Urine Cup for Collection of Urine from Cows

ABSTRACT
A urine cup for continuous and complete collection of urine from cows was constructed from Plastisol, cotton webb strapping, Velcro, snap-fasteners, denim patches, weather stripping, and vacuum hose. The urine cup was made from Plastisol using a heated lead mold. It was large enough to enclose a 9 cm × 6 cm area around the vulva of a cow and was attached by strapping and Velcro to patches glued to the rump. Urine cups were used repeatedly and provided for long-term collection of urine from cows, eliminating the need for indwelling catheters. Applications include long-term nutrient balance, radioisotope, and metabolism studies.

INTRODUCTION
Collection of urine and feces is essential for studies on nutrient balance. Urine often is collected with bladder catheters (2). Catheters have three inherent difficulties: 1) they may be expelled, particularly in large cows after repeated use; 2) infections of the urinary tract may occur; and 3) chronic use may cause urinary tract tissue alterations. Urinary tract infections are associated with use of catheters in humans, predisposing humans to bacteriuria (1, 3). Bacteria may gain entry into the catheterized bladder by either migrating through the irrigation tube within the catheter or by ascending in the periurethral mucous sheath outside the catheter (3). Migration of bacteria in the periurethral space is the major pathway for entry into the bladder and is a major risk factor for catheter-associated bacteriuria (3) in humans. The same situation may be valid for urinary catheterization of cows. As an alternative, an external collection apparatus was constructed to be placed over the external genitalia, similar in principle to that of Veenhuizen et al. (4). The objective of this paper is to describe the device, its construction, and use.

MATERIALS AND METHODS
Construction of Mold
The mold for the cup was constructed from a lead brick measuring 5 cm × 10 cm × 20 cm (Figure 1). The brick was cut and trimmed to required dimensions (Figure 2). A metal plate was bolted to the face of the mold to form a lip around the cup and provide flaps for attachment of straps (Figure 1).

Preparation of Urine Cup and Complete Apparatus
The lead mold was suspended by a wire in a furnace, heated to 150 to 200°C for at least 2 h, removed, and completely immersed into Plastisol4 (Renosol Corporation, Farwell, MI) for approximately 3 min while being held with a wire (Figure 1). The mold was raised slowly from the Plastisol to allow excessive polymer to drain evenly and then replaced in the furnace to cure for 9 min. After curing, it was allowed to cool before the cast was cut and dried loose.
Two 5 cm × 5 cm Velcro (Velcro USA, Manchester, NH) (hook-side) patches were sewn
to denim material, glued (with urethane type glue), and riveted with female-end snap fasteners to both rear flaps on the cup (Figure 3). Two female-end snap fasteners were riveted to the two rump flaps of the cup. Four cotton-webb straps (2.5 cm wide and 38.0 cm long) were used as harnesses fixed with male-end snap fasteners on one end and a 10 cm × 2.5-cm Velcro hook-side strip on the other. The male-end fasteners were snapped into the female-end fasteners on all four cup flaps (Figure 3). Four 5.0 cm × 10-cm Velcro loop-side patches were sewn to denim material. Denim patches were cut 2.50 cm larger than

Figure 1. Appearance of mold used to make urine cup.
corresponding Velcro strips and folded at one end, providing a 1.3 cm leaf for easier separation. The face of the cup was lined with heavy duty rubber weather stripping to prevent discomfort from friction and to provide a snug fit (Figure 3).

**Installation of Urine Cup**

Hair was lightly clipped from appropriate positions, and the clipped areas were cleaned with soap, rinsed, and allowed to dry. The cup was held in position; locations for rear patches were traced first, followed by those for rump and thigh patches, respectively (Figure 4). Rump straps were placed alongside the tail in a position that seemed to cause least friction and irritation to tail or pin bones. Thigh straps were placed symmetrically on either side (Figure 4). Two Velcro (loop-side) patches were glued

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Figure 2. Mold dimensions.

Figure 3. Exploded side view of urine cup, fasteners and seal.
to either side (thigh) and two were glued on either side of the backbone (rump) of the cow (Figure 4). Velcro (loop-end) anchor patches were glued in place at least 12 h prior to cup placement to allow for adequate drying of adhesive. A shrink-to-fit thermal tube was used to connect one end of a 3.2 cm diameter drainage hose (vacuum cleaner hose) to the terminal end (outlet) of the urine cup (Figure 5). Attachment of the sleeve was reinforced around the terminal end of the cup with duct tape.

The distal end of the drainage hose was inserted approximately 10 cm inside the opening of a 20-L urine collection jug and fastened with a wire to the jug handle. The collection jug was placed behind the cow below floor height in a collection well. One end of a nylon string was attached to the urine drainage hose at about the height of the hocks. The string was placed through an opening in the cover over the well and a weight (about 100 g) was attached to the end to pull the hose away from the cow to prevent her from lying or stepping on it. The completed detachable urine collector is illustrated in Figure 6.

Figure 4. Top view of attachment to cow.

Figure 5. Frontal view of urine cup.
RESULTS AND DISCUSSION

Cows seemed more comfortable with urine cups than with catheters in previous trials. When the cups were correctly positioned, there was little if any leakage. Until we became experienced in positioning and seating the cup, there was an occasional drip around the bottom lip of the cup just below the vulva. However, losses were minimal and less than with catheters that fail to seat adequately. Fecal contamination rarely occurred and could be prevented by adjustment of the cup so that the anus of the cow did not retract too far from the top of the cup.

 Twelve urine cups were constructed and used for collections in several metabolic and radioisotopic experiments. Collections lasted for 5 to 7 d with no difficulties. Urine cups were cleaned in detergent and rinsed in hot water after each collection period. Different adhesives were used to glue patches on the animals with varying degrees of success. Branding cement seemed to be the most durable. The rigidity and durability of adhesion seemed to depend upon various factors including skin moisture, skin oils, cleanliness, exposure to water, animal movement and, most importantly, correct placement of the cup. In a later study, paint thinner (mineral spirits) was very effective in dissolving adhesive for removal of anchors. On the average, anchors remained in place for at least 5 to 7 d; some were used much longer.

A slightly larger diameter drainage hose could be used to fit snugly directly over the terminal end of the cup, eliminating the need for a shrink-to-fit connector. These and other subtle modifications are possible to make the apparatus more flexible.

On certain experiments urine was collected via both catheter and cup; the latter gave larger volumes of urine. Blood clots, which we often observe in the urine of catheterized cows, were not in urine collected via cups. However, the presence of certain uterine or vaginal secretions may be a problem in some applications.

Urine cups, being more durable, are more economical over the long run. Catheters cost approximately $10.00 each and may be used for one to three collections if properly sterilized and stored. Urine cups cost approximately $20.00 each (labor and materials). Patches and strapping might need replacement following several applications. However, the cost of a cup would seem to be relatively low, considering it probably can be used for 20 to 30 collections before Velcro patches wear out. Elimination of infections and clots is difficult to assess economically but is a factor in animal care and cost.

There are many applications for catheters, and in certain situations they are indispensable. Size of the mold can be altered to produce smaller or larger cups for cattle of appropriate size or for sheep or goats. A smaller modified version of the above apparatus has been successfully used on heifers and sheep. These urinary cups are an alternative for most basic research trials with cows.

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REFERENCES


