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Personality is associated with feeding behavior and performance in dairy calves

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ABSTRACT

Performance varies considerably at weaning, perhaps in part because it is associated with the personality traits of the animals. Our objective was to identify calf personality traits using standardized tests and determine whether these were associated with measures of feeding behavior and performance. Fifty-six dairy calves were housed in 7 groups of 8 calves each with access to an automated milk feeder and ad libitum access to water, starter, and hay. We measured starter DMI and the number of unrewarded visits to the automated milk feeder during each of 4 periods: prestep (full milk allowance; 7–41 d of age), step (milk allowance reduced to 50%; 42–50 d of age), weaning (51–54 d of age), and postweaning (55–68 d of age). At 27 and 76 d of age, each calf was subjected to 3 novelty tests: novel environment (30 min), human approach (10 min with an unknown stationary human), and novel object (15 min with a black 140-L bucket). During each of the tests, 7 behaviors were scored: latency to touch and duration of touching the human or object, duration of attentive behavior toward the human or object, number of vocalizations, number of quadrants crossed as a measure of activity, and duration of inactivity, exploration, and playing. Data were averaged across ages and then across tests. Principal component analysis revealed 3 factors (interactive, exploratory–active, and vocal–inactive) that together explained 73% of the variance. Calves that were more exploratory–active began to consume starter at an earlier age and showed greater starter dry matter intake during all experimental periods and greater overall average daily gain. Calves that were more interactive and vocal–inactive had more unrewarded visits to the milk feeder during initial milk reduction. We conclude that personality traits are as-

sociated with feeding behavior and performance around weaning.

Key words: temperament, behavioral syndrome, fear, animal welfare

INTRODUCTION

Cattle are known to differ in their individual responses to stressful events. This individual variation may have important consequences for production. Animals that are generally calmer or less reactive have improved growth rates, meat quality, and milk production (reviewed by Haskell et al., 2014), improved immune function (Fell et al., 1999; Hulbert et al., 2011), and decreased physiological responses to stressful events (Curley et al., 2008) compared with excitable or more reactive animals.

Fearfulness and excitability in cattle are often assessed by measuring responses to isolation and handling, activity during restraint (typically in a squeeze chute), flight speed after release from restraint, and responses to milking and handling (Haskell et al., 2014). Responses to handling have received considerable focus given their relationship with performance. For example, excitable beef cattle (measured as reactivity to confinement in a chute and flight speed following release from the chute) have lower growth rates (Müller and von Keyserlingk, 2006; Cafe et al., 2011; Bruno et al., 2016), lower BW (Cziszter et al., 2016), and poor carcass quality such as yield and quality grade, back fat, and marbling score (Nkrumah et al., 2007; Reinhardt et al., 2009) compared with calm cattle. Dairy cattle scored as more reactive in the milking parlor produce less milk (Sutherland and Dowling, 2014; Hedlund and Løvlie, 2015), milk out slower (Sewalem et al., 2011), and have reduced lifetime production efficiency (Neja et al., 2015).

Few studies have focused on personality traits of young cattle and how these relate to performance despite the growing evidence that early-life growth and nutrition are predictive of long-term productivity, such as first-lactation milk yield (e.g., Heinrichs and

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Heinrichs, 2011; Soberon et al., 2012; Van De Stroet et al., 2016), feed intake, efficiency, and body and carcass composition at slaughter (reviewed by Greenwood and Cafe, 2007). Beef calves that were more excitable at weaning had lower BW at weaning, preconditioning, and slaughter (Francisco et al., 2012). Similar results were reported by Torres-Vázquez and Spangler (2016) for weaning and yearling weights. To our knowledge, no studies have related personality traits with performance before the weaning period in young ruminants.

During the first weeks of life, calves need to learn where, how, and what to eat; these skills can have a profound effect on growth rates. For dairy calves, the transition from a milk diet to a solid-feed diet is often associated with delayed growth (De Paula Vieira et al., 2010; Sweeney et al., 2010). To mitigate growth checks at this time, calves should be consuming starter before the onset of weaning. However, the age at which dairy calves begin to consume substantial quantities of starter is variable, with one study reporting a range of 23 to 82 d of age to consume 200 g of starter (de Passillé and Rushen, 2016). This variation in starter intake before weaning is thought to be one reason why weight gains before the weaning period are variable (e.g., from 0.1 to 1.6 kg/d in Soberon et al., 2012). Personality may play an important role in the development of these feeding patterns and, consequently, performance before weaning.

The literature to date has focused on the effects of reactivity on performance in cattle. Previous work examining behavioral responses to a novel object or human has resulted in weak or negligible correlations with performance (e.g., Breuer et al., 2000; Hedlund and Løvlie, 2015), perhaps due to limited characterization of behaviors during these tests. For example, exploration and playfulness are often measured when the individual is exposed to an unfamiliar environment (open field or novel environment tests; de Passillé et al., 1995; Peralas et al., 2017), but to our knowledge no study has examined how these traits are associated with feeding behavior measures or performance in cattle.

The objectives of this study were to describe personality traits of preweaned dairy calves using a series of novelty tests and to determine how these traits relate to performance and the development of solid feeding behavior. We also investigated the relationship between personality and behavioral responses to weaning.

MATERIALS AND METHODS

The study was conducted from April to October 2015 at the University of British Columbia (UBC) Dairy Education and Research Centre in Agassiz, British

Columbia, Canada. The study was approved under the UBC Animal Care protocol no. A14-0245 and A15-0117.

Housing and Animal Management

Fifty-six Holstein calves (32 females, 24 males) were enrolled in this study. These calves were also used in another experiment investigating how milk allowance affects BW gains (see Rosenberger et al., 2017). Briefly, all calves were separated from the dam within 6 h of birth, weighed, moved into individual sawdust-bedded pens, and fed 4 L of colostrum within 6 h of birth. At 7.5 ± 1.3 d of age, calves were moved to sawdust-bedded group pens with a partially slatted floor. Groups were filled in relation to birth dates of calves, and once group size reached 8 a new group was begun until all 7 groups (56 calves) were formed. Calves were randomly assigned to 1 of 4 milk-feeding allowances (6, 8, 10, or 12 L of milk/d) within each group of 8 calves, with each group containing 2 calves on each allowance. Milk was reduced to 50% of the allowance at 42 d of age and reduced by 20%/d from d 50 until calves were completely weaned at d 55. Calves assigned to the different milk allowances were similar in sex, BW, calving ease, and order of enrollment in the group.

Calves within each group had access to pasteurized whole milk, fed at 40°C using an automated milk feeder (CF 1000 CS Combi; DeLaval Inc., Tumba, Sweden) equipped with 1 teat. Calves could come and go from the milk feeder as they wished. Milk allowance delivered at each visit accrued hourly at a rate of 5% of the daily value every hour from midnight to 2000 h, with a minimum and maximum portion size of 0.5 and 9 L, respectively. Calf starter (Hi-Pro Medicated; Hi-Pro Feeds, Chilliwack, BC, Canada) was fed ad libitum from the same feeder. Only one calf at a time could feed from each of the milk and grain feeders. Intake, time, and duration of each visit for both milk and starter were recorded by the feeder. Farm hay and water were available ad libitum.

Data Recording and Calculations

Daily intake of milk and starter was recorded by the automated feeding system until 68 d of age. We also recorded the number of rewarded (when the calf visited the feeder and received milk) and unrewarded (when the calf visited the feeder but did not receive milk) visits to the milk feeder. Average milk and starter DMI, total DMI (sum of milk and starter DMI), and average number of rewarded and unrewarded visits to the milk feeder were calculated for 5 experimental periods:

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