Are neonatal beef calves getting enough to drink in northern Australia?

J. Muller[1], G.Fordyce[2] and A. Anderson[3]

[1]Department of Agriculture and Fisheries, Charters Towers Qld 4820 Australia
[2]Queensland Alliance for Agriculture and Food Innovation, University of Queensland, Charters Towers Qld 4820 Australia
[3]Department of Agriculture and Fisheries, Spyglass Beef Research Facility Qld 4820 Australia
Presenting author: Jarud Muller jarud.muller@daf.qld.gov.au

Summary

The incidence of low milk delivery was assessed in 14 Brahman neonatal calves in the dry tropics of northern Queensland. Calf measures included live weight (as growth is primarily a function of milk intake) and urea space (a measure of body water). Urea space data were inaccurate. One calf dehydrated due to the dam having larger teats. Each of the remaining calves was categorised as having early (n=7) or delayed growth pattern (n=6), depending on whether calf live weight versus day of life had higher adjusted R^2 for linear or exponential regression, respectively. Delayed calves did not reach the average growth rate of early calves (0.97±0.09 kg/d) until 4.2±0.7 days of life (P<0.05); and gained 0.57±0.1 kg/d prior to reaching this age. The high incidence of delayed growth in neonatal Brahman calves appeared to be related to delayed lactation, which may potentiate calf mortality under more stressful conditions.

Introduction

Pre-weaning beef calf mortalities in northern Australia can be as high as 60% (McGowan *et al.* 2014) and thus can have large impacts on live weight production. Less than half of occurring calf mortalities are explained by risk factors including predation, mis-mothering, large teats and infectious disease.

A detailed study on tropical cattle (Bunter *et al.* 2013) reported that most (67%) pre-weaning mortalities occurred during the first week of life (neonatal life) and that most of these losses were unexplained. High environmental and nutritional stress prior to and around calving is associated with increased calf mortalities (McGowan *et al.* 2014). Tropically adapted calves in extensively managed herds are highly likely to die if they do not suckle within the first 2-3 days of life (Fordyce et al 15). Based on the above, high nutritional or environmental stresses may be leading to low or delayed lactation in dams, ultimately leading to limited milk for the neonate and dehydration-mediated mortality. This study investigated how hydration status varies in tropically adapted neonatal calves.

Materials and Methods

This study was conducted at Spyglass Beef Research Facility (100 km north of Charters Towers) situated in the dry tropics; early in the typical calving period for beef cattle of the region (late dry season). Live weight and urea space of 14 Brahman calves were measured daily in the first week of life. Urea space is the volume in which injected urea distributes through the animal's body water (Hammond and Rumsey 1990) and has been used as a practical way to estimate calf total body water (Dalton 1964) and thus percentage body water. Visual assessments for evidence of milk intake included daily measurement of calf para-lumbar fossa distension (5 point scale) and udder distension (5 point scale). Cow body condition during the study was 2.8 ± 0.03 (5-point scale).

Analyses. Initial graphing of calf live weight over time indicated two distinct growth patterns: where calves grew rapidly from birth; and where calf growth was delayed for several days after birth. The latter was represented by an exponential curve. Calves were categorised as early or delayed growth if linear regression of live weight vs. day of life provided a higher or lower *adjusted* R^2, respectively, than exponential regression.

Data were initially tested for normality using the Shapiro Wilk test (α = 0.05). The average growth rate of the early growth group was used as a reference to compare with delayed growth calves. The days taken for each delayed growth calf to reach this growth rate was calculated, as was the live weight gain to this point ('target growth from birth'). Time taken for the delayed calf group to reach the target growth rate was compared to zero days using a one-way t-test. Birth weights of early and delayed calf groups were compared using a two-way t-test. Bartlett's test was used to confirm equality of variances; α = 0.05. Within groups, time to reach 'target growth from birth' was tested against birth weight using simple linear regressions. Analyses excluded the one dehydrating calf.

To determine if evidence of suckling explained growth pattern within group, both calf para-lumbar fossa distension and dam udder distension were linearly regressed over calf day of life.

Results

All calves in the study appeared to be well-hydrated through neonatal life except one that dehydrated due to its dam having larger teats. Of the apparently well-hydrated calves, 7 were categorised as early growth and 6 were categorised as delayed growth.

Delayed growth calves took 4.2 ± 0.7 days to reach a growth rate of 0.97 ± 0.09 kg/d, i.e., the average growth rate of early growth calves from birth (P < 0.05). The daily growth rate of delayed calves before they commenced high growth was 0.57 ± 0.1 kg/d.

Birth weight (30.1 ± 0.8 kg) did not differ between early growth and delayed growth groups (P = 0.8). There was limited relationship between time to reach target growth from birth and birth weight for either growth pattern, where simple linear regression approached significance (P = 0.06; *adjusted* R^2 = 0.32).

Evidence of milk consumption did not differ between early and delayed growth calves, as measured by rate of change in para-lumbar fossa distension (P = 0.16) or rate of change of dam udder distension) (P = 0.54) over the first week following calving.

Excluding the extreme values that were above 210% (n = 2) or below 55% (n = 4); urea space was 85.5 ± 1% (n = 61) of live weight over neonatal life.

Discussion

The study has shown that approximately half of a Brahman calf cohort experienced very little growth until an average of 4 days post-calving under well-managed conditions in the dry tropics. Calf growth is determined by solid and fluid accruing as tissue growth and is primarily a function of milk intake (Totusek *et al.* 1973; Black 1982; Castells *et al.* 2014). Birth weight did not differ between early and delayed growth calves. This suggests that a foetal nutritional restriction and consequent issues reported in calves including low muscle fibre development (Funston *et al.* 2010) and possibly calf metabolic ability to use milk was not limiting factor growth in this study.

Pre- and post-partum dam energy and protein nutrition has clear implications for early post-natal lactation yields as shown in dairy studies (Coulon and Remon 1991; Bell *et al.* 2000; McCarthy *et al.* 2105). Water is also important for milk production (Meyer *et al.* 2004). In Brahman cows, daily milk yield tended to be associated with body condition (McBryde *et al.* 2013). Trends of change in calf para-lumbar fossa-distension and cow udder distension did not differ between growth pattern groups, and this may be because that milk delivery was still occurring albeit at sub-optimal levels.

Considering the above, delayed growth in neonatal calves may be explained by low milk production in the first few days post-partum. The dams in this study were in extensive pasture conditions though were in fair condition and appeared not to be under any heat stress. It is hypothesised that neonatal calves of delayed growth would be prone to dehydration mediated mortality under higher levels of nutritional and/or environmental risk factors.

Detailed investigation into the impact of nutrition on lactation yields within the first few days post-partum may clarify potential nutritional interventions to reduce calf mortalities across northern Australia.

Urea space as a percentage of live weight values averaged around 85%, which exceeds that of previous reports. Previous reports of average % body water in young calves include: 73.6 ± 6.4% as measured by urea space as a percentage of live weight (Dalton 1964) and 73.0 ± 1.2% as measured by desiccation (Haigh *et al.* 1920). Therefore the urea space method was not useful in the circumstances of this study.

Conclusion

A high incidence of delayed growth in neonatal Brahman calves occurred; with evidence that this was related to delayed lactation.

Acknowledgement

The staff at Spyglass Beef Research Facility are gratefully acknowledged for their assistance.

References

Bell, AW, Burhans, WS, Overton, TR (2000) Protein nutrition in late pregnancy, maternal protein reserves and lactation performance in dairy cows. *Proceedings of the Nutrition Society* **59**, 119–126.

Black, DH (1982) Calf rearing in the tropics: Growth rates and utilisation of milk substitute diets. *Tropical Animal Health Production* **14**, 172-176.

Bunter, K, Johnston, D, Wolcott, M, Fordyce, G (2013) Factors associated with calf mortality in tropically adapted beef breeds managed in extensive Australian production systems. *Animal Production Science*

Castells, L, McNeill, DM, Dixon, RM, Kidd, LJ, Fletcher, MT, Goodwin, K (2014) 'Phosphorus Supplements in Pregnancy Improves Lactation Performace of Young Cows, Proceeding of the Australian Society of Animal Production.' Darwin.

Coulon, JB, Remon, B (1991) Variations in milk output and milk protein content in response to the level of energy supply to the dairy cow: a review. *Livestock Production Science* **29**, 31-47.

Dalton, RG (1964) Measurement of body water in calves with urea. *British Veterinary Journal* **120**,

Funston, RN, Larson, DM, Vonnahme, KA (2010) Effects of maternal nutrition on conceptus growth and offspring performance: Implications for beef cattle production. *Journal of Animal Science* **88**,

Haigh, LD, Moulton, CR, Trowbridge, PF (1920) Composition of the bovine at birth. *Univeristy of Missouri Agricultural Experiment Station* **Research Bulletin 38**,

Hammond, AC, Rumsey, DRWaTS (1990) Prediction of Body Composition in Holstein Steers Using Urea Space. *Journal of Dairy Science* **73**,

McBryde, K, Pilkington, R, Fordyce, G, Smith, D, Limburg, N (2013) Measuring milk yield in beef cattle. *Proceedings, Northern Beef Research Update Conference, 2013*

McCarthy, MM, Yasui, T, Ryan, CM, Mechor, GD, Overton, TR (2105) Performance of early-lactation dairy cows as affected by dietary starch and monensin supplementation. *Journal of Dairy Science* **98**, 3335-3350.

McGowan, M, McCosker, K, Fordyce, G, Smith, D, O'Rourke, P, Perkins, N, Barnes, T, Marquart, L, Morton, J, Newsome, T, Menzies, D, Burns, B, Jephcott, S (2014) Northern Australian beef fertility project: Cash Cow (Final Report).

Meyer, U, Everinghoff, M, Gädeken, D, Flachowsky, G (2004) Investigations on the water intake of lactating dairy cows. *Livestock Production Science* **90**, 117–121.

Totusek, R, Arnett, DW, Holland, GL, Whiteman, JV (1973) Relation of estimation method, sampling interval and milk composition to milk yield of beef cows and calf gain. *Journal of Animal Science* **37**, 153-158