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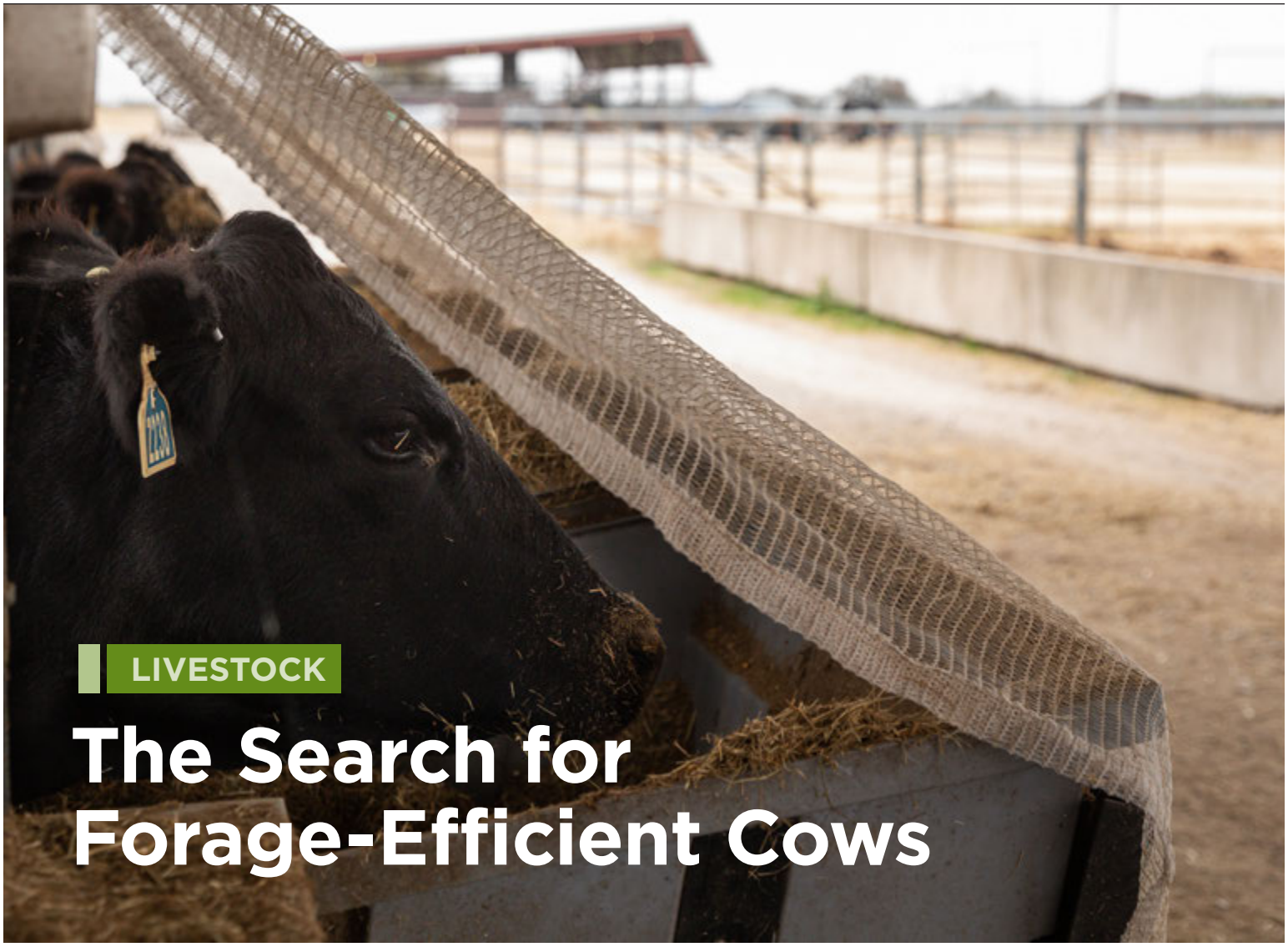
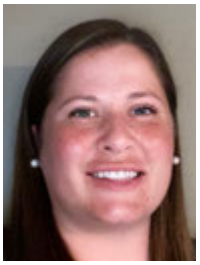
NOBLE NEWS & VIEWS



LIVESTOCK

The Search for Forage-Efficient Cows



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For many years, selection for improved beef production centered on heavier weaning weights and rapid post-weaning gain. Recently, measurement of post-weaning feed intake has facilitated direct improvement in feed efficiency, resulting in animals with a lower feed-to-gain ratio.

The biological mechanisms that control feed intake (the amount consumed by an animal in one day) are highly complex and remain poorly defined. Nevertheless, most scientists agree that intake of low-quality forage is driven primarily by rumen capacity, whereas intake of high-quality, grain-based diets is driven by chemostatic (hormonal) mechanisms. These fundamental differences suggest that the genes controlling intake in forage diets might be different than the genes controlling intake in concentrate-based diets. The question remains whether a growing animal that efficiently converts calories from a high-quality, grain-based ration to weight gain is also an efficient forage utilizer as a mature animal.

WHAT WE DID

Researchers at Noble Research Institute and Oklahoma State University set out to determine if intake and performance of cows are similar when fed a high-quality diet (grain + hay) versus a low-quality diet (grass hay) during two different feeding periods.

Story continues on next page

This is an important question, because approximately 70% of the feed energy used in beef production is consumed by the cow herd (Gregory, 1972). Furthermore, beef cows spend approximately 60 to 75% of the year consuming moderate to low-quality forage.

During the fall of 2019, 48 non-lactating pregnant Angus-cross cows were divided into four pens of 12 cows each based on age and body weight. The GrowSafe® feed intake system (technology used to measure individual animal voluntary intake) was used in each of the four pens with four feed intake units per pen to evaluate dry matter intake and ranking of animals on two different diets. Two pens were initially assigned to a hay diet with 100% grass hay (10% protein, 55% total digestible nutrients (TDN)) and the other two pens were initially assigned to a grain + hay diet with 43% grass hay, 57% concentrate (11.7% protein, 67% TDN). The concentrate was made up of 23% cracked corn, 24% soybean hull pellet and 10% liquid molasses.

At the beginning of the study, cows were adapted to their assigned diet for 14 days. Following adaptation, feed intake was measured for 45 days. On day 60, diets were switched so that each pen received the opposite diet from the previous period. Cows were then adapted to their new diet for 14 days followed by 45 days of feed intake measurement.

PRELIMINARY RESULTS

In our study, we found that on a dry matter basis, cows consumed approximately 1.8% of their body weight daily on the hay diet and approximately 2.3% of their body weight on the grain + hay diet. However, there was tremendous variation in feed intake. For example, minimum and maximum hay diet intake was 1.1 and 2.6% of body weight, respectively. Similarly, minimum and maximum grain + hay diet intake was 1.5 and 3.3% of body weight, respectively.

Under these conditions, average daily consumption of the grain + hay diet was highly correlated to average daily consumption of the hay diet. This suggests that, on average, cows with a big appetite consume a lot of feed regardless of diet quality or source of calories (grain versus forage). However, there was a modest negative correlation between body weight gains among the two diets. This data suggest that cattle consuming a moderate-quality forage diet do not perform at the same rate (positively or negatively) as cattle consuming a higher-quality diet.

In Table 1, cows A and B are both 6 years old and are similar in body weight, with cow B consuming more from both diets than cow A. However, feed-to-gain conversion told us a different story. Feed-to gain-conversion is how many pounds of feed/hay it takes to make 1 pound of body weight gain. Cow A gained weight easier on hay, requiring approximately 15 pounds of hay for every 1 pound of weight gain; whereas, she needed 44 pounds of the grain + hay diet to achieve 1 pound of gain. In comparison, Cow B gained weight relatively easily on the grain + hay diet, needing less than 11 pounds for each pound of gain, but she needed almost 45 pounds of hay per 1 pound of gain.

Table 1. Dry matter intake (DMI) and feed:gain ratio (F:G) from two cows consuming a moderate-quality hay-only diet and a higher-quality grain+hay diet during two 60-day feeding periods.

(Cow), Tag #	Age, years	Average Study Body Weight, lbs	Hay Diet DMI (lbs/ day)	Hay Diet F:G (lb:lb)	Grain + Hay Diet DMI (lbs/ day)	Grain + Hay Diet F:G (lb:lb)
(A) A324	6	1,500	28.1	14.8	36.0	44.1
(B) A337	6	1,425	38.6	44.5	44.5	10.8

Table 2. Dry matter intake (DMI) and average daily gain (ADG) from two cows consuming a moderate-quality hay-only diet and a higher-quality grain+hay diet during two 60-day feeding periods.

(Cow), Tag #	Age, years	Average Study Body Weight, lbs	Hay Diet DMI (lbs/ day)	Hay Diet ADG (lb:lb)	Grain + Hay Diet DMI (lbs/day)	Grain + Hay Diet ADG (lb:lb)
(C) Z238	7	1,750	28.9	1.0	31.1	1.8
(D) Z241	7	1,740	40.5	0.3	52.0	4.2

In Table 2, cows C and D exemplify the difference in average daily gain (ADG) in this study. Both cows are the same age with similar body weight; however, cow D had a greater intake on both diets and gained poorly on the hay diet while gaining 4.2 pounds per day on grain + hay diet. Cow C was more efficient on the hay diet than cow D, gaining more body weight while consuming 12 pounds per day less, but was less efficient on the grain + hay diet.

WHAT'S NEXT

Genetic markers for feed intake and feed efficiency to date have been developed using growing animals consuming a high-quality diet. Therefore, a second objective in this study is to determine if genes known to control high-quality feed intake show differential expression depending on the type of diet the cows were consuming. To answer this question, muscle tissue samples were collected at the beginning, midpoint and end of the study. Ribonucleic acid (RNA) will be extracted from these tissue samples to determine if gene expression is similar or substantially different depending on the diet.

SUMMARY

Thus far, results from this study and a handful of other studies indicate that ranking for feed intake may be similar regardless of diet quality or type. Data from this study also shows us that there are big differences in intake, performance and efficiency between animals of the same weight class that we cannot detect through phenotype alone. This suggests that current selection tools, such as genomic testing and expected progeny differences (EPDS), for feed intake should be useful in selecting low-intake replacement females for forage-based production systems. However, using these tools to select for low intake and above average daily gains may have negative implications when selecting replacement heifers to be efficient cows on forage.

Reference

Gregory, K. E. 1972. Beef cattle type for maximum efficiency "Pulling it all together." J. Anim. Sci. 34: 881