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Effect of Varying Feeding Formulas on the Growth Performance of Buffalo Heifers

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present experiment was conducted at dairy farm during the year 2020-21 at CSAUA&T Kanpur. The growth rate of buffalo heifers is a major problem at dairy farms. Twelve buffalo heifers were selected for digestibility that on a nutrition slide sample contains 86.50% DM, 20.10 %CP, 2.00 EE, 15.5% CF, 52.70% NFE and 9.50%Ash. The average dry matter intake per 100 kg body weight was (6.34, 5.44, 7.06 kg) the digestibility coefficient of DM was recorded (61.40, 59.95, 62.77) and digestibility coefficient of CP (63.55, 61.78, 65.77) and digestibility coefficient of CF (56.11, 54.75, 58.99) and digestibility coefficient of EE (64.89, 64.39, 67.52) and digestibility coefficient of NFE (64.06, 62.58, 65.75) and digestibility coefficient of Organic matter (64.45, 62.75, 66.99). The average live weight in buffalo heifers was increased (627.04, 610.44, 687.73) g per day

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in group I, II and III groups respectively. The growth parameters were statistically significant. Group III was shown better performance in respect of growth parameters in other groups I and II from the present study, it was apparent that the extra concentrate to be added in diet for proper development of growing heifers, III group was higher in growth. Digestibility coefficients of Dry matter, Crude Fiber, Ether extract, Nitrogen free extract and Organic matter were also higher in group III.

Keywords: Heifers; DM; CF; EE; NFE; OM.

1. INTRODUCTION

Livestock sector plays a crucial role in shaping the rural economy of India. It is a major continuous income generating activity for the rural households. Livestock rearing and crop husbandry are the two important components of mixed farming which influence agricultural economy leading to sustainable agriculture and are complementary to each other [1-4]. On an average animal husbandry contributes about 26 per cent to agricultural gross domestic product (GDP) of the country, whereas, the contribution is much higher in hot semi-arid and arid regions where conventional crop production is always a gamble due to uncertain and scanty rainfall [5-8]. Livestock and fisheries sector contribute over 4.11 per cent of total GDP of India (Economic Survey, 2017-18). A symbiotic relationship exists between men, land and livestock. India is endowed with the largest livestock population in the world [9-13].

India with mere 2.4 per cent of the world land mass supporting nearly 16.65 percent of the world human population and 20 percent of the world livestock population (Livestock census, 2019). India ranks first in respect of buffaloes and goats, second in cattle and sheep population in the world [14-18]. It has about 58 per cent buffaloes, 16 per cent cattle, 20 percent goats and about 5 per cent sheep of world livestock population (Livestock census, 2019). Similar findings were reported by [19].

The country is endowed with several breeds of cattle (43), buffalo (16), sheep (42) and goat (33) (National Bureau of Animal and Genetic Resources). Similar findings were reported by [20].

In the past, farmers could restore the fertility of their land by letting it lie fallow for several years or longer. But as poverty in rural areas, Livestock contributes a large portion of draft power for agriculture, with approximately half the cattle population and 25 percent of the buffalo population being used for work and cultivation. The population pressure increases, fallow periods decline or even disappear and different ways of maintaining food production are needed [21-23].

The growth of the body as whole is most commonly measured as an increase in weight size measures such as height, length and heart girth [24,25]. A combination of weight and size measurement is more useful than either alone and increase in weight and size are highly useful measures of growth, but they are obviously incomplete [26,27,28]. They do not show the nature of tissue formed nor are they suitable measures of coordinated development. The amount of the true growth tissue viz. protein and minerals can be obtained by a balance experiment [29,30].

Since the total food intake for growth is governed primarily by the energy needs stating the protein requirement in relation to the energy intakes has a certain advantage. A similar relationship is provided in dietary standards for man by the statement that the calories, using the factors employed in calculating physiological fuel values from the practical standpoint [31,32,33].

2. MATERIALS AND METHODS

The experiment was carried out for 90 days (15 January to 14 April, 2021) on buffalo heifers at University Dairy Farm, Kanpur. The twelve buffalo heifers have been selected of approximately similar age of within two years and similar weight from herd these heifers divided into three groups consisting of four heifers in each group. The buffalo heifers allotted to each group were strictly in random distribution on the basis of similarity in age. The conditions for weight similarity happened to be practically impossible, so variation within the weight was controlled through replication for eliminating much of the response made.

2.1 Randomization of Treatment

List 1. Treatment details

S. No	Treatments	Ear No	Date of birth	Initial weight
1	T_1	22	29-11-2018	185.56
2	T_1	38	11-07-2018	211.67
3	T_1	24	16-10-2018	273.73
4	T_1	17	18-11-2018	307.27
5	T_2	30	27-09-2018	157.44
6	T_2	34	12-11-2018	253.40
7	T_2	36	12-10-2018	276.29
8	T_2	26	25-07-2018	282.64
9	T_3	32	03-10-2018	153.69
10	T_3	28	26-11-2018	264.98
11	T_3	18	21-08-2018	282.64
12	T_3	16	18-08-2018	285.13

2.2 Recording Observations

When all the animals were habituated for experimental conditions, they were committed of each buffalo heifer under resumed feeding of supplement the growth of each buffalo heifer was measured after each week in the morning under the following heads: -

1. Live weight (Kg)
2. Heart girth (cm)
3. Length (cm)

2.2.1 Live weight

The weight of each buffalo heifer was recorded in the morning before the feed was given. The body weight was calculated by the following formula:

$$\mathbf{B} = \frac{L \times G}{C}$$

Where;
B = Body weight (kg)
L = Length (cm)
G = Girth (cm)
C = 64.4 if girth is less than 164 cm. or 61 if girth is 165-200 cm.

2.2.2 Heart girth

In the same way hearth girth of each buffalo heifer was recorded as circumference by measuring tape in cm.

2.2.3 Length

The length was recorded at the same time by the measuring tape in centimetre from point of shoulder to the pin bone.

2.2.4 Method of feeding

Out of three groups one group (T_1) was fed according to Morrison's standard of feeding while the animal of other two groups were kept respectively, at a concentrate mixture intake of 20 per cent above the Morrison's standard (T_3) and 20 per cent below the Morrison's standard (T_2) attempt was made to keep the intake equal to Morrison's recommended average value for different body in all groups. The concentrate was supplied in the morning of each day. The experiment was continued for 90 days, all the precautions regarding feeding and sanitation were taken into consideration.

3. EXPERIMENTAL FINDINGS

3.1 Chemical Composition of Various Ration

The chemical composition of ration fed to different groups i.e. Wheat straw, Berseem (as green fodder) and concentrate mixture are given below in Table 1

Plan of nutrition: The twelve buffalo heifers were taken and divided into three equal groups (T_1, T_2, and T_3) having four animals in each group. In group T_1, the animal was fed conventional feeding systems in T_3 and T_2 were fed more than 20% and less than 20% recommended dose of concentrate respectively. Wheat straw was offered ad-lib and 5 kg berseem offered to each animal. Similar findings were reported by [6].

Table 1. Chemical composition of ration fed to different groups

Feed materials	DM (%)	CP (%)	EE (%)	CF (%)	NFE (%)	Total Ash (%)
Wheat straw	90.00	3.00	1.00	38.00	46.00	12.00
Berseem	20.00	16.50	2.50	24.50	46.25	10.25
Concentrate	90.00	20.00	1.80	15.60	51.10	11.50

3.2 D.M. Intake and Per 100 kg Body Weight

The average D.M. intake per day per animal was 6.34±0.46, 5.47±0.43, and 7.06±0.52 kg in I, II and III groups respectively (Table-2). The D.M. consumption was higher in group III than other animal groups, but differences between the groups were nonsignificant (Table -2). The D.M. consumption per 100 kg body weight per day was 2.63±0.15, 2.31±0.18, and 2.96±0.27 kg in groups I, II, and III, respectively (Table-2). The D.M. consumption per 100 kg body weight was higher in group III followed by I and II groups, respectively but the differences between all the groups were nonsignificant (Table-2). The D.M. intake per kg metabolic body size per animal was 35.22±1.98, 30.93±2.45, and 39.58±3.66 in group I, II and III respectively (Table -2). The difference in D.M. consumption per kg metabolic size was found to be nonsignificant. The digestible crude protein intake was 522.19±36.44, 449.64±31.41, and 601.39±36.16 g/day, respectively in group I, II and III (Table-2). The digestibility of crude protein intake was higher in group III than the other groups but this difference was non- significant between different groups of animals (Table-2). The total digestible nutrients intake was 3.37±0.19, 3.26±0.16 and 3.74±0.23 kg per day in the group I, II and III respectively. The TDN intake was highest in group III and lowest in group II. TDN intake value was statistically significant and data differences between groups were nonsignificant. Similar findings were reported by [34,35].

Table 2. The average D.M. Intake per day

Animal No	Body weight of the animal (kg)	Total D.M Intake (kg)	Metabolic body size $W^{0.75}$	D.M. Intake per100 (kg) body weight	D.M. Intake g/kg Metabolic body weight $W^{0.75}$	DCP Intake (g)	TDN Intake (kg)
Group -1							
1	185.56	5.19	139.17	2.79	37.33	425.74	2.87
2	211.67	6.10	158.75	2.88	38.46	508.07	3.38
3	273.73	7.29	205.29	2.66	35.53	564.90	3.43
4	307.27	6.81	230.45	2.21	29.57	590.05	3.82
Mean	244.55	6.34	183.41	2.63	35.22	522.19	3.37
S.E.±	27.90	0.45	20.93	0.15	1.98	36.44	0.19
Group-2							
1	157.44	4.46	118.08	2.83	37.83	365.89	2.80
2	253.40	5.12	190.05	2.02	26.98	426.49	3.32
3	276.29	6.41	207.21	2.32	30.97	491.52	3.44
4	282.64	5.92	211.98	2.09	27.96	514.67	3.49
Mean	242.44	5.47	181.83	2.31	30.93	449.64	3.26
S.E.±	29.02	0.43	21.76	0.18	2.45	31.41	0.16
Group-3							
1	153.69	5.81	115.26	3.78	50.48	501.99	3.17
2	264.98	7.02	198.73	2.64	35.33	603.07	3.57
3	282.64	7.87	211.98	2.78	37.16	627.57	4.12
4	285.13	7.56	213.84	2.65	35.37	672.93	4.11
Mean	246.61	7.06	184.85	2.96	39.58	601.39	3.74
S.E. ±	31.29	0.52	23.43	0.27	3.66	36.16	0.23
C.D.	135.32	2.04	101.49	0.96	12.80	162.76	0.90

3.3 Digestibility Coefficient of Dry Matter

The D.M. digestibility was 61.40±0.19, 59.95±0.13 and 62.77±0.24 per cent in groups I, II, and III, respectively (Table-3). Higher digestibility was observed in group III followed by I and II group respectively. The differences between all groups touched the level of significance at 1%. Similar findings were reported by [9,36,37].

3.4 Digestibility Coefficient of Crude Fiber

The digestibility coefficient of crude fiber was 56.11±0.27, 54.75±0.47 and 58.99±0.77 in groups I, II and III respectively (Table 4). Critical analysis of data showed that crude fiber digestibility was higher ($p<0.01$) in group III. The differences between group III and I were also touching the level of significance at 1%, while other groups were non-significant differ from each other (Table-4). Similar findings were reported by [9,36,37].

3.5 Digestibility Coefficient of Crude Protein

The digestibility coefficient of crude protein was 63.55±0.56, 61.78±.48 and 65.77±0.20 percent in I, II and III groups respectively (Table-5). Analysis of data showed that the digestibility of crude protein was significantly higher ($p<0.01$) in group III. The differences between group III and I were also touching the level of significance at 1%, while other groups were non-significant differ from each other (Table-5). Similar findings were reported by [9,36,37].

3.6 Digestibility Coefficient of Ether Extract

The digestibility coefficient of ether extract in three groups viz. I, II and III were 64.89±0.39, 64.39±0.20, and 67.51±0.32 respectively (Table-6). Higher digestibility of ether extract was observed in III group than the other experimental groups of animals. The differences between group III and I were also touching the level of significance at 1%, while other groups were non-significant differ from each other. Similar findings were reported by [9,36,37].

3.7 Digestibility Coefficient of NFE

The digestibility coefficient of Nitrogen free extract was 64.06±0.34, 62.58±0.41 and 65.75±0.25 in I, II and III groups respectively (Table-7). Statistical analysis of data showed significant difference ($p< 0.01$) in the digestibility of nitrogen free extract by all the groups of animals as compared to group II, significantly higher digestibility of nitrogen free extract was observed in IIIrd group than the other groups of animals (Table-7). Similar findings were reported by [9,36,37].

Table 3. Digestibility coefficient of dry matter (DM) in animals of various treatment

Treatment		Total DM consumed (g)	D.M. Voided (g)	D.M. digested (g)	Digestibility coefficient (%)
	1	5195.24	2034.46	3160.78	60.84
	2	6106.16	2345.99	3760.17	61.58
Group I	3	7294.36	2797.39	4496.97	61.65
	4	6814.78	2619.61	4195.17	61.56
Mean		6352.63	2449.36	3903.27	61.40
S.E.		±456.50	±166.57	±290.04	±0.19
	1	4467.91	1804.15	2663.76	59.62
	2	5129.18	2048.60	3080.58	60.06
Group II	3	6419.00	2574.02	3844.98	59.90
	4	5928.86	2357.32	3571.54	60.24
Mean		5486.22	2196.02	3290.21	59.95
S.E.		±431.13	±169.36	±261.93	±0.13
	1	5818.67	2205.86	3612.81	62.09
	2	7022.08	2612.92	4409.16	62.79
Group III	3	7877.90	2908.53	4969.37	63.08
	4	7564.40	2789.76	4774.64	63.12
Mean		7070.76	2629.26	4441.49	62.77
S.E. ±		±453.25	±153.65	±299.64	±0.24
C.D		2054.90	1692.50	11306.70	0.88

Table 4. Digestibility coefficient of Crude Fiber (CF) in animals of different treatment

Treatment		Total CF consumed(g)	CF Voided (g)	CF digested (g)	Digestibility coefficient (%)
	1	1384.22	614.88	769.34	55.58
	2	1616.42	715.76	900.66	55.72
Group I	3	2005.18	872.66	1132.52	56.48
	4	1742.62	755.08	987.54	56.67
Mean		1687.11	739.59	947.51	56.11
S.E. ±		129.42	53.28	76.25	0.27
	1	1455.20	653.10	802.10	55.12
	2	1672.66	738.82	933.84	55.83
Group II	3	1793.20	817.35	975.85	54.42
	4	1605.34	743.92	861.42	53.66
Mean		1631.60	738.29	893.30	54.75
S.E. ±		70.48	33.59	38.51	0.47
	1	1473.44	627.25	846.19	57.43
	2	1625.32	974.51	950.81	58.50
Group III	3	1876.22	759.50	1116.72	59.52
	4	1826.12	720.96	1105.16	60.52
Mean		1700.27	770.55	1004.72	58.99
S.E. ±		66.39	73.44	64.98	0.77
C.D		462.44	256.72	284.79	2.26

Table 5. Digestibility coefficient of Crude protein in various treatments

Treatment		Total CP consumed(g)	CP Voided (g)	CP digested (g)	Digestibility coefficient (%)
	1	687.02	261.28	425.74	61.97
	2	799.36	291.29	508.07	63.56
Group I	3	875.14	310.24	564.90	64.55
	4	920.24	330.19	590.05	64.12
Mean		820.44	298.25	522.19	63.55
S.E. ±		50.95	14.66	36.44	0.56
	1	604.58	238.69	365.89	60.52
	2	687.45	260.96	426.49	62.04
Group II	3	796.38	304.86	491.52	61.72
	4	819.02	304.35	514.67	62.84
Mean		726.88	277.21	449.64	61.78
S.E. ±		44.18	16.45	33.58	0.48
	1	769.46	267.47	501.99	65.24
	2	911.27	308.20	603.07	66.18
Group III	3	953.90	326.33	627.57	65.79
	4	1021.46	348.53	672.93	65.88
Mean		914.02	312.63	601.39	65.77
S.E. ±		53.26	17.38	36.16	0.20
C.D		236.18	74.12	162.76	2.03

3.8 Digestibility Coefficient of Organic Matter (O.M.)

The digestibility coefficient of organic matter was 64.45±0.38, 62.75±0.46 and 66.99±0.47 per cent in animals of group I, II and III group respectively (Table-8). Maximum digestibility coefficient of organic matter was recorded in the group III. The differences between group III and I were also touching the level of significance at 1%, while other groups were nonsignificant differences from each other (Table-8). Similar findings were reported by [9,36,37].

Table 6. Digestibility coefficient of Ether extract in various treatments

Treatment		Total EE consumed (g)	EE Voided (g)	EE digested (g)	Digestibility coefficient (%)
	1	92.36	31.62	60.74	65.77
	2	102.22	36.56	65.66	64.24
Group I	3	114.18	39.52	74.66	65.39
	4	111.46	39.82	71.64	64.28
Mean		105.05	36.88	68.17	64.89
S.E. ±		4.95	1.90	3.10	0.39
	1	93.14	33.20	59.94	64.36
	2	99.35	34.96	64.39	64.82
Group II	3	112.46	40.63	71.83	63.88
	4	114.20	40.52	73.68	64.52
Mean		104.78	37.32	67.46	64.39
S.E. ±		5.10	1.91	3.21	0.20
	1	107.13	33.94	73.19	68.32
	2	116.53	38.27	78.26	67.16
Group III	3	131.30	42.40	88.90	67.71
	4	130.40	43.22	87.18	66.86
Mean		107.13	39.45	81.88	67.51
S.E. ±		5.82	2.13	3.72	0.32
C.D		24.37	9.12	15.42	1.44

Table 7. Digestibility coefficient of nitrogen free extract (NFE) of various treatment

Treatment		Total NFE consumed (g)	NFE Voided (g)	NFE digested (g)	Digestibility coefficient (%)
	1	2439.22	893.25	1545.97	63.38
	2	2871.16	1043.96	1827.20	64.64
Group I	3	3432.56	866.00	1566.56	64.40
	4	3216.44	1130.91	2085.53	64.84
Mean		2987.34	983.53	1756.31	64.06
S.E. ±		216.91	62.81	127.04	0.34
	1	2424.12	922.63	1501.49	61.94
	2	2938.46	1121.32	1817.14	61.84
Group II	3	2887.34	1067.17	1820.17	63.04
	4	3072.43	1121.44	1950.99	63.50
Mean		2830.59	1058.14	1772.44	62.58
S.E. ±		316.79	46.94	95.56	0.41
	1	2555.32	891.30	1664.02	65.12
	2	2820.20	971.85	1848.35	65.54
Group III	3	3288.16	1108.44	2179.72	66.29
	4	3240.19	1103.61	2136.58	65.94
Mean		2975.96	1018.80	1957.16	65.75
S.E. ±		204.97	52.98	122.30	0.25
C.D		829.14	151.11	532.02	1.55

3.9 Weight Gain (gm) per Day by Various Groups

The rate of daily live weight gains (g/d) were 627.04±11.92, 610.20±13.58 and 687.73±5.22 g/d in I, II, and III groups, respectively (Table-9). Analysis of variance of data showed that growth rate was significantly higher ($p< 0.01$) in group III than the control group, whereas difference between groups III and I were significant and differences between other groups were non-significant (Table-9). Similar findings were reported by [9,38,39,40].

Table 8. Digestibility coefficient of organic matter (OM) in various treatments

Treatment		Total OM consumed (g)	OM Voided (g)	OM digested (g)	Digestibility Coefficient (%)
	1	658.42	240.66	417.76	63.45
	2	731.02	254.40	476.62	65.20
Group I	3	862.32	307.34	554.98	64.36
	4	854.44	300.60	553.84	64.82
Mean		776.55	275.75	500.80	64.45
S.E. ±		49.54	16.59	33.20	0.38
	1	602.22	231.38	370.84	61.58
	2	710.54	260.06	450.48	63.40
Group II	3	856.16	311.82	544.34	63.58
	4	805.38	302.51	502.87	62.44
Mean		743.57	276.44	467.14	62.75
S.E. ±		55.50	18.78	37.40	0.46
	1	675.21	226.47	448.74	66.46
	2	754.42	323.16	431.26	65.90
Group III	3	862.22	278.50	583.72	67.70
	4	806.46	259.36	547.10	67.84
Mean		774.67	271.87	502.70	66.99
S.E. ±		39.77	20.19	37.14	0.47
C.D		224.63	85.38	165.30	2.20

Table 9. Weight gain of various treatments

Treatment		Initial body wt. (kg)	Final body wt. (kg)	Gain wt. (kg)	Gain wt. g/day
	1	185.56	239.75	54.19	602.20
	2	211.67	266.95	55.28	614.32
Group I	3	273.73	332.80	59.07	656.34
	4	307.27	364.44	57.17	635.32
Mean		244.55	300.98	56.42	627.04
S.E. ±		27.90	28.79	1.07	11.92
	1	157.44	209.13	51.66	574.02
	2	253.40	307.94	54.54	606.03
Group II	3	276.29	332.47	56.18	624.32
	4	282.64	339.91	57.27	636.44
Mean		242.44	297.36	54.91	610.44
S.E. ±		29.02	8.36	1.22	13.58
	1	153.69	214.42	60.73	674.88
	2	264.98	326.57	61.59	684.42
Group III	3	282.64	345.55	62.91	699.02
	4	285.13	347.46	62.33	692.62
Mean		246.61	308.50	61.89	687.73
S.E. ±		31.29	31.71	0.47	5.22
C.D		135.32	139.05	4.51	49.92

3.10 Nitrogen Balance by Different Groups

The sample of feed feces and urine were analyzed for nitrogen content. In order to estimate the quantity of nitrogen retained by the animals. The nitrogen balance was 37.63±5.85, 30.97±2.22 and 49.58±3.67 in I, II and III groups respectively (Table-10). The differences between all the groups were nonsignificant. Similar findings were reported by [38,41,35].

Table 10. Nitrogen balance

Animal no	Nitrogen intake (gm)	Nitrogen outgo feces	Nitrogen outgo urine(gm)	Total nitrogen outgo (gm)	Percent retention	Nitrogen balance
1	109.92	41.80	37.16	88.96	19.06	20.96
2	127.89	46.60	43.12	89.72	29.84	38.17
Group I 3	140.02	49.63	43.45	93.08	33.52	46.94
4	147.20	52.83	47.92	102.75	30.19	44.45
Mean	131.25	47.71	42.41	93.62	28.15	37.63
S.E. ±	8.15	2.35	2.21	3.17	3.14	5.85
1	96.73	38.19	32.50	70.69	26.92	26.04
2	109.99	41.75	38.75	80.50	26.81	29.49
Group II 3	127.42	48.77	46.90	95.67	24.91	31.75
4	131.04	48.69	45.72	94.41	27.95	36.63
Mean	116.29	44.35	40.96	85.31	26.64	30.97
S.E. ±	7.98	2.63	3.35	5.97	0.63	2.22
1	123.11	42.79	40.15	82.94	32.62	40.17
2	145.80	49.31	46.22	95.93	34.20	49.87
Group III 3	152.62	52.21	50.20	102.41	32.89	50.21
4	163.43	55.76	49.57	105.33	35.55	58.10
Mean	146.24	50.01	46.53	96.65	33.8	49.58
S.E. ±	8.52	2.75	2.30	4.97	0.67	3.67
C.D	37.94	11.85	12.36	22.26	8.69	19.25

4. CONCLUSION

Three groups of buffalo heifers were arbitrarily selected. With respect to similar age considerations, each group comprised four heifers. Morrison's feeding standard was followed for all three groups, with the exception of groups III and II, which received 20% high and low concentrate in addition, and group I, which was considered as a control group and received no feed concentrate. For every group, the DCP and TDN intake were determined using body weight and maintained at Morrison's standard. The experiment lasted for ninety days.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Azmi AFA, Hassim HA, Mohd Nor N, Ahmad H, Meng GY, Abdullah P, Bakar MZA, Vera J, Deli NSM, Salleh, Zamri-Saad AM. Comparative growth and economic performances between indigenous swamp and murrah crossbred buffaloes in Malaysia. Animals. 2021;1(4): 957-975.
2. Barman D, Prajapati KB, Pawar MM, Das H, Prasad CK, Ahirwar M. Effect of feeding cotton seed cake (CSC) on growth performance and blood biochemical profile in Mehsana buffalo calves. Indian J. Anim. Res. 2019;53(5): 604-608.
3. Basiony AZ. Performance of growing lambs and buffalo calves given flavomycin as a feed supplement. Annals Agric. Sci. 1994;32(4):1791-1800.
4. Chaudhary SK, Dutta N, Jadhav SE, Pattanaik AK. Influence of customized supplement on voluntary feed intake and nutrient metabolism in crossbred calves. Indian J. Anim. Res. 2021;55(2):174-179.
5. Gami RK, Thakur SS, Mahesh MS. Protein sparing effect of dietary rumen protected lysine plus methionine in growing Murrah buffaloes (*Bubalus bubalis*), Proceedings of the National Academy of Sciences, India Section B: Biological Sci. 2017;87(3):885–891.
6. Chauhan TR, Sharma ND, Dahiya SS, Gupta R, Arora U, Lall D. Effect of plane of nutrition on milk yield, composition and nutrient utilization in lactating buffaloes in their early lactation. Buffalo J. 2000;16(2): 215-222.
7. Gupta S, Mohini M, Malla BA, Mondal G, Pandita S. Effects of monensin feeding on performance, nutrient utilisation and

enteric methane production in growing buffalo heifers. Tropical Anim. Health Production. 2019;51(4):859-866.
8. Khan EU, Pasha TN, Rashid MA, Aleem M. Feeding of TMR at different dietary energy levels: Intake, growth performance, feed efficiency, structural development, and economics in pre-pubertal Nili Ravi buffalo heifers. J. Anim. Plant Sci. 2019;29(4):905-911.
9. Abdel-Raheem SM, Hassan EH. Effects of dietary inclusion of Moringa oleifera leaf meal on nutrient digestibility, rumen fermentation, ruminal enzyme activities and growth performance of buffalo calves. Saudi J. Biological Sci. 2021;28(8):4430-4436.
10. Ahmad F, Khan MA, Wadood F, Mubeen M, Asghar A, Yaseen A, Mohyuddin SG. Value addition of wheat straw with corn steep liquor and its performance on growth rate in growing buffalo calves. Pakistan J. Sci. 2020;72(2):108-108.
11. Ali FM. Effect of feeding levels on the performance of erashy Heifers. East African Scholars J. Agri. Life Sci. 2019; 2(7):378-383.
12. Anjum MI, Afzal M. Influence of substituting wheat straw with corncobs in fattening rations for growth rate and nutrient digestibility in buffalo calves. J. Animal Plant Sci. 2015;25(5):1216-1221.
13. AOAC. Official Methods of Analysis. 13th Edition, Association Official Analytical Chemists, Washington DC; 1980.
14. Paul SS, Bhar AK, Lamba M. Double and triple cross in cattle Dehradoon farm. Indian J. Anim. Sci. 2008;78(6):661-665.
15. Pawar MM, Kamra DN, Chaudhary LC, Agarwal N, Chaturvedi VB. Nutrient's utilization, methane emission, immune function, blood metabolites and performance of buffalo calves fed *Trachyspermum copticum* seed oil. Indian J. Anim. Sci. 2019;89(1):63-67.
16. Prakash PD, Reddy V, Reddy R, Krishna N. The catalytic effect of supplementation of protein meals on utilization of rice straw-poultry droppings rice bran diet in buffaloes. Anim. Feed Sci. Technl. 1996; 63(4):229-243.
17. Prayaga KC, Hensshall JM. Adaptability in tropical beef cattle, genetic parameters of growth adoptive and permanent traits in a crossbred population. Australian J. experimental Agri. 2005;45(7/8):971-983.
18. Riaz M, Azhar MA, Sharif M, Yaqoob M, Rashid H. Effect of rearing methods on the growth performance and welfare status of calves. Pak. J. Agric. Sci. 2021; 58(1):253-260.
19. Livestock census livestock population; 2012.
Available: www.ndri.org
20. NBAGR Livestock breeds in India nbagr.ac.in; 2O17.
21. Kumar B, Thakur S. Effect of supplementing bypass fat on the performance of buffalo calves. Indian J. Anim. Nutr. 2007;24(4):233-236.
22. Kumar R, Karl D, Kumar D, Singh V, Sihag S. Effect of rumen protected amino acids and fish meal on feed conversion ratio of murrah buffalo heifers. Int. J. Curr. Microbiol Appl. Sci. 2018;7(3): 2587-2597.
23. Kundu SS, Goutam MU, Sontakke K, Sharma VK. Effect of energy and protein levels on nutrient utilization and their requirements in growing Murrah buffaloes. J. Tropical Anim. Health Production. 2016;48(4):807–815.
24. Samal L, Chaudha LC, Agarwal N, Kamra DN. An Impact of phytogenic feed additives on growth performance, nutrient digestion and methanogenesis in growing buffaloes. Anim. Production Sci. 2016; 58(6):1056-1063.
25. Sharma B, Nimje P, Tomar SK, Dey D, Mondal S, Kundu SS. Effect of different fat and protein levels in calf ration on performance of Sahiwal calves. Asian-Australasian J. anim. Sci. 2020;33(1):53.
26. Madhuri SB, Suman CL, Panday HS. Growth performance of progenies of two breed cross in cattle. Indian Veterinary J. 2007;12(7):1251-1254.
27. Mehta AG. A nutritional composition for oral administration to an animal. Dairy Sci. 1994;57(11):7226.
28. Patil NA, Atkare VG, Zinjarde RM, Ingole AS. Adoption of recommended feeding and management practices of buffalo calf. J. Soils Crops. 2016;26(2):285-289.
29. Madhuri SB, Suman CL. Growth performance of progenies of two breed cross in cattle. Indian veterinary J. 2008; 85(7):736-738.
30. Marwan AA, Mousa SA, Singer AM. Impact of feeding Exogenous Fibrolytic Enzymes (EFE) on digestibility, rumen fermentation, haemobio chemical profile and productive performance in buffalo calves. Int. J. Veterinary Sci. 2019;8(3): 127-133.

31. Singh H, Grewal RS, Kaur S, Kaur J, Singh C, Lamba JS, Malhotra P. Effect of organic Cu and Zn on the performance of pre-ruminant buffalo calves. Int. J. Curr. Microbiol. App. Sci. 2018;7(5):763-769.
32. Singh PK, Kamboj ML, Chandra S, Kumar A, Kumar N. Influence of weaning on growth, health and behaviour of buffalo (*Bubalus bubalis*) calves. Indian J. Animal Res. 2019;53(5):680-684.
33. Snedecor GW, Cochran WG. Statistical methods. 6th Edition, The Iowa State University Press, Ames; 1968.
DOI: 10.2307/2985653
34. Siddiki MA, Amin MR, Kabir AKMA, Faruque MO, Khandaker ZH. Effect of high and low energy-based concentrate diet supplementation on nutrient intake and body weight changes of buffalo bull calves at Subornochar Upozila of Noakhali district in Bangladesh. Bang J. Anim. Sci. 2021;50(1):50-56.
35. Singh S, Kundu SS, Kushwaha BP, Maity SB. Dietary energy levels response on nutrient utilization, nitrogen balance and growth in *Bhadawari buffalo* calves. Livestock Research Rural Development. 2009;21(8):1-7.
36. Marwan AA, Mousa SA. Influence of basil oil as an essential oil on buffalo calves performance, digestibility, haemo biochemical profile and rumen fermentation indicators. Egyptian J. Nutrition Feeds. 2021;24(2):211-221.
37. Mousa MA, Osman AS, El-aref M. The influence of fiber particle size on body performance, feed intake and digestibility of Egyptian buffalo heifer. J. Int. Academic Res. Multidisciplinary. 2018; 6(2):47-57.
38. Kushwaha BP, Subendu B, Kunwar MK, Singh B, Das N. Effect of dietary protein on intake, nutrients utilization, nitrogen balance, blood metabolites, growth and puberty in growing Bhadawari buffalo (*Bubalus bubalis*). J. Tropical Anim. Health Production. 2015;47(1):213–220.
39. Madavi S, Dahiwale P, Meshram P, More S. Effect of feeding jowar straw in combination with soybean straw on growth performance of crossbred calves. Int. J. Veterinary Sci. Anim. Husb. 2020;5(6): 46-49.
40. Sarwar M, Khan MA, Nisa M, Bhatti MA, Shahzad MA. Nutritional Management for Buffalo Production. J. Anim. Sci. 2009; 22(7):1060–1068.
41. Sharma VK, Kundu SS, Prusty S, Datt C, Kumar M. Nutrient utilization, growth performance and blood metabolites in Murrah buffalo calves (*Bubalus bubalis*) divergently selected for residual feed intake. J. Archives Anim. Nutrition. 2016; 70(6):455-469.

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