Prediction of milk yield of 3-year-old Angus cows and the influence of maternal milk production on the postnatal growth of beef steers.

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Abstract

Maternal milk production influences calf weaning weight which is the major driver for economic return in a cow-calf operation. The objective of this study was to use measures of calf milk intake to estimate milk production of Angus (AA; n=43), Angus×Friesian (AF; n=32), Angus×Jersey (AJ; n=40) and Angus×Kiwi-Cross (AK; n=21) cows, and to determine how milk yield was related to calf growth rate (n=64) from birth to one year of age. Milk production was estimated by the weigh-suckle-weigh (WSW) technique at an average 32, 49, 80, 120 and 160 days (D) post-partum. Third-order Legendre polynomials were fitted to milk data using random regression to estimate the lactation curve for each cow. Live weight of all steers was recorded at birth and thereafter accompanying every WSW measurement. Post-weaning live weight was recorded at an average D240, D330 and D350 of age. Growth curves for each steer were estimated by fitting third-order Legendre polynomials to live weight data using random regression. The average total milk production from D32 to D160 was 1337 ± 22 kg for AF cows, 1245 ± 20 kg for AJ cows, 1301 ± 32 kg for AK cows and 1017 ± 20 kg for Angus cows. The AF, AJ and AK cows produced more ($P<0.05$) milk from D32 to D160 than the AA cows. The AF cows produced more ($P<0.05$) milk than AJ cows, with AK cows being intermediate and not differing ($P>0.05$) from either AF or AJ cows. Crossbred cows produced more milk ($P<0.05$) at all stages of lactation when compared with straightbred AA cows. In the present study, as the proportion of Friesian or Jersey in the crossbreds increased from 0 to 50%, an extra 325 kg and 240 kg of milk, respectively, was expected compared to the AA cows. Total energy intake from milk was higher ($P<0.05$) for the AF-, AJ- and AK-reared steers compared to those reared by AA dams. This resulted in higher liveweight gains so that steers reared by crossbred cows were heavier ($P<0.05$) from D60 to D270 than those reared by AA cows. Results also revealed that the higher live weight at D60 in AJ-reared steers compared to AA-reared steers was due to differences in milk consumption from D32 to D60. The higher live weight of AF- and AK-reared steers at D60 compared to AA-reared steers was attributed to a maternal effect on steer size; however, from D90 until weaning at D160, any differences in live weight were due to differences in milk consumption. Estimation of the theoretical pasture consumption revealed that AA- reared steers compensated for the lower milk intake by eating more grass, however, this was not enough to support high daily gains during the pre-weaning period. The differences in live weight seen at weaning between steers were maintained post-weaning until D270 and were

attributed to differences in milk consumption during the pre-weaning period. Under non-limiting nutrient availability, AF, AJ and AK cows were able to produce more milk and wean heavier calves compared to straightbred AA cows.

Key words: milk production, weaning weight, energy intake, pasture consumption

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Preamble

The relationship between maternal lactation performance and offspring postnatal growth is of great economic importance in animals that nurse their young, such as beef cattle. Milk production in beef cows is affected by several factors including: breed and age of the cow (Rutledge et al., 1971); the suckling capacity of the calf (Gifford, 1953); sex of the calf (Barton, 1970a, Barton, 1970b, Hickson et al., 2009b), parity (Johnson et al., 2002) and dam nutrition (Hickson et al., 2009a). Milk is the sole source of nutrients for a newborn in early postnatal life and remains a significant component of the diet until weaning, and accordingly is a major driver of calf liveweight gain from birth to weaning (Neville, 1962, Grings et al., 2007).

The assessment of the quantity of milk a beef cow is capable of producing throughout lactation is not a commonly performed practice in a cow-calf operation as it can be difficult, time-consuming and dangerous. For research purposes, various techniques have been developed which can be allocated into two categories: 1) estimation of milk yield by repeated measurements of a characteristic known to be related to milk yield (ie. calf's milk intake) and 2) direct measurement by extracting and weighing the milk produced by a cow at different time points of the lactation. Some of the most commonly used methods to estimate or measure milk yield in beef cows are: machine milking trained cows (Cole and Johansson, 1933), milking while the calf nurses (Gifford, 1953); the suckling method (Knapp and Black, 1941, Drewry et al., 1959, Neville, 1962); the use of oxytocin before machine milking (Anthony et al., 1959, Marston et al., 1992) and the use of isotope dilution or transfer techniques (Macfarlane et al., 1969, Yates et al., 1971, Auchtung et al., 2002, Holleman et al., 1975) .

Data generated by these methods are seldom easy to interpret and compare across studies. Difficulties arise when comparing milk yields using different methods and even modifications within the same method. Additionally, the diverse breeds, cow's live weight and feeding regimes across studies make comparisons challenging; and despite good experimental designs, there are also experimental factors that need to be considered such as interacting effects of stage of lactation, sampling errors and analytical procedures (Oftedal, 1984) and the diverse statistical models used to generate and explain lactation curves.

Calf weaning weight is a major driver of economic return in a cow-calf operation. Regardless of the technique used to measure milk yield, various authors (Gifford, 1953, Neville, 1962, Schwulst et al., 1966, Barton, 1970b) have concluded that milk yield influences calf weaning weights and have reported correlations to be in the range of 0.17 to 0.94. Barton (1970b) stated that the size of this correlation tends to be lower as lactation progresses, which indicates that older calves rely upon non-milk nutrient sources to maintain a desirable liveweight gain. Little is known about the influence of maternal lactational performance on the post-weaning growth of their progeny and consequently conflicting results have been reported in this area.

The first section of this review deals with the methods used to measure and estimate milk yield in beef cows, their general assumptions, inconsistencies and most commonly known sampling errors as well as their potential advantages. The purpose of this section was to determine the suitability of the various methods for experimental conditions such as those presented in New Zealand with grazing animals. Where possible, comparisons between methods were presented. A comparison of the expected milk yield of the various breeds and crossbreeds of cows used in this experiment was beyond the scope of this review. The second section of this review deals with the relationship between maternal milk production and postnatal growth of the offspring. Partial milk conversion efficiency and differences in calf growth relative to the maternal stage of lactation were also considered.