

Effect of rumen liquor inoculation on the onset of rumination and body weight gain in cattle calves

KOPAL BIHARI, D. V. SINGH, SANJAY KUMAR, J. PALOD, S.K. SINGH and ANIL KUMAR¹

Department of Livestock Production Management, ¹Department of Animal Nutrition, College of Veterinary and Animal Science, G.B. Pant University of Agriculture and Technology, Pantnagar 263 145 (U. S. Nagar, Uttarakhand)

ABSTRACT: Oral inoculation of rumen liquor, collected from fistulated bullock, was attempted in a total of 32 calves (20 crossbred and 12 Sahiwal cattle) following three different protocols, viz. beginning from 6, 11 and 16 days. Inoculum's amount began from 5 ml/day, with periodic increment of 5 ml/day, till onset of rumination was observed. There was a significant advancement in the onset of rumination (AOR) as evinced by onset of regurgitation. AOR was advanced by 13 days in crossbred cattle calves (27.80 ± 1.58 vs. 40.50 ± 0.54 days) and 15 days in Sahiwal calves (25.50 ± 1.65 vs. 41.50 ± 0.43 days). There was no significant effect of protocol followed, indicating that inoculation of rumen liquor could be practiced as late as 16th day age of the calves to achieve similar results. Inoculated calves also had significantly ($P < 0.01$) more gain in body weight at 90 day age in both the breeds than control groups.

Key words: Body weight, calves, crossbred cattle, inoculation, rumen liquor, rumination, Sahiwal cattle

India continues to be the largest milk producing nation in the world with close to 17% of global milk production, arriving mainly from ruminants (NDDB, 2012-13). In ruminants, rumen is the first and largest compartment, and it can hold as much as 225 l of ingested substances (in cattle), besides harboring huge amount of a variety of microbes, including bacteria, fungi and protozoa, living in a symbiotic manner and help the host to digest ingested materials. Rumen bacteria vary in size and shape where as rumen protozoa are larger in size (predominantly ciliates) and their number is roughly 5×10^{10} /g and 1 m/g of rumen material, respectively.

In the rumen, microbes exist in three distinct locations, viz. adhere tightly to the wall of rumen, associated with feed particles and freely floating in the rumen liquid. The strained content of the rumen consist of microbial suspension with about 10^{10} bacteria/ml and 10^6 protozoa/ml. Most of the rumen microorganisms are strictly anaerobic. The chemical composition of rumen fluid is thought to closely reflect the healthy/ unhealthy interaction between rumen microflora and diet. Just as diet and feed quality is important for livestock production, rumen health is also critical to the growth and production.

It is, therefore, conceivable that the methods of rearing particularly under intensive husbandry conditions influence faunation of the calves to a considerable extent. Since early establishment of ciliates

in the rumen is important to the development and growth of calves, all practices that advance or delay the onset of rumen faunation, thus affecting the progress of transformation of a suckling calf into a ruminant, are of great importance and may have far-reaching consequences.

Generally calves take about 45 days time in initiating rumination in normal course (Reece, 2004). The advancement in the onset of rumination may have several advantages. There are a few reports on this aspect in goats, where onset of rumination was advanced by about a week time in kids (Singh and Singh, 2009). Similar reports are scanty in case of calves. Present study was, therefore, undertaken to ascertain whether advancement of onset of rumination is possible in Sahiwal and crossbred cattle calves and its effect on the performance of calves.

MATERIALS AND METHODS

Present study was carried out at Instructional Dairy Farm, G.B. Pant University of Agriculture and Technology, Pantnagar from Sep. 1, 2013 to Feb. 28, 2014. Rumen liquor collection was made from about 12 years old fistulated healthy crossbred bullock, weighing about 550 kg. Rumen ingesta were taken out manually and squeezed by fisting to drain the liquid contents quickly into the thermos flask (500 ml capacity). Such completely filled-in and closed lid thermos flask was

taken to the calf shed within shortest possible time (2-3 minutes) in order to maintain anaerobic conditions. Due care was taken not to agitate the thermos in order to avoid possible damage to the microbes in the collected rumen liquor (Fig. 1).



Fig. 1: Collection of Rumen Liquor

A total of 32 calves (20 of crossbred cattle and 12 of Sahiwal cattle) were used for the study. Experiment was attempted in three protocols, viz. T1, T2 and T3 with beginning of rumen liquor inoculation at 6, 11 and 16-day age of calves. All the three protocols (T1, T2, T3) were used in crossbred cattle calves, where as only two protocols (T2, T3) could be used on Sahiwal calves as per the availability of calves.

Inoculation of the rumen liquor was done orally using disposable 10 ml sterile syringe, needle removed

(Dispovan, 2014). An increasing trend in inoculation volume was followed (beginning from 5 ml orally daily, with increment of 5 ml/ day after 5 days periodic interval) and continued till onset of rumination was observed. Thus, the maximum dose achieved was 25 ml/ day (Table 1). Experiment was continued till 90 days age of the calves in order to record various parameters.

Observations recorded on the calves included their date of birth, date of onset of rumination as evinced by onset of regurgitation (Reece, 2004); body weight (BW) on weighing bridge (in kg) at birth, 15-day, 30-day, 45-day, 60-ds and 90-day. Parameters studied included age at the onset of rumination and increase in body weight, as below:

i. Age at onset of rumination (AOR) in days	Date of onset of rumination - date of birth
ii. Body weight gain/ day, (BWGD) in kg	(BW at 90 days - birth weight)/ 90
iii. Per cent increase in body weight (PBW)	[(BW at 90 days - birth weight) / birth weight]*100

Data obtained under the study for crossbred and Sahiwal cattle were analyzed separately using standard methods as described by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

Age at Onset of Rumination (AOR): Mean values with respect to age at onset of rumination (AOR) in crossbred and Sahiwal cattle calves under various groups were significantly lower ($P < 0.05$) in all the treatment group calves than the corresponding control group calves. Findings showed significant improvement in this physiological activity in crossbred calves (27.80 ± 1.58 vs. 40.50 ± 0.54 days) and Sahiwal calves (25.50 ± 1.65 vs. 41.50 ± 0.43 days), leading to 13 and 16 days advancement, respectively (Table 2). Literature is scanty on the present topic as such in general, and in crossbred cattle and Sahiwal cattle calves, in particular. However,

Table 1: Protocols of rumen liquor inoculation in crossbred cattle and Sahiwal cattle calves

Age of calves (day)	Treatment Protocols &			Control against protocols		
	dose of rumen liquor (ml/ day)			(with no rumen liquor)		
	T1	T2	T3	T1	T2	T3
6 to 10	5	-	-	-	-	-
11 to 15	10	10	-	-	-	-
16 to 20	15	15	15	-	-	-
21 to 25	20	20	20	-	-	-
26 to 30	25	25	25	-	-	-
No. of crossbred cattle calves	4	3	3	4	3	3
No. of Sahiwal cattle calves	-	3	3	-	3	3

Table 2: Age at onset of rumination (in days) in crossbred and Sahiwal cattle calves under different treatments

Groups	Crossbred cattle calves		Sahiwal calves	
	Treatment	Control	Treatment	Control
T1	31.00 ^a ± 2.04 (4)	39.75 ^b ± 0.63 (4)	-	-
T2	27.33 ^A ± 0.67 (3)	40.33 ^B ± 0.88 (3)	27.67 ^A ± 0.33 (3)	42.00 ^B ± 0.58 (3)
T3	24.00 ^A ± 3.79 (3)	41.67 ^B ± 1.33 (3)	23.33 ^A ± 2.97 (3)	41.00 ^B ± 0.58 (3)
Overall	27.80 ^A ± 1.58 (10)	40.50 ^B ± 0.54 (10)	25.50 ^A ± 1.65 (6)	41.50 ^B ± 0.43 (6)

- Values with different small (P<0.05) and capital (P<0.01) letters as superscripts in the same row for crossbred and Sahiwal calves differ significantly from each other.
- Values within parentheses indicate number of observations.

Khare (2005) and Khare *et al.* (2006) based on their study on week old 20 Barbari kids found age of onset of rumination of treated group significantly (P<0.01) advanced than control group (16.90±0.95 vs. 22.37±0.89 day) kids through rumen liquor inoculation. These findings indicate possible role of rumen liquor inoculation in calves for their early rumen development. It may be a welcoming move for the farmers, as such inoculated calves may be weaned early and thus present intervention may improve economics of the farm.

There are conflicting reports as to the time at which protozoa first appear in the rumen of calves but it is, no doubt, rather late after birth. Although, they may appear in first or second week after birth, provided the rumen pH is >6.0, and were generally demonstrated from third week after birth (Lengemann and Allen, 1959). According to other reports they do not appear until calves are 8 weeks old, only in 15 per cent of animals (Latteur, 1953), or even as late as 16 weeks after birth Conrad *et al.* (1958).

Further, the results obtained indicated non-significant (P>0.05) effect of protocol used. It may, therefore, be recommended that out of the three protocols attempted, rumen liquor inoculation could be attempted as late as 16th day age of calves with similar results in advancement in the onset of rumination in crossbred and Sahiwal cattle calves.

Body weight (BW) at different ages: The mean values for birth weight of crossbred and Sahiwal calves were statistically indifferent. Whereas, BW for 15, 30, 60 and 90-day age of cross bred calves were 23.8±1.6 and 21.2±1.9, 28.0±1.6 and 24.9±1.6, and 32.4±1.3 and 28.8±1.9 kg and 37.30±1.13 and 31.90±0.78 kg for treatments (T1, T2, T3) and control groups, respectively.

These values for Sahiwal calves were 23.5±0.4 and 22.2±2.4, 27.2±1.0 and 24.0±2.6, 31.5±1.6 and 27.1±1.6 kg and 38.66±1.40 and 30.00± 1.23 kg for treatments (T2, T3) and control groups, respectively. It is evident from the results that treatment group calves were heavier than control group calves at all the ages (Table 3). This might indicate that rumen liquor inoculation had positive response on the body weight of calves at all ages. Further, early rumination in calves might have led to improvement of feed and nutrient intake, resulting in increased body weight. Above results are in consonance with Khare *et al.* (2006) in Barbari kids.

The mean values for body weight gain per day (BWGD) at 90 days of age of cross bred calves were 0.850±0.005 and 0.136±0.007 kg and for Sahiwal calves 0.200±0.005 and 0.118±0.004 kg for treatment and control groups. All these values were significantly (P<0.05) higher for treatment groups than control groups. This suggested that rumen liquor inoculation led significant (P<0.05) increase in BWGD uniformly in both the breeds (Table 4).

Per cent increment in body weight was significantly (P<0.05, P<0.01) higher in treatment group as compared to control group. The values showed significantly positive improvement in body growth in cross bred calves (80.51 ± 3.76 vs. 65.40 ± 6.07) and in Sahiwal calves (87.71 ± 3.52 vs. 58.61 ± 6.04) leading to 15 and 29 % increment, respectively (Table 5).

As there has been scanty literature available on the topic, present area of investigation has been new. Although, positive findings were obtained, these were based on limited number of calves available during the period of study. Further, previous workers on goats have

Table 3: Body weight (kg) of crossbred and Sahiwal cattle calves at different ages and treatments

Group	Protocol		Age of calves (in days)				
			Birth	15 th	30 th	60 th	90 th
Crossbred	Treatment	T1	22.0±2.2	25.4 ±1.9	29.6±2.2	33.8±1.9	38.5 + 2.2
		T2	20.0±1.2	23.9±0.7	27.7±1.2	32.4±1.9	37.0 + 2.6
		T3	20.0±1.2	23.0±0.8	26.7±0.8	30.9±1.0	36.0 + 1.2
		Overall	20.8±0.9	23.8±1.6	28.0±1.6	32.4±1.3	37.3±1.2
	Control	T1	21.3±1.5	21.3 ±1.5	26.6 ±0.9	30.0±0.8	33.5 + 0.9
		T2	19.3±1.8	21.6±1.7	24.0±1.8	28.7±2.5	31.0 + 2.1
		T3	17.7±2.2	20.6±2.3	23.9±1.9	27.7±0.7	31.7 + 0.7
Sahiwal	Treatment	Overall	19.6 +1.4	21.2±1.9	24.9±1.6	28.8±1.9	31.9 + 0.8
		T2	19.4 +1.4	24.7±0.3	29.0±1.2	33.5±1.9	39.7 +2.0
		T3	22.0 +1.2	22.2±0.6	25.4±0.9	29.4±1.4	37.7 +2.2
		Overall	20.7 +0.9	23.5±0.4	27.2±1.0	31.5±1.6	38.7 + 1.4
	Control	T2	20.33±2.8	21.9±2.3	24.0±2.9	25.9±2.5	31.0 + 2.5
		T3	18.00±1.2	22.4±2.7	24.0±2.2	28.2±1.0	29.0 + 0.6
		Overall	19.7 +1.5	22.2±2.4	24.0±2.6	27.1±1.6	30.0 + 1.3

Table 4: Body weight gain per day (BWGD) in crossbred and Sahiwal calves (kg) during 90 days period under different treatments

Groups	Crossbred cattle calves		Sahiwal calves	
	Treatment	Control	Treatment	Control
T1	0.185 ^a + 0.006 (4)	0.135 ^b + 0.010 (4)	-	-
T2	0.190 ^A + 0.015 (3)	0.126 ^B + 0.009 (3)	0.196 ^A ± 0.008 (3)	0.116 ^B ± 0.003 (3)
T3	0.180 ^a + 0.001 (3)	0.160 ^b + 0.001 (3)	0.203 ^A ± 0.008 (3)	0.120 ^B ± 0.010 (3)
Overall	0.850 ^A + 0.005 (10)	0.136 ^B ± 0.007 (10)	0.200 ^A ± 0.005 (6)	0.118 ^B ± 0.004 (6)

- Values with different small (P<0.05) and capital (P<0.01) letters as superscripts in the same row for crossbred and Sahiwal calves differ significantly from each other.
- Values within parentheses indicate number of observations.

Table 5: Per cent increase in body weight gain (PBW) in crossbred and Sahiwal calves (kg) during 90 days period under different treatments

Groups	Crossbred cattle calves		Sahiwal calves	
	Treatment	Control	Treatment	Control
T1	77.22 ^A ± 8.56 (4)	59.22 ^B ± 7.72 (4)	-	-
T2	84.86 ^A ± 5.19 (3)	61.36 ^B ± 7.30 (3)	80.33 ^A ± 0.76 (3)	55.00 ^B ± 9.45 (3)
T3	80.53 ^a ± 4.68 (3)	77.66 ^b ± 16.48 (3)	95.10 ^A ± 2.65 (3)	62.23 ^B ± 8.94 (3)
Overall	80.51 ^A ± 3.76 (10)	65.40 ^B ± 6.07 (10)	87.71 ^A ± 3.52 (6)	58.61 ^B ± 6.04 (6)

- Values with different small (P<0.05) and capital (P<0.01) letters as superscripts in the same row for crossbred and Sahiwal calves differ significantly from each other.
- Values within parentheses indicate number of observations.

obtained similar findings in advancement of rumination and growth of kids. In absence of fistulated animals, rumen liquor could be obtained from slaughter houses. The area seems attractive from future research point of view and warrants further study.

SUMMARY AND CONCLUSIONS

Rumen development and its health are important aspects in calf husbandry. Generally calves take about 45 days to begin rumination. Rumen liquor, collected from adult ruminant, contains all established and necessary bacteria and protozoa, which could be used to appropriately inoculate calves in order to advance onset of rumination. Under present study an attempt was made to inoculate a total of 32 calves (20 crossbred and 12 Sahiwal cattle) with rumen liquor, collected from fistulated bullock, following three different protocols, viz. beginning from 6, 11 and 16 days. Inoculum's amount began from 5 ml/ day, with periodic increment of 5 ml/ day, till onset of rumination was noticed.

There was a significant advancement in the onset of rumination (AOR), by 13 days in crossbred cattle calves (27.80 ± 1.58 vs. 40.50 ± 0.54 days) and 15 days in Sahiwal calves (25.50 ± 1.65 vs. 41.50 ± 0.43 days). There was no significant effect of protocol followed, indicating that inoculation of rumen liquor could be practiced as late as 16th day age of the calves to achieve similar advancement in onset of rumination. Inoculated calves also had significantly ($P < 0.01$) more body weight at 90 day age in both the breeds than control groups. The mean values for body weight gain per day (BWGD) and per cent increment in body weight (PBW) at 90 days of age were significantly ($P < 0.05$, $P < 0.01$) higher for treatment groups than control in cross bred cattle calves (0.850 ± 0.005 vs. 0.136 ± 0.007 kg; 80.51 ± 3.76 vs. 65.40 ± 6.07) and Sahiwal calves (0.200 ± 0.005 vs. 0.118 ± 0.004 kg; 87.71 ± 3.52 vs. 58.61 ± 6.04), leading to 15 and 29% increment, respectively.

ACKNOWLEDGEMENTS

Authors are thankful to the Vice-Chancellor, Dean, CVASc., Dean, PGS, Director Experiment Station and Jt. Director, Instructional Dairy Farm, GBPAU&T.,

Pantnagar for providing necessary facilities to conduct present study.

REFERENCES

- Conrad, H.R, Hibbs, J.W. and Frank, N. (1958). High roughage system for raising calves based on early development of rumen function. *J. Dairy Sci.*, 41: 1248-1261.
- Dispovan (2014). Dispovan, Hindustan Syringes & Medical Devices Ltd. 174, 178/25 Ballabhgarh, Faridabad, India – 121 004.
- Khare, P. (2005). Studies on the effect of certain management interventions on well being of goats under semi- intensive system of rearing. MVSc. Thesis submitted to GBPUA&T, Pantnagar.
- Khare, P., Singh, D.V. and Singh, S.K. (2006). Effect of early ruminal cud feeding on the onset of rumination in Barbari kids. Proc. National Symposium on 'Conservation and Improvement of Animal Genetic Resources under low input system: Challenges and Strategies', Feb. 9-10. 2006, DAD 332: 203.
- Lengemann, F.W. and Allen, N.N. (1959). Development of rumen function in dairy calf. II. Effect of diet upon characteristics of the rumen flora and fauna of young calves. *J. Dairy Sci.*, 42: 1171-1181.
- Latteur (1953). (cit.: Jancarick, A.-Proksova, M.-Reichl, J.: Biologie vyzivy sajicich miladat, Praha, CSAZV, 1957).
- NDDB (2012-13). Annual Report, National Dairy Development Board, Anand.
- Reece, W.O. (2004). Duke's Physiology of Domestic Animals. 12th Ed. Cornell Univ. Press Ithaca.
- Singh D.V. and Singh S.K. (2009). Completion Report, "Livelihood Support to Rural Women Through Biotechnology Intervened Package on goatry", D.B.T. Funded Project GBPUA&T Pantnagar.
- Snedecor, G.W. and Cochran, W.B. (1994). *Statistical Methods*. 8th Ed. The Iowa State University Press, Ames, IOWA, USA.

Received: March 26, 2015

Accepted: June 28, 2016