2012

Comparing Pfizer GeneSTAR and Igenity PROFILE DNA tests in Crossbred Cattle

M.G. Gonda
South Dakota State University

G.A. Perry
South Dakota State University

B.P. Holland
South Dakota State University

C.L. Wright
South Dakota School of Mines and Technology

BEEF 2012-05

Comparing Pfizer GeneSTAR and Igenity PROFILE DNA tests in crossbred cattle[1]

M. G. Gonda, G. A. Perry, B. P. Holland, and C. L. Wright

Animal Science Department, South Dakota State University, Brookings, SD

SUMMARY

Our objective was to compare the performance of Pfizer's GeneSTAR and Igenity's PROFILE DNA tests in crossbred beef cattle. Hair follicles were collected from 394 crossbred steers that were part of the South Dakota State University Calf Value Discovery project (n = 145) and calves that were fed at the SDSU Southeast Research Farm (n = 249) in 2011. Hair follicles were sent to Pfizer Animal Genetics and Igenity for testing with their GeneSTAR and PROFILE DNA tests, respectively. Marbling score (100-999 scale), ribeye area, fat thickness, carcass weight, yield grade, quality grade, and % kidney, pelvic, and heart fat was collected post-harvest on all steers. Using this dataset, we first asked whether each DNA test was associated with marbling scores. If the DNA tests were not associated with marbling, then the tests may not be useful for predicting genetic merit for marbling in crossbred cattle. The GeneSTAR and PROFILE DNA tests were associated with marbling scores, but this association was not high. Second, we asked whether GeneSTAR and PROFILE DNA test results were associated with each other. If test results were not correlated, then using both DNA test results together may improve genetic predictions. GeneSTAR and PROFILE tests for tenderness were highly correlated, suggesting that DNA markers for tenderness are similar for both tests. GeneSTAR and PROFILE DNA tests for marbling and feed efficiency were not highly correlated, raising the possibility that both tests could be used jointly to improve genetic predictions for these traits. However, using both GeneSTAR and PROFILE DNA tests jointly did not appreciably improve predictions for marbling score in our dataset. We conclude that, although both GeneSTAR and PROFILE DNA tests were associated with marbling score, the correlation between these tests and marbling was low in our sample of crossbred cattle. Further, using GeneSTAR and PROFILE DNA tests for marbling and feed efficiency may improve genetic predictions for these traits, but we did not find evidence that using both tests jointly improves predictions for marbling.

INTRODUCTION

Genomic tests have the potential to allow producers to more accurately predict genetic merit for their cattle. More accurate genetic predictions will improve response to selection and allow producers to manage their cattle more effectively. Several DNA tests are available to beef producers, but most of these tests are specific to only a single breed (e.g., Angus). However, two commercially available DNA tests are marketed to producers raising cattle of any breed type and composition.

GeneSTAR is one of these DNA tests. GeneSTAR is marketed by Pfizer Animal Genetics and predicts genetic merit for three traits: marbling, feed efficiency, and tenderness. The DNA test results are reported to producers as "Most Valuable Predictions" (MVP). Lower MVP for feed efficiency and tenderness and higher MVP for marbling are more desirable. Along with the MVP, the % ranking of the individual relative to all other animals in the Pfizer GeneSTAR database is reported.

The second commercially available DNA test for cattle of all breed types is Igenity's PROFILE test. Igenity's PROFILE predicts genetic merit for more traits than GeneSTAR: residual feed intake, ADG, marbling, % choice, yield grade, fat thickness, heifer pregnancy rate, stayability, maternal calving ease, and docility. Unlike GeneSTAR, PROFILE reports DNA test results to producers as a categorical 1-10 score. A score of 1 is most favorable for residual feed intake and yield grade, while a score of 10 is most favorable for all other traits.

Although both tests have been evaluated independently, GeneSTAR and PROFILE test results have not been compared to each other in the same sample of animals. Presently, producers have little to no information on whether GeneSTAR or PROFILE should be used in their herds. Further, genetic predictions may be improved by using both DNA tests jointly if correlations between GeneSTAR and PROFILE tests for the same trait are low. Our objectives were as follows:

1) Test whether Pfizer's GeneSTAR and Igenity's PROFILE DNA tests were associated with marbling score in a sample of crossbred beef cattle.

2) Estimate the correlation between the GeneSTAR and PROFILE DNA test results. If the correlation between GeneSTAR and PROFILE Marbling tests is low, test whether using both tests jointly improves genetic predictions for marbling.

MATERIALS AND METHODS

Animal and Trait Data

Crossbred steers were sampled from the 2011 South Dakota State University (SDSU) Calf Value Discovery (CVD) project (n = 145) and the SDSU Southeast Research Farm (n = 249). For the 2011 CVD project, 9 producers enrolled steer calves. Calves were finished at a commercial feedlot (Vander Wal Yards, Bruce, SD) for 211 or 231 days prior to slaughter. Carcass data from these steers was collected in June 2011. Carcass data collected includes ribeye area, marbling (100-999 scale), fat thickness, HCW, dressing %, USDA yield and quality grade, and % kidney, pelvic, and heart fat (% KPH).

Crossbred steers sampled from the SDSU Southeast Research Farm were either purchased at an auction barn (n = 178) or raised at the SDSU Cottonwood Research Station (n = 71). At the SDSU Southeast Research Farm, carcass data was collected in June and August 2011. Carcass data collected includes HCW, USDA yield and quality grade, ribeye area, marbling (100-999 scale), fat thickness, and % KPH.

DNA Sample Collection

Hair follicles were removed from the tail switch of steers by hand and placed into hair follicle sample collectors following the instructions of the two DNA testing companies. Hair follicle samples from each steer were sent to Pfizer and Igenity for DNA testing. Pfizer and Igenity extracted the DNA from hair follicles and tested DNA with their GeneSTAR (Pfizer) and PROFILE (Igenity) marker panels. The DNA test results were subsequently returned to the investigators.

Data Analysis: Effect of DNA tests on marbling scores

The effects of each DNA test on marbling score were estimated with a linear model. Marbling score was the dependent variable and the independent variables were marbling DNA test score (MVP for

GeneSTAR and 1-10 categorical scores for PROFILE), herd (CVD or Southeast Research Farm), and HCW. All independent variables were fixed effects except for HCW, which was modeled as a covariate. Steers at the Southeast Research Farm were concurrently part of an externally funded nutrition study. The nutrition study did not affect carcass performance and thus nutritional treatment was not included in our model.

The effect of the PROFILE DNA test scores for ribeye area, fat thickness, and USDA yield and quality grade were also estimated on their respective traits with the same linear model as described above. The GeneSTAR DNA test does not estimate genetic merit for these traits, so only the PROFILE DNA test was evaluated. All statistical analyses were completed in JMP v 8.0 software (SAS, Cary, NC). A *P* value less than 0.05 was considered to be statistically significant.

Data Analysis: Correlation between GeneSTAR and PROFILE DNA tests

For comparing GeneSTAR and PROFILE DNA test results, Pearson correlation coefficients were estimated between all pairs of DNA test scores. Because the correlation coefficient between marbling GeneSTAR and PROFILE DNA test scores was low, we included both marbling GeneSTAR and PROFILE test scores in our linear model described above for the statistical analysis for objective 1. As for objective 1, correlation coefficients were estimated with JMP v 8.0 software.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1. Description of carcass traits in our study population.

Carcass trait	Sample mean	SD	Minimum	Maximum
HCW, lbs. (n = 391)	756.8	71.44	424.9	954.6
Dressing % (n = 145)	62.9	2.42	45.0	67.0
Ribeye area, in^2 (n = 390)	11.86	1.047	9.57	15.01
Backfat, in (n = 390)	0.51	0.150	0.10	1.00
% KPH[1] (n = 390)	2.06	0.207	1.52	2.65
Yield grade, 1-5 (n = 391)	2.88	0.697	1.00	4.00
Marbling, 100-999 (n = 390)	483	90.4	250	755

[1] % Kidney, pelvic, and heart fat

Table 2. Description of Pfizer GeneSTAR MVP results (n = 389).

GeneSTAR MVP[1]	Sample mean	SD	Minimum	Maximum
Feed Efficiency	-0.175	0.725	-2.14	1.52
Marbling	-0.008	0.187	-0.66	0.51
Tenderness	-0.011	0.305	-0.87	1.21

[1] Pfizer Animal Genetics, Kalamazoo, MI

Table 3. Description of Igenity PROFILE test results.

PROFILE score[1]	Sample mean	SD	Minimum	Maximum
Residual feed intake (n = 388)	6.41	1.17	3	9
ADG (n = 389)	5.85	1.04	2	9
Tenderness (n = 377)	6.29	1.95	1	10
Marbling (n = 389)	6.65	1.11	4	10
% Choice (n = 389)	6.65	1.11	4	10
Yield grade (n = 389)	6.26	1.05	3	9
Backfat (n = 389)	5.56	0.99	3	8
Ribeye area (n = 388)	4.74	0.96	2	8
Heifer pregnancy rate (n = 388)	5.50	1.13	2	8
Stayability (n = 388)	6.55	1.11	3	10
Maternal calving ease (n = 389)	5.03	1.03	1	8
Docility (n = 388)	6.08	0.99	2	9

[1] Neogen Corporation, Lansing, MI

Objective 1 Results

The Pfizer GeneSTAR marbling MVP and Igenity marbling PROFILE were significantly associated with marbling score ($P < 0.05$). A 100-unit change in marbling score resulted in a 1.7-unit change in GeneSTAR MVPs and a 5.56-unit change in PROFILE score. The amount of variation in marbling score explained by the GeneSTAR marbling and PROFILE tests was 0.01 and 0.049 respectively. The PROFILE test scores for yield grade and fat thickness were significantly associated with their respective phenotypes ($P < 0.05$). The PROFILE score for ribeye area, however, was not significantly associated with actual ribeye areas ($P = 0.38$).

Objective 2 Results

Pearson correlation coefficients were estimated for all pairs of DNA test results (Table 4). Most of the correlation coefficients were low ($r < 0.20$). The highest correlation coefficients were usually between DNA tests for carcass traits. The correlation between the tenderness GeneSTAR and PROFILE DNA panels was -0.62. This coefficient is negative because of the definitions of the DNA test scores: larger values are more favorable for the tenderness PROFILE and smaller values are more favorable for the tenderness GeneSTAR MVP. Correlation coefficients between feed efficiency and marbling GeneSTAR MVP and PROFILE scores were lower. The correlation coefficient between feed efficiency MVP and PROFILE scores was 0.14 and the correlation coefficient between marbling MVP and PROFILE scores was 0.13.

Because correlation estimates were low between DNA test results for marbling, we tested whether using marbling DNA test scores jointly could improve predictions for marbling score. Including both DNA tests in our model for marbling score did not appreciably improve marbling score predictions. Both marbling DNA tests accounted for only 5.4% of the variation in marbling score. We could not repeat the same analysis for feed efficiency because individual feed efficiency data was not available.

Within DNA panels, the highest correlation was between marbling and % choice PROFILE scores. The correlation coefficient was 1.0 between these DNA panels. Thus, both panels include the same DNA markers, which makes sense because % choice is only determined by marbling and maturity. Maturity is

not a genetically determined trait. The correlation between fat thickness and yield grade PROFILE scores was also high (r = 0.66), suggesting both panels harbor similar DNA markers.

Interpretation of Results

In our sample, both DNA panels were statistically associated with marbling score; however, the effect sizes were small. These results are similar to what is reported by the companies offering these genetic tests. Why were the effect sizes so small? Many non-genetic factors affect marbling and other carcass traits in cattle. For example, the CVD project animals were taken from 9 cow-calf producers which each raised and fed their cattle differently during the pre-weaning phase. These environmental differences between calves before entering the feedlot would have affected marbling and other carcass traits. Additionally, each of these genetic tests only include a small number of genes that affect marbling score. Many genes that affect marbling have not yet been identified and thus could not be included in the DNA tests.

The GeneSTAR and PROFILE tenderness tests were highly correlated, suggesting that each company is using similar genes to estimate genetic merit for tenderness. This result is not surprising because several genes with large effects on tenderness have been discovered (e.g., calpastatin and u-calpain). Genetic testing has the potential to increase the accuracy of our genetic predictions for a large number of traits. However, genetic selection is only one of several tools available to beef producers for improving carcass characteristics. Environmental effects (e.g., nutrition, management) also affect carcass traits. Additionally, genetic tests available to crossbred commercial beef cattle only include a fraction of the total number of genes that affect economically important traits. As the technology improves, these tests should become better predictors of genetic merit for commercial producers.

Table 4. Pearson correlation coefficients[1,2] between DNA score panels[3]

	Pfizer GeneSTAR			Igenity PROFILE											
	FE^{MVP}	$Marb^{MVP}$	$Tend^{MVP}$	RFI	ADG	Tend	Marb	% Ch	YG	Fat	REA	HP	Stay	MCE	Doc
FE^{MVP}	----	0.218	-0.039	0.137	0.229	0.001	0.130	0.130	0.065	0.100	-0.102	-0.061	0.016	0.063	0.010
$Marb^{MVP}$		----	0.029	0.016	0.191	-0.057	0.129	0.129	0.157	0.139	-0.008	-0.015	0.023	0.014	-0.016
$Tend^{MVP}$			----	-0.175	-0.120	-0.619	-0.080	-0.080	-0.058	-0.029	-0.073	-0.003	-0.095	0.083	-0.081
RFI				----	0.310	0.177	0.172	0.172	0.273	0.248	-0.055	-0.214	0.077	-0.120	0.125
ADG					----	0.190	0.384	0.384	0.336	0.269	-0.200	0.027	-0.014	-0.106	0.124
Tend						----	0.039	0.039	0.179	0.064	-0.026	0.203	0.086	-0.126	0.089
Marb							----	1.000	0.329	0.328	-0.090	-0.006	0.077	-0.088	0.108
% Ch								----	0.329	0.328	-0.090	-0.006	0.077	-0.088	0.108
YG									----	0.662	-0.150	0.107	-0.036	-0.207	0.118
Fat										----	-0.090	-0.109	-0.180	-0.232	0.087
REA											----	0.068	0.053	-0.005	0.116
HP												----	0.097	0.079	0.099
Stay													----	-0.061	-0.039
MCE														----	0.043
Doc															----

[1] Off-diagonals represent the correlation coefficient between two different DNA panels. For example, r = 0.218 is the correlation between the GeneSTAR marbling Most Valuable Prediction (MVP) and GeneSTAR feed efficiency MVP.

[2] 95% confidence intervals for correlation coefficients ranged from 0.11 to 0.20.

[3] FE = Feed efficiency; Marb = Marbling; Tend = Tenderness; RFI = Residual feed intake; % Ch = % Choice; YG = Yield grade; Fat = Fat thickness; REA = Ribeye area; HP = Heifer pregnancy rate; Stay = Stayability; MCE = Maternal calving ease; Doc = Docility; MVP = Most valuable prediction