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# Evaluation of electronic identification transponders implanted in the rumen of cattle

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**Summary.** The performance of electronic identification transponders encased in ceramic capsules inserted into the reticulo-rumen was assessed in 3 groups of cattle: 1059 two-year-old feedlot steers, 11 penned calves and 46 grazing calves. Insertion of capsules presented little difficulty and at slaughter, examination of the reticulo-rumen showed no visible signs of damage to the reticulo-endothelium due to the capsules. The retention rate of the capsules was 100% in adults when slaughtered 55–107 days after capsules were inserted. All losses of capsules from calves occurred before calves were 21 weeks of age. Transponders were successfully read both in the live animal and in the body on the slaughter chain. All transponders in the reticulo-rumen of grazing calves were functioning normally up to 46 weeks after being implanted. At slaughter, capsules were recovered easily with no risk of contaminating meat or by-products. Small steel metallic objects near the capsule appeared not to affect the reading distance of the transponder.

**Additional keywords:** electronic identification, implanted transponders, rumen.

## Introduction

Information recorded on individual animals is required for various purposes such as the selection programs for genetic improvement (Sundstrom and Allen 1993), monitoring liveweight and breeder management. Electronic identification (EID) transponders are a possible mechanism for identifying animals. The point of attachment of EID transponders to the animal remains an issue. Implantation of transponders in the anal region and ear has proved unsatisfactory because of readout failure and problems with recovery at slaughter (Hasker *et al.* 1992; Hasker and Bassingthwaighte 1995). Insertion of boluses into the reticulo-rumen of cattle has proved successful for correction of trace element deficiencies (McClure *et al.* 1986), delivery of ionophores for bloat control (Parrott *et al.* 1990) and pulse delivery of anthelminthics (Rowlands *et al.* 1989). The rumen has the potential to meet the specifications of Austen and Goldstein (1988): the transponder be easily applied, protected from damage, is tamper-proof, easily read and easily recovered at slaughter. Hanton (1981) reported success with inserting an identification device into the rumen of cattle. However, retention of boluses could be a problem.

This paper reports the performance of EID transponders encased in ceramic capsules when inserted into the reticulo-rumen of adult steers and calves as assessed by their retention, reliability and retrieval at slaughter.

## Materials and methods

Observations were carried out in south-east Queensland with 3 groups of animals: feedlot steers, penned and grazing calves. The EID transponders used in the experiment had a reading distance of up to 800 mm and were encased in a moulded, round-ended, cylindrical ceramic capsule (60 by 20 mm, 40 g, specific gravity 2.0). The capsule prototype was developed by Animalife I.D. (74 Dewar Drive, Loganholme, Qld 4129).

### *Steers in feedlot*

EID capsules were inserted into 1059 Brahman-cross steers with an average weight of 431 kg and ranging in age from 24–30 months, during induction into a commercial feedlot. Groups of 50, 299, 350 and 360 animals were treated on different dates and were slaughtered 55, 72, 107 and 77 days respectively after treatment. The steers were restrained in a squeeze crush with head bail. Nose grips were applied, the head pulled upward and the capsule inserted in the oesophagus using a modified bloat–capsule applicator. After insertion, the animal was restrained for a further 30 s to ensure the capsule had been swallowed and was in the reticulo-rumen. A hand-held scanner was held close to the rib-cage of each animal to check that the capsule was in place. After each group had been treated, animals were moved freely down a race past a fixed scanner mounted on the outside of the race to check that transponders were still in place and functioning. The steers were fed high grain content rations.

At slaughter, checks for functioning transponders were made with a hand-held scanner on the animal soon after stunning and on the reticulo-rumen in the offal room following evisceration. Capsules lodged in the reticulum were recovered in the offal room by making an incision in the wall of the reticulum and removing the capsule by hand. Those lodged in the rumen could not be recovered at this stage because of time constraints, and were retrieved from a grate placed over the entrance of the discharge chute for gut contents. The actual location of the capsules was recorded for the fourth group of steers.

*Calves in pens*

Capsules were inserted into 11 male dairy calves (8 Friesian, 2 Illawarra and 1 Guernsey) ranging in age from 1–4 weeks and in liveweight from 36–57 kg. The calves were restrained by a handler while a second person inserted the capsules into the oesophagus with a modified bloat–capsule applicator. In some cases the throat of the animal was massaged with the hand to encourage swallowing. A hand-held scanner was used to check for functioning transponders every 3–4 weeks.

Calves were fed milk daily and had *ad libitum* access to lucerne chaff. Five of the calves were already eating some hay when the capsules were inserted.

Eight calves were slaughtered 16–24 weeks after insertion of capsules and the mucosa of the reticulum and rumen of the 5 animals retaining capsules were inspected closely for signs of tissue damage.

*Grazing calves*

Capsules were inserted into 46 Brahman-cross calves of mixed sex and ranging in age from a few days to 14 weeks (Table 1). The calves were suckling their dams and because of drought, supplements of hay, grain and molasses were fed.

**Table 1. Age distribution of grazing calves when capsules were inserted**

| Age (weeks) | 0–1 | 2–3 | 4–5 | 6–7 | 8–9 | 10–11 | 12–13 |
|---|---|---|---|---|---|---|---|
| No. of calves | 12 | 8 | 5 | 5 | 1 | 8 | 7 |

The insertion process was similar to that for the penned calves with animals being restrained by 2 handlers while a third inserted the capsule into the oesophagus with the modified bloat–capsule applicator. Animals were held for 20–30 s after insertion to ensure the capsule was swallowed.

A hand-held scanner was used to check for functioning transponders immediately after insertion and again 7, 61, 127, 229 and 322 days later. This provided an indication of the age at which capsules were lost.

Thirteen heifers were slaughtered 10 months after implanting and a further 5 at 2 months later. At this time animals were aged from 42–60 weeks (mean of 50 weeks). At slaughter of the first group of heifers, the transponders were checked with a hand-held scanner and a fixed scanner as bodies moved along the rail at the abattoir, immediately after stunning. No scanners were available to check the transponders at the slaughter of the second group. In the viscera room, the reticulo-rumens were opened, the capsules recovered and their locations noted.

The retention rate of capsules inserted in grazing calves aged 0–6 weeks was compared with those inserted at 6–14 weeks.

*Reading distance*

Metal in the vicinity of the transponder and reader antenna can reduce reading distance. This effect was tested by reading with a hand-held scanner an EID capsule held in the hand together with either selenium pellets or 5 cm steel nails.

## Results

*Feedlot steers*

Little difficulty was experienced in inserting the capsules, the total operation taking about 90 s/steer; 60 s to insert the capsule and a further 30 s to ensure the capsule had been swallowed. Interrogation was simple, with the scanners giving virtually instantaneous readings (<0.1 s response time).

All capsules were retained and transponders were functioning normally when read following stunning and in the offal room. Detailed records kept for the fourth group of 360 steers showed that 87% of the capsules were lodged in the reticulum.

*Penned calves*

The calves swallowed the capsules readily when they were placed in the oesophagus. Four calves regurgitated capsules. This occurred 7–13 weeks after capsules were inserted when all calves were less than 16 weeks old. No visible signs of damage to the reticulo-rumen were observed in the 5 animals examined at slaughter.

*Grazing calves*

Few problems were experienced when inserting the capsules into the grazing calves. Slight variations in diameter of capsules resulted in some being difficult to eject from the modified bloat–capsule applicator. This difficulty was not experienced with the other groups. Seven calves from 1 day to 3 weeks old regurgitated capsules within minutes of insertion. Capsules were re-inserted into 5 of these animals. The other 2 calves showed signs of distress after the capsules were inserted and no attempt was made to re-insert them at this time.

At the scanning on day 8, no readout was detected from 8 calves. Capsules were re-inserted into these calves as well as the 2 calves that remained without capsules from the initial day.

On day 62, no readout was detected from 12 calves (5 re-inserted on day 8) and by day 128 from 4 more calves (1 re-inserted on day 8). These capsules were not replaced. No capsules were regurgitated after day 128.

Regurgitation rate of capsules after day 8 (Table 2) was significantly higher ($P<0.05$) for those inserted in calves under 6 weeks of age (56%) than those inserted in older calves (10%).

Of the total 24 capsules regurgitated after day 1, 18 were lost from calves under 14 weeks of age. These

**Table 2. Retention rate of capsules inserted into the reticulo-rumen of grazing calves of different ages**

| Age at insertion (weeks) | No. of calves | No. of capsules lost[A] | Retention rate (%) |
|---|---|---|---|
| 0–5 | 25 | 14 | 44 |
| 6–14 | 21 | 2[B] | 90 |
| l.s.d. ($P$ = 0.05) | | | 25 |

[A] Capsules regurgitated after day 8.
[B] Calves were 12 weeks of age when inserted.

18 included 5 of 6 capsules re-inserted on day 8 and subsequently lost. None were lost from calves over 21 weeks of age.

Sixteen of the 18 animals that were slaughtered had retained their capsules. All capsules were recovered, 11 from the rumen and 5 from the reticulum. Some of the capsules in the rumen were positioned close to the opening from the rumen into the reticulumsuggesting that these may have been dislodged from the reticulum during slaughter and evisceration.

*Reading distance*

The presence of 6 selenium pellets or four 5-cm-nails had no apparent affect on reading performance of EID capsules. However, reading distance decreased as the number of nails increased.

## Discussion

The potential of the reticulo-rumen as a site for lodging EID devices for practical identification of individual beef cattle was demonstrated by the following observations: (i) capsules could be easily inserted into both calves and 2-year-old steers; (ii) 100% retention rate in the steers; (iii) perfect readout of capsules retained 46 weeks after insertion into calves; (iv) easy recovery at abattoirs; and (v) absence of any effect of small metallic objects on transponder reading distance.

An important practical issue is the minimum age at which capsules can be inserted with a high probability of retention. This study provides strong indications. The 100% retention rate in older steers indicates that capsules can be inserted into mature cattle with the confidence that they will be retained. The regurgitation rates of capsules inserted into penned and grazing calves under 6 weeks of age (36 and 56% respectively) were unacceptably high. The frequency of our observations did not allow us to pinpoint the age at which losses ceased. However, no capsules were lost from calves older than 21 weeks.

On this basis we suggest, with some degree of confidence, that inserting capsules into animals over 5 months of age would give almost total retention. In practice this would require capsules to be inserted at weaning. However, this is of no benefit to producers who wish to identify animals at a younger age: (i) stud breeders who would prefer to identify animals as soon as possible after birth; (ii) producers on large commercial properties who wish to insert capsules at branding when calf ages would range from a few days to more than 12 months. Further work is warranted with large numbers of calves to establish a relationship between age and capsule retention rate.

The results suggest that these capsules would tend to lodge in the reticulum when inserted into adult cattle. For calves, the data suggest that they are more likely to lodge in the rumen, but it is possible that some were dislodged from the reticulum during slaughter and evisceration. However, it is probably immaterial whether the capsules lodge in the rumen or reticulum. If their use becomes widespread, an automated or semi-automated system would be established in abattoirs with capsules being retained on a sieve or screen as ingesta is cleared.

Earlier studies with EID transponders implanted in the anal area and ears (Hasker *et al.* 1992; Hasker and Bassingthwaighte 1995) had raised concerns amongst Australian Quarantine Inspection Service (AQIS) staff and abattoir management because of difficulties in retrieving implants at slaughter. The risk of implants entering the food chain was considered very real. However, the rumen capsules have been well received by these same groups as there is minimal risk of meat products being contaminated and capsules can be recovered without interruption to the slaughter process.

Cattlemen can implement this technology. Currently, 2 suppliers are marketing capsules containing EID transponders priced at about $A10. However, Austen and Goldstein (1988) suggest a price of $A2–3 for the technology would be more acceptable. Manufacturers should endeavour to modify their product to reduce the unit price without jeopardising efficiency. As the technology advances and manufacturing runs become larger, unit costs would be expected to decline.

## Conclusions

Ceramic capsules containing EID transponders can be inserted successfully into the reticulo-rumen of cattle ranging in age from a few weeks to a few years without causing ill effects.

Retention rates approaching 100% can be expected from capsules inserted into the reticulo-rumen of animals over 5 months of age.

Retrieval of capsules at slaughter was simple and could be easily automated. Hence, the problems of recovery and possible meat contamination experienced with implanted EID transponders do not exist with reticulo-rumen capsules.

The perfect operation of transponders in all capsules retained in animals after 46 weeks suggests a high longevity of transponders encased in capsules. This represents a distinct advantage over results obtained with transponders implanted directly in the ear or anal region. In addition, transponders in capsules could readily be re-used.


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