *et al.* (2003) as they reported varying levels of ME in the rations significantly influence the feed efficiency in 12-15 months old Nili-Ravi buffalo calves raised on low and high energy ration. Increase in dietary energy up to standard level increased the feed efficiency however, excess intake of energy from standard level negatively effects the feed efficiency (Tarazón-Herrera *et al.*, 1999).

Protein intake (gm) per kg gain: The values of required protein per kg gain for low, medium and high concentrate group are presented in table 2. The heifers of treatment A & B have used 53.5 & 16.7% less protein for the production of 1 kg weight as compare to treatment C i.e. 961.14 VS 1475.10 & 1263.91 VS 1475.10 gm, respectively. This might be due to efficiency of buffaloes, as they are known to be more efficient utilizer of low quality fibrous diet (Mahmoudzadeh and Fazaeli, 2009).

Table 2. Average daily nutrient intake and weight gain

Parameters	Low (A)	Medium (B)	High (C)	P-Value
Avg. daily protein intake from green fodder (gm)	264.86±7.91	258.40±7.35	261.36±8.27	0.65
Avg. daily protein intake from concentrate (gm)	109.84±2.38[c]	219.19±4.74[b]	324.58±7.58[a]	<0.001
Avg. total protein intake (gm)	374.70±10.09[c]	477.59±11.76[b]	585.94±15.36[a]	<0.001
Avg. daily energy intake from green fodder Mcal/Kg	6.93±0.21	6.76±0.19	6.84±0.22	0.65
Avg. daily energy intake from concentrate Mcal/Kg	1.68±0.04[c]	3.35±0.07[b]	4.96±0.12[a]	<0.001
Avg. total energy intake Mcal/Kg	8.61±0.24[c]	10.12±0.26[b]	11.80±0.32[a]	<0.001
Avg. daily gain (gm)	497.32±17.92	503.63±19.09	532.77±20.67	0.258
Mean feed efficiency	0.135±.004[a]	0.113±.003[b]	0.108±.004[b]	<.0001
Protein/Kg gain required (gm)	961.14±53.05[c]	1263.91±87.13[b]	1475.10±85.89[a]	<0.001

*Low=concentrate ration @ 0.5% of body weight, Medium= concentrate ration @ 1.0% of body weight, High=concentrate ration @ 1.5% of body weight

†Different superscripts indicate significant difference (P<0.05)

Body measurements and body mass index (BMI): The mean height at wither (WH) and body mass index (BMI) of Nili-Ravi buffalo heifers were not affected (P>0.05) by varying protein and energy levels (table 3). The reason of same WH and BMI might be due to a non-significant difference in average daily gain and same body frame of all the heifers on completion of experiment. Fiaz *et al.* (2012) raised Sahiwal cattle heifers on varying dietary energy levels and observed no difference in the WH of cattle. Rashid *et al.* (2013) also reported non-significant (P>0.05) difference in WH of male buffalo calves on three different feeding regimens.

Blood and serum chemistry: The data on blood profile and serum chemistry are presented in table 3. The blood parameters (PCV, MCV, platelets count and total leukocytic count) were not affected (P>0.05) by the varying energy and protein levels. Lohakare *et al.* (2006) raised crossbred calves on different protein levels and found similar results for PCV. Anjum *et al.* (2012) reported that various dietary treatments had no influence (P>0.05) on the hematological values (lymphocytes and monocytes) in growing buffalo heifers. The variation in hematological parameters occurs mostly due to breed, season and age (Naveen *et al.*, 2008). The serum urea level was found lower (P<0.05) in low protein and energy diet compared with high protein and energy diet but varying level of protein and energy were unable to influence significantly (P>0.05) to serum cholesterol level among all the three treatments. These findings are partially in-line with the finding of Li *et al.* (2008) who studied the impact of different dietary protein levels on blood metabolites in 15 healthy calves and found that there is direct relationship between dietary protein level and urea concentration in blood. The higher protein intake is associated with higher blood urea level, agrees with previous report (Bartlett *et al.*, 2006).

Table 3. Body measurements, BMI and blood profile of buffalo heifers.

Parameters	Low (A)	Medium (B)	High (C)	P-Value
Avg. height at wither (cm)	103.31±0.57	103.43±0.54	104.04±0.55	0.30
Avg. BMI	135.56±1.71	136.02±1.59	136.48±1.92	0.59
Avg. PCV %	40.03±0.78	40.42±0.74	40.83±0.95	0.74
Mean MCV (fl)	42.79±0.38	42.61±0.52	42.46±0.42	0.78
Mean Platelets count (10^9 /lit)	141.03±9.33	140.48±10.69	138.33±10.25	0.94
i-Mean Lymphocytes (%)	39.96±2.16	42.03±2.11	42.39±2.10	0.59
ii-Mean Monocytes (%)	3.45±0.39	3.00±0.37	3.78±0.58	0.47
iii-Mean Granulocytes (%)	56.44±2.20	54.32±2.16	54.37±2.15	0.63
Avg. Urea level in serum (mg/dl)	47.20±1.41[b]	50.08±2.05[ab]	51.41±2.29[a]	0.04
Avg. Cholesterol level in serum (mg/dl)	70.45±3.43	71.73±2.65	74.34±3.11	0.56

*Low=concentrate ration @ 0.5% of body weight, Medium= concentrate ration @ 1.0% of body weight, High=concentrate ration @ 1.5% of body weight

†Different superscripts indicate significant difference (P<0.05)

Digestibility of nutrients: The apparent digestibility of organic matter, ether extract, ash and ADF in buffalo heifer calves raised on different levels of protein and energy did not show any treatment effect (P>0.05) (Table 4). However, DM, CP and NDF digestibility gradually increased in calves received diet with higher concentrate level (Table 4). Dry matter and CP digestibility was significantly (P<0.05) higher in buffalo calves consumed concentrate ration 1.5% of body weight regarding other two treatment groups and no difference (P= 0.03) was observed in the DM digestibility of calves raised on low & medium concentrate level diet. The digestibility of NDF was also found higher (P<0.05) in high concentrate group compared with low concentrate group but no difference (P>0.05) was observed in NDF digestibility of low & medium and medium & high concentrate level group. The urine pH was in normal range (pH: 7-8.4) as reported by (Parrah *et al.*, 2013) and not effected (P>0.05) by varying levels of concentrate ration.

Total tract digestibility of dry matter, crude protein & neutral detergent fiber fractions showed a curvilinear association with respect of more dietary CP level (Table 4). The concentrate level and digestion are inter-linked because the diet comprises higher amount of concentrate was consumed more by buffalo calves which enhanced their digestibility. The CP contents of diet are often related positively to DM intake (Allen, 2000). The intake of CP increased linearly with increasing dietary CP level (Promkot and Wanapat, 2005). Archibeque *et al.* (2007) showed improved (P<0.01) dry matter digestibility on different CP rations 71.8% (low), 75.8% (medium) 77.7% (high) and 77.5% (oscillating).

Prusty *et al.*, (2016) reported significant (P<0.05) differences regarding digestibility of DM and CP in Murrah buffalo calves and cross bred calves on varying protein levels diet. Tauqir *et al.* (2011) offered three level of protein (low, medium and high) and reported that the digestibility of CP intake increased as dietary CP level increased. The digestibility of CP increases linearly with increasing dietary CP levels (Lohakare *et al.*, 2006; Promkot and Wanapat, 2005). The NDF fraction with low rate of digestion, is considered primarily the dietary constituent associated with gut fill effect (Tauqir *et al.*, 2011). The enhanced NDF digestibility in current study can be illuminated by higher intake of digestible NDF by buffalo calves through concentrate ration.

Table 4. Effect of varying levels of dietary protein and energy on nutrient digestibility in buffalo heifers.

Treatments	Low (A)	Medium (B)	High (C)	P-Value
Dry matter intake Dig %	66.06±2.32[b]	67.22±1.09[b]	71.14±0.96[a]	0.03
Organic matter Dig%	67.61±2.37	68.75±1.18	70.14±1.17	0.38
Crude protein Dig %	61.21±1.72[b]	62.01±1.20[b]	65.85±0.88[a]	0.03
Fat Dig %	64.91±2.77	66.35±1.14	68.47±1.47	0.35
Ash Dig%	54.20±5.10	55.86±0.89	57.36±1.52	0.81
NDF Dig%	51.43±2.13[b]	52.91±1.32[ab]	56.09±1.02[a]	0.10
ADF Dig%	46.40±2.97	47.96±2.17	49.25±2.02	0.69
Avg. urine pH	8.39±0.14	8.41±0.15	8.31±0.14	0.82

*Low=concentrate ration @ 0.5% of body weight, Medium= concentrate ration @ 1.0% of body weight, High=concentrate ration @ 1.5% of body weight. †Different superscripts indicate significant difference (P<0.05)

Conclusion: Keeping in view the findings like average daily gain (ADG) that was noticed same among all treatment groups and feed efficiency (FE) which is higher for group A buffalo heifers with low level of concentrate ration it may also be seen that medium and high levels of concentrate resulted in increased the cost of production i.e. group B and C, respectively. Therefore, it may be concluded that Nili-Ravi buffalo heifers can be raised from 6-14 monthsof age on concentrate ration at 0.5% of body weight alongside green fodder with minimal cost and without affecting their production performance.

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