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Effect of feeding different levels of rumen undegradable protein on growth and economics of production in female crossbred calves#

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Abstract

A feeding trial of 120 days was conducted in crossbred calves to examine the impact of feeding varied levels of rumen undegradable protein on growth and economics of production. Eighteen weaned female crossbred calves of age ranging between six to nine months were chosen from University Livestock Farm and Fodder Research and Development Scheme (ULF & FRDS), Mannuthy and randomly allotted to three dietary treatments (CP 20%, TDN 70%) varying in undegradable protein levels: Control- 35%; T1 -45%; T2 – 55%, respectively of total CP. The experimental calves were given feed as per ICAR standards (ICAR, 2013). The average daily gain (ADG) and total body weight (TWG) were similar between groups. The average feed cost per kg body weight gain was considerably (P<0.05) lower in T1 and T2 groups compared to control. Thus, it was determined that feeding concentrate mixture (20% CP and 70% TDN) with an RUP level of 45 per cent of total CP was economical without affecting the growth rate of calves.

Keywords: *Rumen undegradable protein (RUP), daily gain, growth, economics*

Dietary crude protein (CP) is of two types i.e. rumen degradable protein (RDP) and rumen undegradable protein (RUP). RDP is mainly required for survival of the rumen microbes which in turn improve the fermentation in rumen and supply the host enough microbial protein (Das *et al*., 2014; Javaid *et al*., 2017). RDP and RUP, which are dietary CP fractions, supply metabolisable protein.

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The metabolisable protein requirements of rapidly growing ruminants cannot be satisfied by microbial protein alone. As a result, adding protein that is ruminally less degradable will be advantageous and results in availability of extra amino acids at intestinal level which are efficiently utilised by fast growing ruminants (Butler, 1998). By RUP supplementation, the wasted ammonia produced from feed proteins in the rumen is much decreased, improves protein utilisation (Javaid *et al*., 2011) and the availability of amino acids to the host ruminants for growth, reproduction and milk production is proportionately increased (Walli, 2008). But studies on growth and economics of production are limited in growing calves. Hence the current research project was envisaged to study the influence of dietary levels of rumen undegradable protein on growth and economics of production in crossbred calves.

Materials and methods

Eighteen healthy female crossbred calves of six to nine months of age were selected from University Livestock Farm and Fodder Research and Development Scheme, Mannuthy. The experimental calves were randomly allotted into three groups of six animals each. Calves were housed individually in well ventilated, clean and dry shed with facilities for feeding and watering. All the calves were dewormed before starting the feeding trial. All the calves were maintained under uniform managemental conditions throughout the experimental period.

Experimental feed

The experimental calves were fed with concentrate mixtures (CP 20%, TDN 70%) containing varying levels of undegradable protein *viz*., Control: 35%, T1: 45%, and T2:55% of CP, respectively. Green fodder and potable drinking water were provided *ad libitum*. The experimental animals were fed according to the feeding standard (ICAR, 2013) and kept on their respective diets for 120 days.

Body weight of the animals was recorded at fortnightly intervals during the 120 days of feeding trial.

Daily dry matter intake (DMI)

Weighed quantities of experimental feed were fed individually to all the animals in the morning 8 AM and afternoon 2 PM. The ort or residue if any in the manger was collected manually and weighed daily for analysing the moisture content and estimating daily DMI during the entire experimental period. Ingredient compositions of feeds fed to three experimental groups are given in Table1.

Table 1. Ingredient composition of the experimental feeds, %

Ingredients	Parts		
	Control	T1	T2
Maize	20.75	29	35.5
Rice polish	4.25	4.25	4.25
Deoiled rice bran	1.25	5.5	9.5
Corn gluten feed	21.25	15	7.25
Deoiled coconut cake	1.5	9.25	17.5
Soybean meal	5.5	4.5	2
Gingelly oil cake	15.75	10.25	5.25
Alfalfa protein concentrate	2	5.5	10
Black gram husk	14	7.5	4
Wheat bran	10.75	6.5	2
Calcite	2	1.75	1.75
Common salt	0.5	0.5	0.5
Mineral mixture	0.5	0.5	0.5
Total	100	100	100
Feed supplements (g/100kg)			
VIT AB_2D_3	25g	25g	25g

Table 2. Chemical composition[1] of the experimental diets and fodder (on DM basis)

Nutrients (%)	Dietary Treatments			Hybrid Napier green fodder
	Control	T1	T2	
Dry matter	92.97±0.20	92.62±0.15	92.26±0.14	17.37±0.71
Crude protein	20.02±0.09	20.06±0.04	20.10±0.05	12.49±0.26
Crude fibre	10.44±0.15	8.8±0.10	7.64±0.13	30.14±0.20
Ether extract	3.39±0.05	3.50±0.03	4.01±0.03	1.68±0.14
Total ash	9.43±0.12	8.89±0.17	9.18±0.04	10.22±0.26
Nitrogen Free Extract	56.72±0.17	58.75±0.19	59.07±0.17	45.46±0.46
Acid insoluble ash	0.87±0.03	0.89±0.03	0.93±0.02	2.64±0.05
Neutral detergent fibre	32.33±0.11	30.71±0.26	30.78±0.36	60.17±0.30
Acid detergent fibre	15.63±0.12	14.25±0.14	13.72±0.12	39.62±0.20
Calcium	1.24 ± 0.02	1.18 ± 0.03	1.19 ± 0.02	0.54 ± 0.04
Phosphorus	0.73 ± 0.01	0.71 ± 0.01	0.70 ± 0.02	0.26 ± 0.02

[1]Mean values are based on six replicates with SE

Table 3. Summarised data on body weight, total weight gain and average daily gain[1]

Parameters	Control	T1	T2	P value
Initial body weight (kg)	112.87±5.84	113.13±7.05	113.63±8.33	0.997^{ns}
Final body weight (kg)	182.33±6.94	191.10±11.80	192.10±11.28	0.763^{ns}
Total weight gain (kg)	69.47±3.93	77.97±5.55	78.47±4.35	0.335^{ns}
Average daily gain (kg)	0.55±0.03	0.62±0.04	0.62±0.03	0.335^{ns}
Feed to gain ratio	9.95 ±0.53	8.59 ±0.30	9.00 ±0.28	0.069^{ns}

[1]Mean values are based on six replicates with SE. ns-non significant (P>0.05)

Data obtained on body weight and economics of production were analysed statistically by using SPSS 24.0 software.

Results and discussion

The chemical composition of experimental feed fed to calves is shown in Table 2. The mean initial body weight, final body weight, total body weight gain, average daily gain and feed to gain ratio of calves fed three different feeding regimens, *viz*., control, T1, and T2 are given in Table 3. Data analysis revealed that the above parameters were statistically similar (P>0.05) between groups.

According to the findings reported by Kumar and Walli (1994), there was no observed difference in the average daily gain (ADG) between the group of crossbred calves that was fed formaldehyde-treated groundnut cake and the group that was fed untreated groundnut cake. Sampath *et al*. (1996) also found that increased RUP levels from 34 to 50 per cent of total CP had no influence on average daily gain. In an experiment with beef cattle at two levels of RUP (33 and 41%, respectively), Fauzyah *et al*. (2017) found no statistically significant (P>0.05) change in ADG. Additionally, Dorri *et al*. (2021) reported that feeding lambs with varying amounts of RUP and RDP had no effect on average daily growth (38:62, 27:73).

In contrast to present study Patel *et al*. (2012) found that buffalo heifers fed bypass protein (formaldehyde-treated) had the highest average daily gain as compared to that of control group.

Similar to the findings of the present study, Gajera *et al*. (2013) noticed that feed conversion ratio was unaltered across treatment groups when Jaffrabadi heifers were fed bypass nutrients (lysine, methionine, and fat). In contrast, Mehsana heifers fed bypass nutrients in their concentrate feed had higher feed conversion efficiency (Patel *et al*., 2015).

Table 4. Economics of production of calves fed on experimental feeds

Parameters	Control	T1	T2	P value
Total concentrate feed intake (kg)	1873.32± 4.09	1879.90± 6.02	1898.27± 5.91	-
Concentrate feed intake/animal (kg)	312.22± 4.09	313.32± 6.02	316.38± 6.36	0.855^{ns}
Cost of concentrate feed /kg (Rs)	33	32	31	_
Total grass intake (kg)	12034.49	11336.48	12588.86	_
Grass intake/animal (kg)	2005.75± 117.83	1889.41± 167.48	2098.14± 184.71	0.657^{ns}
Cost of grass /kg (Rs)	4.95	4.95	4.95	-
Total cost of feed, (Rs/animal)	20231.69± 692.96	19378.75± 1018.92	20193.55± 1081.592	0.775^{ns}
Total body weight gain, (kg/animal)	69.47±3.93	77.97±5.55	78.47±4.35	0.335^{ns}
Cost per kg gain,(Rs)	294.51^{b}± 15.49	250.93^{a}± 8.90	258.06^{a}± 7.56	0.032*

[1]Mean values are based on six replicates with SE. ns-non significant (P>0.05).
*Means with different superscripts within a row differ significantly (P<0.05)

Economics of production

The economics of production of calves maintained on three experimental feeds are given in Table 4. The average feed cost per kilogram weight gain for the calves belonging to the control, T1, and T2 groups were Rs. 294.51, Rs. 250.93, and Rs. 258.06, respectively. The results revealed that due to the higher total body weight gain observed in T1 and T2 compared to control group, the mean cost of production per kg body weight gain differed significantly (P<0.05) between the control group and treatment groups.

Patel *et al*. (2012) noticed that the cost for each kg body weight growth in heifer calves fed bypass protein was substantially (P< 0.01) lower compared to control group. Barman *et al*. (2017) found that cotton seed cake supplemented group (Rs. 172.9) had a lower feeding cost per kg weight gain than the control group (Rs. 194.4) in Mehsana buffalo calves. Kumari *et al*. (2017) also reported that groups T2, T3 supplemented with protected protein had lower feeding costs per unit body weight gain than group T1 (control) in Murrah buffalo heifers. Feeding costs were reduced by 2.92 percent when 3 g of rumen-protected methionine and 20 g of rumen-protected lysine were added to the typical traditional manner of feeding (Gavade *et al*., 2019). In contrast, Sorathiya *et al*. (2015) noticed that the cost per kg gain was comparable across the formaldehyde-treated protein fed groups and untreated protein fed groups in Surti buffalo heifers.

Conclusion

It was concluded that feeding a concentrate mixture (20% CP and 70% TDN) containing an RDP: RUP ratio of 55:45 as a per cent of total CP was cost-effective in enhancing the growth performance of female crossbred dairy calves.

Conflict of interest

The authors declare that there are not conflicts of interest.

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