Agriculture

EXTENSION UtahStateUniversity

extension.usu.edu

July 2015 AG/Beef/2015-01pr

On-Ranch Application of DNA Technology

Kevin Heaton and ***Katelyn Christensen***

Introduction

Ranchers look forward to improving herd genetics each fall as they select replacement heifers. The decision to keep or cull affects the long-term economic and genetic progress of the ranch. Often culling decisions are based off visual appearance or other parameters which may inherently have individual rancher bias. With recent advancements in genetics, analysis, ranchers can now test for specific economic important traits which will increase the genetic progress and improve the economic sustainability of their ranches over time. DNA markers are now correlated with the following traits: residual feed intake, average daily gain, tenderness, percent grading choice, yield grade, fat thickness, rib eye area, heifer pregnancy rate, stayability, maternal calving ease and docility.

Improving genetics is one area that successful high profit producers spend as much or more money on than other producers (Feuz and Feuz, 2012). Although investing in genetics offers producers the ability to improve their herds and increase profitability, single trait selection is risky and can produce undesirable consequences as most economically significant traits are influenced by multiple genes.

While the results of DNA testing are very helpful in improving genetics of livestock, some traits are more heritable than others. Producers should understand heritability of the different traits as they use genetics to make improvements (Table 1. Cushman & Perry, 2012; Barton et al., 2011).

Desired production parameters are often influenced by many genes; therefore ranchers should use DNA test results with discretion and understand that they are not 100% accurate. As the heritability decreases, generally the environmental effects increase.

Table 1. Estimated heritability of genetically important traits in cattle.

Selected Trait	Heritability percentage
Fat Thickness	45%
Yield Grade	35%
Tenderness	25%
Heifer Pregnancy Rate	20%
Stayability	15%
Calving Ease	15%

On Ranch Demonstration

Several ranchers in southern Utah participated in a demonstration project highlighting techniques in DNA collection and analysis. Due to the small scale of some ranches and the fact that they ran in common with other participating ranchers, the results of the commingling ranchers were grouped together as one ranch. Ranchers were taught how to correctly sample DNA and how to interpret the results.

Collect DNA Samples

DNA collection requires either a blood, tissue, or hair sample. One of the easiest methods to collect DNA is collecting tail hair. Hair samples of 20-30 hairs were pulled from the tail switch and placed in labeled, self-adhesive envelopes (Figures 1 & 2). Hair bulbs must be intact, as they contain the genetic material to be tested. Genetic profiling tests were sent to a Neogen Company called Igenity. The cost of the DNA profile analysis was $38 per head.

Figure 1: Pulling a hair sample.

Figure 2: Hair collection envelopes.

Discussion of Results

Genetic profiling allows the producer to identify animals which are superior in economically important traits including average daily gain, feed intake, marbling, tenderness, pregnancy rate, calving ease, and docility. Selection for carcass traits, such as palatability and yield, benefit the most from DNA selection, because individual analysis is so costly and difficult to obtain (Table 2) (Barton, et al., 2011).

Igenity uses a pro-rated production index to rate beef cattle and cattle are weighted on a simple 1-10 scale, 1 being the worst and 10 being the best. The following are the traits and their weighted influence on the index: residual feed intake 15%, average daily gain 15%, tenderness 10%, percent choice 20%, stayability 30%, and maternal calving ease 10%. Notice in Table 2 that Ranch 4 has the lowest production index and also the highest production index suggesting a great opportunity for culling low producing livestock. In addition, this index provides a way for producers to compare the quality of their livestock with neighboring ranches. Furthermore, every set of cattle has genetically inferior and genetically superior cattle for each trait analyzed, which offers opportunity for improvement.

Graph1 shows the individual DNA result for residual feed intake (RFI). RFI predicts how individual cows will utilize its feed resources. Low RFI values indicate that an animal will gain more on the same amount of feed or will utilize less feed and gain the same amount as an animal with a higher score. Note that Ranch 6 has a few individuals who are extremely efficient (RFI = 1) and some individuals who are inefficient (RFI = 10). In comparing individuals with a RFI of 1 to a RFI of 10, the RFI 1 would eat 4.2 lbs of feed less per day compared to a RFI 10 (Igenity Results Key, 2015). Selection for efficient animals would be a huge advantage for producers since feed costs represent the most significant cost of maintaining a cow herd.

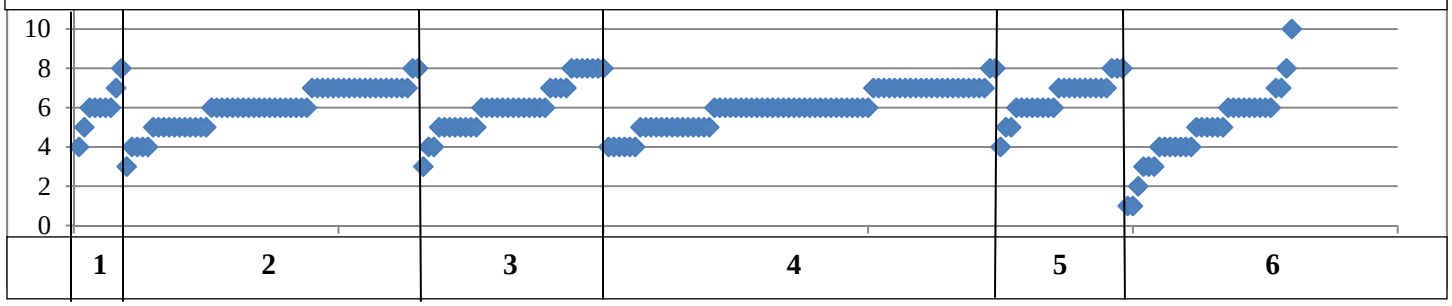
Comparing RFI across ranches, overall there are more individuals cows with RFIs above five than below, suggesting that ranchers should put more emphasis on selecting for efficient livestock. Since none of the participating ranchers have the ability to measure intake and production output on each cow, DNA analysis maybe the only way to achieve improvement in RFI.

Graph 2 shows the individual DNA results for marbling/% choice for the six ranches. Marbling/% choice give a numerical value which indicates the likelihood of improved marbling, 1 = less marbling and 10 = higher marbling. Most ranches had above average scores for marbling which indicate that participating ranchers are producing acceptable beef products and they have room for improvement.

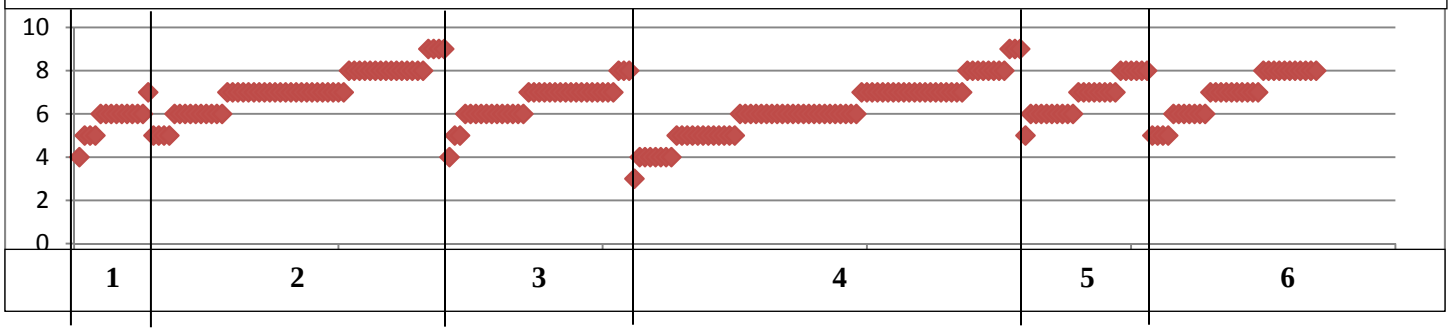
Table 2. The range of economically important traits on six ranches in southern Utah.

Ranch	Ranch 1	Ranch 2	Ranch 3	Ranch 4	Ranch 5	Ranch 6
# Cows	14	56	35	74	24	32
Igenity Production Index	4.40 – 5.30	5.15 – 6.95	5.05 – 7.00	4.35 – 7.75	4.55 – 6.75	4.95 – 7.10
Residual Feed Intake	4 – 8	3 – 8	3 – 8	4 – 8	4 – 8	1 – 10
Average Daily Gain	2 – 7	4 – 7	3 – 8	1 – 8	4 – 7	4 – 8
Tenderness	3 – 7	1 – 9	3 – 10	1 – 10	1 – 10	3 – 10
Marbling/Percent Choice	4 – 7	5 – 9	4 – 8	3 – 9	5 – 8	5 – 8
Yield Grade	4 – 6	4 – 9	3 – 10	4 – 9	4 – 9	4 – 8
Fat Thickness	3 – 6	3 – 8	3 – 9	4 – 7	4 – 7	4 – 7
Rib Eye Area	3 – 7	2 – 7	3 – 7	2 – 7	2 – 5	3 – 8
Heifer Pregnancy Rate	3 – 8	4 – 8	4 – 8	3 – 9	3 – 7	5 – 8
Stayability	4 – 8	5 – 9	5 – 8	4 – 9	3 – 9	5 – 9
Maternal Calving Ease	4 – 7	3 – 7	3 – 6	3 – 9	3 – 7	3 – 7
Docility	5 – 8	3 – 8	4 – 7	4 – 9	3 – 9	4 – 8

Graph 1: Residual feed intake on six ranches in southern Utah. (1= more efficient, 10=less efficient).



Graph 2: Marbling/Percent Choice on six ranches in southern Utah. (1=lower marbling, 10=higher marbling).



Summary

Genetic analysis provides producers with another tool to identify individuals in a herd which have the greatest potential to be most productive or least productive, thus improving ranch sustainability. This project demonstrated that on each ranch there were both genetically inferior and superior livestock for the production traits analyzed. Participating ranchers are using the results to select replacements and are cautioned to avoid single trait selection. This project also created a baseline for genetic quality which individual ranches could compare with future DNA test results.

References

Barton, L.R., Rood, K.A., and Rickords, L.F. (2011). Benefits of DNA-based technology in beef production. Utah State University Extension. AG/Agribusiness/2011-03. Logan, Utah. http://extension.usu.edu/files/publications/publication/AG_Agribusiness_2011-03.pdf

Cushman, R.A., & Perry, G.A. (2012). What we know about the genetics of reproduction. Applied Reproductive Strategies in Beef Cattle, Proceedings. Sioux Falls, South Dakota.

Feuz, B., & Feuz, D. (2012). Investing in genetics. Utah State University Extension. AG/Agribusiness/2012-01. Logan, Utah. http://extension.usu.edu/files/publications/publication/AG_Agribusiness_2012-01.pdf

Igenity® Results Key for Beef. (2015). www.igenity.com

No endorsement of products mentioned is intended nor is criticism implied of products not mentioned.

Utah State University is committed to providing an environment free from harassment and other forms of illegal discrimination based on race, color, religion, sex, national origin, age (40 and older), disability, and veteran's status.

USU's policy also prohibits discrimination on the basis of sexual orientation in employment and academic related practices and decisions. Utah State University employees and students cannot, because of race, color, religion, sex, national origin, age, disability, or veteran's status, refuse to hire; discharge; promote; demote; terminate; discriminate in compensation; or discriminate regarding terms, privileges, or conditions of employment, against any person otherwise qualified. Employees and students also cannot discriminate in the classroom, residence halls, or in on/off campus, USU-sponsored events and activities.

This publication is issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Kenneth L. White, Vice President for Extension and Agriculture, Utah State University.