Feedstuffs Reprint

New equations for predicting water intake of dairy cows published

DAIRY cattle suffer more rapidly and severely from inadequate water than from a deficiency of any other nutrient (National Research Council [NRC], 1978 and 2001).

Given that milk is about 87% water, lactating cows need to consume copious amounts of water every day, primarily as free drinking water but also as moisture in the feed. On average, a cow receives 60-80% of her water needs via drinking water, with feed providing most of the remainder (Cardot et al., 2008).

Water restriction results in rapid and substantial reductions in dry matter intake (DMI) and milk production. Steiger Burgos et al. (2001) measured as much as a 27% reduction in feed intake when water was restricted, with meal size cut by more than 50%. From a herd management perspective, sufficient water availability boosts DMI, and peak feed consumption is associated with peak water intake.

According to Woodford et al. (1984), lactating cows have the greatest free water intake and water flux of any domesticated ruminant.

Greater water accessibility is associated with greater daily milk yield. Dairy cows prefer and drink more from larger water troughs (Filho et al., 2004).

Recent work from the University of Guelph in Ontario has found that milk production increases by approximately 2 lb. per day for every 1 in. increase in the cow's water trough space, within a range of 1.5-5.0 in. per cow (Sova et al., 2013).

Given this relationship between water intake and milk production, accurately predicting drinking water requirements must be a fundamental component of any dairy management system. Accurate predictions are necessary when designing housing to ensure that water system capacity will meet cattle requirements.

Since the 2001 publication, the dairy industry has generally considered the Dairy NRC water intake equation to be the most accurate, and it is widely used.

However, researchers from the University of California-Davis and the University of Nebraska (Appuhamy et al., 2016) recently published equations that provide improved predictions of free water intake for dairy cattle.

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Bottom Line

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Improved equations

Like many previous water equations, the main factors used to predict water consumption include DMI, milk production, the dry matter (DM) content of the diet, temperature/environment and mineral intake, such as sodium (Beede, 2006).

Appuhamy et al. (2016) reviewed the published literature and found 55 papers that were comprised of 93% Holstein or Holstein crosses in North America (47%), Europe (25%) and Australia (8%). Most of the data were from herds fed a total mixed ration (TMR), with only 10% from pastured herds.

Most extant drinking water prediction equations require DMI as an important measure. The challenge is that many dairy farms do not measure — or do not accurately measure — feed intake. Consequently, this research group focused on developing improved prediction equations that work well with or without a measure of feed intake.

• **When a good on-farm measure of dry matter intake is available.** When DMI is available, Appuhamy et al. found that this equation worked best for predicting water intake:

Free water intake (kg per day) = -91.1 + 2.93 x DMI + 0.61 x DM% + 0.062 x NaK + 2.49 x CP% + 0.76 x TMP.

In this equation, DM% is the dry matter content of the diet, NaK is the dietary sodium and potassium content (mEq/kg of DM), CP% is the dietary crude protein content and TMP is daily mean ambient temperature (°C). This equation described 76% of the variation in drinking water intake and accurately predicted water consumption with little bias. Most important, this new equation worked better than the currently recommended model in the 2001 Dairy NRC and should be used going forward when water intake is being predicted.

• **When a measure of feed intake is unavailable.** Often, a reliable measure of intake is not available on dairy farms, so in that case, this equation is recom-

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mended:

Free water intake (kg per day) = -60.2 + 1.43 x milk + 0.064 x NaK + 0.83 x DM% + 0.54 x TMP + 0.08 x DIM.

In this equation, milk is milk yield (kg per day) and DIM is days in milk. This equation contains milk yield as a proxy for DMI, given the strong relationship between the two factors. Only 63% of the variation in water intake was explained by this equation, so it is not as useful as the equation that uses a measure of feed intake, but it still provides reasonably accurate predictions.

For some situations, this prediction equation may be most useful because it is driven by inputs that are easily measured on most farms, such as milk yield, dietary sodium and potassium, DM%, average ambient temperature and DIM.

The Bottom Line

Water is the most critical nutrient for the dairy cow. In the future, the dairy industry should use these two new equations to better predict drinking water consumption by dairy cattle.

An accurate prediction of water intake should always be the first step in designing a successful feeding program.

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