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Calf Note #165 – What drives growth?

Introduction

Calf raisers are in the business of growing calves. Our product is a living, healthy calf or heifer prepared to express its genetic potential for production of milk or muscle accretion. To accurately monitor their businesses, each calf raiser should establish specific goals for their calves at key points in the calf's lifecycle – weaning, breeding, etc. Unfortunately, many producers don't routinely measure and monitor growth or calculate what's driving the growth of their calves.

A recent article by Bateman et al. (2011) reported on what factors influenced body weight gain (calculated as average daily gain, **ADG**) in calves fed varying nutritional programs at the Nurture Research Center in Ohio.

The calves were used in several different trials to evaluate different feeding programs, so the amount, type and nutrient content of milk replacers and starters varied by experiment. The researchers also evaluated the effects of calf health, environmental temperature and the incoming body weight and serum total protein of the calf.

The data used to study ADG contained records from 993 calves that were two to three days old at the beginning of each trial. They monitored variables every day for eight weeks and conducted

sophisticated multiple regression analysis to determine important factors affecting growth over the entire eight weeks, or preweaning and postweaning periods.

How much did they grow?

Table 1. Regression coefficients for equations to predict average daily gain preweaning (ADG1), postweaning (ADG2), overall (ADG3), and gain : feed ratio.

Item	ADG1	ADG2	ADG3	G:F
Intercept	-3,201	-1,785	-2,618	0.365
Weaning age, d	-2.67	11.4		0.00236
Starter intake, g/d	0.496	0.460	0.430	0.000049
CMR intake, g/d	5.72	2.16	42.6	...
CMR protein, %	55.8	22.1	44.7	0.00352
CMR fat, %	114.1	75.6	96.5	...
Scour days	-2.64	...	-2.34	-0.00174
Avg. temp., °C	-5.17
Min. temp., °C	4.16
Temp, preweaning, °C	...	-6.99
Initial BW, kg	-5.93	...	-4.80	-0.00339
Starter x CMR	0.0159	0.0020	0.0120	...
CMR intake x CP	-0.0694	...	-0.0440	...
CMR intake x fat	-0.175	-0.144	-0.150	...
SI x CMR x CMR CP ¹	-0.00061	-0.00006	-0.00045	...
SI x CMR x CMR fat ²	-0.00080	...	-0.00057	...
SI x CMR x CP x fat ³	0.000031	...	0.000022	...

¹Starter intake x CMR intake x CMR protein %; ²Starter intake x CMR intake x CMR fat %; ³Starter intake x CMR intake x CMR protein % x CMR fat %.
From Bateman et al., 2011.

Calves arrived at the research facility weighing 42.9 kg (94.6 lbs). By the end of the 56-day experiments, they weighed at average of 77.3 kg (170 lbs), for an ADG of 0.615 kg/day for the experiment. The researchers also measured change in hip width and the calves grew 4.09 cm by the end of all the 56-day studies.

Calves had an average serum TP on arrival of 5.1 g/dl, with a range from 3.0 to 8.2 g/dl. This suggests that the average calf, while receiving some colostrum, had not achieved successful passive transfer (normally, this occurs at a TP concentration of 5.2 g/dl or greater).

What's important to growth

It should come as no surprise, but getting a calf to grow means feeding it correctly. The amount of milk replacer and calf starter offered were the two most important factors affecting ADG during the preweaning period and over the entire 56-day period. For the period after weaning, intake of starter was most important.

Other factors, such as the number of days the calves had scours, outside temperature (which increases maintenance requirement for maintaining body temperature) and initial body weight were all statistically important but not as important as starter intake, particularly after weaning.

Efficiency of growth

Since feed is the most important cost of rearing heifers from birth to calving, calculating the growth per kilogram of feed consumed as an excellent benchmark for whether rations are well formulated, presented and consumed. The Provimi researchers calculated feed efficiency (kilograms of body weight gain per kilogram of total feed consumed) for the entire 56-day period and reported that age at weaning, starter intake and milk protein crude protein improved feed efficiency, whereas increasing number of days with scours and increasing initial body weight impaired feed efficiency.

It's interesting (and may be helpful practically) to look at what influences feed efficiency. Increasing starter intake improved efficiency. From a metabolic standpoint, this is counter-intuitive, since dry feed is used less efficiently (lower digestibility and metabolizability) compared to milk replacer. However, in these studies, calves weren't fed CMR for ad libitum intake. Thus, calves would be expected to consume energy and protein from CMR first, then eat starter to meet energy requirements. So, increasing consumption of starter implied greater total nutrient intake and dilution of maintenance requirements. The end result was improved feed efficiency. Since this is the normal situation on most dairies, the more starter the calf consumes, the more efficient it will be.

Improved efficiency with increased protein from CMR is an interesting concept. The protein in CMR fed during the various studies ranged from 20% to 28% of dry matter, with an average of 24.9%. These data would suggest that as protein in CMR is increased from 20% to 28%, calves utilize feed more efficiently for increased growth. Milk replacer CP was also important in predicting preweaning ADG, total ADG and hip width increase.

Days that calves had scours reduced feed efficiency, as expected. Also, body weight of calves arriving at the farm reduced efficiency, probably because bigger calves have higher maintenance requirements.

Why not serum total protein?

The researchers reported that serum TP didn't affect the prediction of ADG prior to weaning, after weaning or over the entire eight week period. This observation differs from other reports in the scientific literature that suggest TP to be important to health, and, consequently, growth of calves. So, why wasn't it important in this study?

One possible explanation is that another variable – namely number of days that calves had scours – was important and included in the preweaning and overall models. This may be important in that we believe that growth is not simply a function of low TP *per se*, but TP predisposes calves to disease. The actual disease event (in the case of this study, diarrhea preweaning) is what affects ADG and not the simple fact that the calf has low TP. Many calves may have had low TP but did not become sick. Indeed, days with scours was an important variable in predicting growth prior to weaning and overall; however, TP was unimportant in any model tested.

Some others suggest that sickness post-weaning can affect ADG. The research center used is a well managed facility with excellent ventilation. Thus, the risk of post-weaning respiratory infections was lower in these calves compared to others housed in less well ventilated facilities.

Practical implications

This interesting study suggests some important take home messages. Firstly, when calves are fed an moderate amount of CMR (average of 610 grams/day of CMR and ranging from 430 to 1,009 grams/day), intake of calf starter was the most important single factor affecting calf growth to eight weeks of age. Starter intake also affected feed efficiency and change in hip width through eight weeks of age.

The importance of starter intake and management to growth reiterates the importance of managing starter to promote as aggressive starter intake as possible from an early an age as possible. Several factors are involved here – composition and quality of starter, availability of water, pellet quality, when starter is first made available to calves and how it is managed (how much is offered, when is it changed, maximum amounts offered, etc.).

It's the rare farm that intensively manages starter intake. Most producers simply put starter in front of their calves and assume calves will begin to eat it "when they are ready". There are many factors that can increase how much starter calves eat and how soon they begin to eat it. Most calf raisers can calculate the amount of milk or milk replacer consumed by their calves; however, few determine starter intake.

Another important implication is that intake of CMR and the formulation was important to growth over the first eight weeks of life, but not as important as starter intake. To reiterate, calves fed

moderate amounts of CMR don't consume enough ME or protein to support 100% of the gain the calf is capable of; therefore, starter intake will generally be more closely related to ADG.

Finally, serum TP may not always be closely related to ADG. Though TP is often related to susceptibility of disease (both scours and respiratory), there are differences between *susceptibility to disease* (i.e., low serum TP) and *incidence of disease*. On well managed herds, susceptible calves may not experience scours prior to weaning.

Summary

This research documents well the importance of proper feeding management – both liquid and dry – to drive growth. Intensively managing starter intake during the first eight weeks of life plays an essential role in growth, both in terms of body weight and height as well as feed efficiency.

References

Bateman II , H. G., T. M. Hill, J. M. Aldrich, R. L. Schlotterbeck, and J. L. Firkins. 2011. Meta-analysis of the effect of initial serum protein concentration and empirical prediction model for growth of neonatal Holstein calves through 8 weeks of age. J. Dairy Sci. 95 :363–369.

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