

The Performance of Chromium and Ytterbium Intraruminal Controlled Release Devices in Beef Cattle

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The estimation of feed efficiency in beef cattle should be undertaken in the environment where the genetic potential of the animal is to be expressed. Consequently if cattle are to be pasture fed, there is a requirement for accurate feed intake measurements on individual animals in the field. This in turn requires the use of accurate faecal marker delivery systems.

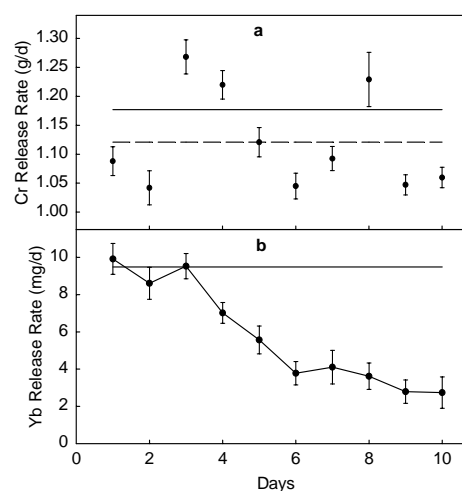
Chromium (Cr) is a commonly used marker in nutrition studies and is used to estimate faecal output (FO). Solid chromic oxide is most often administered at a constant rate via an intraruminal controlled release device (ICRD). Ytterbium (Yb) has also been used to estimate FO but cannot be administered as a solid. The accuracy of FO estimates depends on the constancy of marker release, sampling procedures, sample processing and analytical errors. We have evaluated these factors using both Cr and Yb. We assessed the constancy and accuracy of a commercial Cr ICRD. We also evaluated intraruminal osmotic pumps for the delivery of Yb. Osmotic pumps typically deliver at a constant rate for up to 28 days. Solid chromic oxide and aq. Yb acetate were added to samples of faeces to produce a range of Cr concentrations (0-797mg/kg) and Yb (0-8mg/kg). The samples were dried at 60°C, ground (ball mill), processed (Parker, 1990) and analysed by ICP with lutetium internal standard.

Twenty four Brahman cross bred steers were housed in individual pens and fed chopped buffel grass hay. All were given Cr ICRD and 6 were also given ICRD sleeves containing 4 osmotic pumps (Alzet, 2ML4) filled with Yb acetate solution. After 7d, daily feed intake and FO was measured for 10d. Daily faecal collections were mixed, sub-sampled, and processed as described above. The measured FO (dry matter) and the marker concentrations were used to estimate the release rate of Cr (g/d) and Yb (mg/d) from the intraruminal devices.

The recovery of Cr from spiked samples of faeces was $94.8 \pm 0.8\%$ ($n=18$, $R^2=0.998$). The recovery of Yb was $88.0 \pm 3.1\%$ ($n=18$, $R^2=0.950$). These recoveries were applied to the estimation of faecal marker concentrations from the animal experiments. The daily average estimated rates of release of Cr from ICRDs are shown in Figure 1a. The nominal rate of release of the ICRDs was 1.18g/d (solid line) and the 10-day average for all the animals was 1.12 ± 0.15 g/d (dashed line) which is about 5% lower than the nominal rate but

not significantly different. The daily variation in estimated release rate estimating release rate (or alternatively FO) could be as large as 12%.

Figure 1. Release rates of Cr (a) and Yb (b) from intraruminal devices in cattle fed chopped buffel grass hay. Figure 1b shows the estimated daily release rate of Yb from intraruminal osmotic pumps. The straight solid line represents the nominal release rate of 9.49mg/d.



Release of Yb was at the nominal rate up to day 3 (10 days after placing the devices in the rumen) but then rapidly declined. Osmotic pumps are subject to deterioration due to clogging or decomposition of the osmotically active components. It is not known what ruminal contents caused this deterioration in function.

The requirement for use of ICRDs to estimate FO in the field is that they be sufficiently accurate to allow estimation of the net feed conversion efficiency (NFCE) of individual animals with greater precision than the genetic variation in NFCE. Since the genetic variability of NFCE has been reported as 4.7-6.3% (Archer and Parnell, 1995) the current Cr- and Yb-based methods are not sufficiently accurate ($\pm 12\%$) for use in estimating NFCE of individual cattle.

Parker, W. J. 1990. Application of intraruminal chromium controlled release capsules to the measurement of herbage intake of sheep at pasture. Ph.D. Thesis. Massey Univ. NZ.

Archer, J. A. 1995. Variation and heritability of feed intake and efficiency of Angus bulls. Proc. Aust. Assoc. Anim. Breed. Genet. 11:389.

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