# STUDIES ON ABOMASO-RUMINAL REFLUX IN MILK FED DAIRY CALVES

Jessen, S.; Thorsen T.; Agerholm A. and R.J.Jørgensen
Institute of Clinical Studies, Royal Veterinary and Agricultural University, Bülowsvej 13, DK 1870 Frederiksberg C., Denmark

## INTRODUCTION

Gastro-intestinal disorders constitute the most important findings among an estimated 200.000 neonatal dairy calf mortalities in Denmark (5). Besides infectious diarrhoea, forestomach disturbances play an important role on its own or in combination with general weakness caused by, e.g., diarrhoea. Such disturbances may result from ruminal drinking, from abomaso-ruminal reflux or by forced feeding of weak calves with milk by stomach tube. In any case this leads to disturbed forestomach function, to poor milk utilisation and retarded growth.
Reflux may occur in single calves with intestinal obstruction. Management factors which may precipitate reflux are however unknown. In the present experiment the possible role of feeding irregular amounts of milk on the occurrence of reflux is examined in young bucket fed Jersey calves. The investigation was made possible by the recent development of a simple milk coagulation test (4), to be performed on rumen samples, as an indicator of the occurrence of reflux.

## MATERIALS AND METHODS

**Animals and feeding.** Three to four week old male Jersey calves with a mean bodyweight of approx. 30 kg were allocated into two comparable groups of 5 calves each. Group 1 was fed 2 l of milk replacer twice daily. Group 2 was fed similarly with the exception that on every second day the calves of this group were allowed to drink milk replacer ad libitum for 15 minutes at each meal time. Both groups had access to hay and a calf starter (concentrate).
**Sampling.** Rumen samples were taken prior to feeding and again 90 min after feeding by means of a suction apparatus (3) fitted with a calf stomach tube (article 480010, Eichemeyer, D-7200 Tutthingen, Germany). pH of the rumen samples was measured by a standard laboratory pH-meter. The ability of rumen samples to coagulate milk was observed in black plastic Californian Mastitis Test Plates as described previously (4).
**Observation period.** The calves were observed for two weeks.

## RESULTS

Milk and concentrate uptake and weight gain during the two week observation period is shown in Table 1.
As can be seen, the groups had comparable weight gains and the sum of milk plus concentrate uptake was also comparable.

**Table 1.** Total group weight gain and uptake of milk and concentrate.

| Group | No. of calves | kg gain | kg concentrate | kg milkDM | SFU*/kg gain |
|---|---|---|---|---|---|
| 1 | 5 | 29,0 | 29,5 | 36,4 | 2,9 |
| 2 | 5 | 29,0 | 19,5 | 52,6 | 2,8 |

*SFU = Scandinavian Feed Unit

The results of the pH-measurements are summarized in Table 2 which include all measurements before and after feeding. The table shows that the acidity of the rumen samples was of the same magnitude with the two feeding stretegies used.
A drop in pH was found to occur in response to milk feeding on nearly all occations when comparing pH before feeding with pH 90 minutes after milk feeding. In the case of Group 1, which may represent the normal situation in artificially reared dairy calves,this drop was calculated to 7,8 %. In Group 2 it was highly variable and sometimes negative, i.e. an increase in pH occurred occationally.

**Table 2.** Results of the pH-measurements.

| Group | pH mean | ( range ) |
|---|---|---|
| 1 | 5,72 | (4,9 - 7,1) |
| 2 | 5,64 | (4,9 - 6,9) |

The ability of the rumen samples to coagulate milk was highly variable in both groups. This is shown in Table 3.

In Table 4, the possible correlation between the occurrence of coagulation and the depth of the decrease in pH after milk feeding is shown.

The possible correlation between the amount of milk ingested at any one meal and the decrease in rumen pH following a meal, is shown in Table 5. The table shows that the occational uptake of a large amount of milk is not followed by a large drop in rumen pH.

**Table 3.** Results of the milk coagulation test on rumen samples.

| | | | Experimental day No. 1 | | 2 | | 4 | | 7 | | 8 | | 13 | | 14 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Group | calf No. | | m | e | m | e | m | e | m | e | m | e | m | e | m | e |
| 1 | 1 | b | - | - | + | + | - | - | - | + | - | - | - | - | - | - |
| | | a | - | + | + | + | - | - | + | - | - | - | - | - | - | - |
| | 2 | b | - | - | + | - | - | - | - | - | - | - | - | - | - | - |
| | | a | - | - | + | - | - | - | - | - | - | - | - | - | - | - |
| | 3 | b | - | + | + | - | - | - | - | - | - | - | + | + | + | + |
| | | a | + | - | - | - | - | - | - | - | - | - | + | - | + | + |
| | 4 | b | - | - | + | - | - | - | - | - | - | - | - | - | - | - |
| | | a | - | - | + | + | - | - | - | - | - | - | - | - | - | - |
| | 5 | b | + | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | a | - | + | + | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 6 | b | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | a | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 7 | b | - | - | - | - | - | - | - | + | - | - | - | - | - | - |
| | | a | - | - | - | - | - | - | + | + | - | - | - | - | - | - |
| | 8 | b | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | | a | + | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 9 | b | - | + | + | - | + | - | - | - | - | - | - | - | - | - |
| | | a | + | + | - | + | - | - | + | - | - | - | - | - | - | - |
| | 10 | b | - | + | - | - | - | - | - | + | - | - | - | - | - | - |
| | | a | + | + | - | - | - | + | + | + | + | - | - | - | - | - |

m and e : Morning and evening, respectively
b and a : Before and 90 min. after feeding, respectively

**Table 4.** Number of feeding occations followed by either a small or a large decrease in pH, and the simultaneous occurrence, or absence, of coagulation. Only occations which were negative before feeding are included.

| | negative before feeding but pos. 90 min. after | negative before feeding as well as after feeding |
|---|---|---|
| pH decrease | | |
| less than 7,5 % | 3 | 65 |
| more than 7,5 % | 12 | 43 |

Chi-square test: p = o,oo3

**Table 5.** Number of feeding occations with large or small pH decrease in relation to the amount of milk ingested.

| | Amount of milk ingested at actual meal: | |
|---|---|---|
| pH decrease | More than 4 liter | Less than 4 liter |
| less than 10 % | 13 | 96 |
| more than 10 % | 4 | 35 |

DISCUSSION

Although reflux may lower rumen pH due to hydrocloric acid, a more likely explanation to the drop in pH seen in both groups 90 minutes after feeding is fermentation of milk which has escaped the oesophageal groove during drinking. Such leaking has been reported by others (1 ; 2) who believed that moderate leaking may well be considered to be normal in bucket fed calves.

It is interesting to note that reflux occurred among calves of Group 1 under a traditional milk feeding regime. A certain amount of reflux may therefore be considered normal under such conditions.

It was evident that the irregular milk feeding of Group 2 was well tolerated by the calves and that reflux did not occur more frequently among these than among calves fed constant amounts of milk. In other words, relux, as evidenced by milk coagulation, occurred irregularly in both groups.

A positive coagulation test was observed on several occations before feeding in both groups (17 % in Group 1 and 8,5 % in Group 2). This may be explained by (a) reflux occurring between meals or by (b) still active enzymes from reflux related to last feeding. A third possibility is that (c) sampling itself trigger a certain amount of reflux. We do not believe that possibility (b) is likely since 4 out of 15 pre-feeding positive calves were not positive at the previous feeding and, 9 out of 22 calves with post-feeding positive rumen samples had lost the ability to coagulate milk prior to the next feeding. It all points to the need to determine, somehow, the sensitivity of the coagulation test.

The highly significant positive correlation between a large drop in pH and a conversion from negative to positive coagulation following the same meal, supports the theory that reflux leads to a drop in pH. We believe this drop to be caused by fermentation rather than hydrocloric acid because considerable amounts of gastric juice would be required to produce the pH-changes observed. This interpretation is supported by the finding that in both groups approx. 30 % of the feedings followed by a major drop in pH were not related to coagulation.

ACKNOWLEDGEMENTS

This study was supported by Victor A. Goldschmidt's Fond.

REFERENCES

1. Dirksen, G.and Dirr,L. Oesophageal groove dysfunction as a complication of neonatal diarrhoeas in the calf. The Bovine Practitioner 24, 1989.
2. Dirksen G. and Garry, F. Diseases of the forestomachs in cal ves. Compendium for the Continuous Education of Veterinary Practitioners, 1987, 9, 140-147, 173-179.
3. Geishauser, T. Entwicklung und Prüfung eines Gerätes zur Pan sensaftentnahme und -übertragung sowie zur eingabe flüssiger Artzneimittel beim erwachsenen Rind (Development and testing of an apparatus for rumen liquor sampling and transfer as well as for drenching of adult cattle). Proceedings, XVI World Buiatrics Congress, 13.-17. August 1991, Salvador, Brazil, 685-690.
4. Jørgensen, R.J., Agerholm, A., Jessen, S. and T. Thorsen. A simple test for the demonstration of abomasal juice in

ruminal samples of young calves. Acta vet. scand. 1992, 33 (in press).
5. Lauridsen, B.H. Obduktionsfund i kalvemateriale tilført destruktionsanstalt. (post mortem diagnosis of calves at a knackery). Dansk Veterinærtidsskrift 1987, 70, 425-433.

SUMMARY
The effect of feeding irregular amounts of milk replacer to 3 to 4 week old Jersey calves on the occurrence of abomaso-ruminal reflux was studied by means of a newly developed test. Reflux appeared occationally among calves fed restricted amounts of milk. Feeding calves fluctuating amounts of milk did not provoke futher reflux. A significant correlation was found between reflux and a marked post-feeding drop in ruminal pH when single meals were considered. Reflux and the corresponding drop in rumen pH occurred apparently randomly in one out of three meals and independent of the amount of milk ingested.