



FREQUENTLY ASKED QUESTIONS

March 2009

GeneSTAR Molecular Value Predictions for beef feed efficiency¹, marbling² and tenderness

1. What is GeneSTAR?

GeneSTAR[®] is the Pfizer Animal Genetics DNA testing platform that currently includes three core management traits in beef cattle.

2. What is the history of GeneSTAR?

GeneSTAR was introduced in 2000 as a single-marker test associated with an important gene for marbling. This was followed by an additional three markers for marbling, three markers for tenderness and four markers for feed efficiency. This resulted in a GeneSTAR product which contained four markers each for feed efficiency and marbling, and three markers for tenderness. Today the GeneSTAR product consists of Molecular Value Predictions (MVPs[™]) for feed efficiency, marbling and tenderness. The current DNA-testing platform is based on a panel of 56 DNA markers. It is expected that GeneSTAR MVPs will continue to evolve with more markers added to the panel and prediction for a wider range of traits.

3. What traits are evaluated with the new GeneSTAR MVP platform?

The GeneSTAR platform currently produces Molecular Value Predictions (MVPs) for the traits of feed efficiency, marbling and tenderness. Feed efficiency is predicted on the basis of net feed intake, which measures how much feed an animal actually consumes per day as compared to what is predicted to be the required feed

intake of the animal (also referred to as residual feed intake or net feed efficiency). Animals having a lower net feed intake are more feed efficient. Marbling is a visual assessment of the degree of intramuscular fatness in the *longissimus dorsi* (ribeye) muscle and is a predictor of overall eating quality. Tenderness is predicted on the basis of the peak force required to shear cooked steak after 14 days of postmortem aging.

4. How many DNA markers are included in the evaluation of these traits?

A panel of 56 DNA markers is used in the current GeneSTAR Molecular Value Predictions.

5. How were these markers identified for inclusion in GeneSTAR MVPs?

DNA markers included in the GeneSTAR MVPs were identified in a number of research projects over time. All markers were shown to exhibit statistical significance in their effect upon one or more of the traits evaluated. Markers originated from both public domain and internal Pfizer Animal Genetics research and development programs.

6. Do all of the markers have equal effects and do they affect all three traits?

All markers in the panel are used in the prediction of all traits, although the effect of each marker varies from trait to trait.



7. What is the result of GeneSTAR testing?

A single Molecular Value Prediction (MVP) is calculated for each animal for each trait. The MVP is based on the genotypes observed for the 56-marker panel.

8. How is the GeneSTAR MVP calculated?

The MVP for a trait is predicted from the overall sum of the allelic effects in the animal's genotype for the 56-marker panel for that specific trait. Each of the allelic effects is conservatively estimated in a manner that protects from false positive results. A corresponding reliability value is also calculated based on the frequencies of the markers in the population and the GeneSTAR MVP percentage of genetic variation explained by the overall marker panel.

9. How is the GeneSTAR MVP expressed?

The MVP is expressed in units of the trait deviated +/- from zero (which is defined as the average over all cattle for the trait).

10. What is the GeneSTAR MVP reliability value?

Reliability value is the standard for assessing the accuracy and predictive power of the MVP for a trait. Reliability is based on the correlation between the MVP and the animal's genetic breeding value if all information were known.

The reliability value is expressed as a percentage of the maximum accuracy attainable and is a useful indication of how much additional information may be added in the future as greater numbers of markers are added to the panels used to calculate the MVP.

11. Why is the GeneStar MVP reliability important?

The rate of genetic improvement is affected by three criteria:

- accuracy of breeding value prediction (i.e., reliability)
- intensity of selection
- generation interval

The greatest opportunities lie in improving reliability and selection intensity.

12. Can I determine how the GeneSTAR MVP for an animal ranks in its breed population?

Each animal is benchmarked against breed contemporaries through the reporting of the overall breed average MVPs, as well as individual animal MVP percentile rank.

For example, a 10% rank indicates the individual lies within the top 10 percent of animals within the breed. A 20% rank indicates the individual lies within the top 20 percent. Note that a 90% rank indicates the individual lies within the bottom 10 percent of animals within the breed.

13. How accurate are the GeneSTAR MVP breed averages and percentile ranks?

Breed averages and percentile ranks are calculated based on all animals in our database. A minimum of 500 animal records with genotypes must be present in the database before breed averages are reported.

Stars to MVPs

- 1. I thought that GeneSTAR results were reported as a number of stars, but my results are now GeneSTAR Molecular Value Predictions (MVPs). What is the difference and why was this changed?**

GeneSTAR results were previously reported as a number of stars based on the total number of favorable alleles affecting the trait. A maximum number of eight stars per trait existed in that system. GeneSTAR MVPs are based on many more markers, which do not necessarily have equal effects, and may affect more than one trait simultaneously. When moving to a larger number of markers, the more appropriate method to capture the greatest value from DNA testing is to move to an MVP format. GeneSTAR MVPs are produced for each trait to appropriately account for the sum total of the marker effects on that trait.

- 2. Do I need to resubmit new samples for animals I have previously tested under the star system to make use of the new platform?**

Pfizer Animal Genetics maintains an archive of previously tested animals. Upon request, we are able to retest these animals for the GeneSTAR MVP platform.

- 3. Does the GeneSTAR MVP include information on all of the previous II DNA markers in the star system?**

Yes, the original markers are all included and play a key role in the new product.

- 4. Will the GeneSTAR format be changed in the future?**

It is expected that the GeneSTAR MVP tool will continue to evolve over the next few years to include even larger panels of markers encompassing a wider array of economically relevant traits. However, the platform for reporting MVPs, reliabilities, breed averages and percentile ranks will remain unchanged. As the number of markers increases over time, the percentage of genetic variation described by the MVPs and their reliabilities will increase.

- 5. The GeneSTAR MVP looks like an EPD, is that what it is?**

The GeneSTAR MVP is by definition a “molecular breeding value” based on the specific markers and their effects in the current panel, and represents a portion of the expected underlying genes affecting the traits. By definition the MVP is the same as an EPD from genetic evaluation based on phenotypic records (e.g., from U.S. breed associations), the difference being that the information used to calculate the MVP is only from the individual animals’ DNA genotype information in the GeneSTAR MVP system.

- 6. For traits that have EPDs and GeneSTAR MVP data, how should I use the information?**

Pfizer Animal Genetics supports the inclusion of MVPs into genetic evaluation programs where EPDs currently exist for traits with recorded phenotypes in breed performance databases. As a result, efforts are currently underway in the U.S. to incorporate MVPs with EPDs from national genetic evaluation programs within breeds. Until these processes are in place, both sources of information should be weighed in genetic improvement decisions. Methodology exists to allow the appropriate blending of EPDs with MVPs.

Double-checking the Science— GeneSTAR Validation

1. What is the level of scientific confidence in the GeneSTAR MVP product and process?

Pfizer Animal Genetics' development of DNA-marker panels is an extensive and rigorous four-step process. The four steps involved are: 1) initial discovery of DNA markers which have statistically important effects on performance in economically relevant traits of interest; 2) development of statistical methodology for the inclusion of individual markers into "genome-wide" panels for prediction of trait MVPs and associated prediction accuracies; 3) evaluation of the relationship between MVPs and phenotypic performance for the traits of interest in experimental populations within the Pfizer Animal Genetics research program; and 4) third-party validation of the relationships between trait MVPs and phenotypic performance.

2. Has the relationship between GeneSTAR MVPs and the traits been evaluated in different breeds and production systems?

The relationship between GeneSTAR MVPs and phenotypic performance has been evaluated in a wide range of research populations in Australia and North America within the Pfizer Animal Genetics research and development program. These populations were selected to provide a representative range of commercial breeds and environments in which the GeneSTAR MVPs will be used. The GeneSTAR MVP platform was initially developed using populations totaling 2,866 animals, with additional populations totaling 4,455 animals used to evaluate and further refine the calibration of the prediction equations.

3. Has all of the evaluation of the GeneSTAR system been done by Pfizer Animal Genetics?

No. Upon completion of the thorough and detailed internal Pfizer Animal Genetics evaluation process, a number of external validation studies were conducted. The external validations serve the objective of replicating the internal research and development results and claims for the GeneSTAR MVPs for all traits.

4. What kind of third-party validation process has been used to verify the results discovered by Pfizer Animal Genetics for GeneSTAR MVPs?

External validation of the GeneSTAR MVPs has been conducted in both Australia and North America. The National Beef Cattle Evaluation Consortium (NBCEC) has been involved in several external validation analyses in North America. The purpose of the NBCEC commercial DNA validation service is to independently verify associations between genetic tests and traits as claimed by a commercial company, such as Pfizer Animal Genetics, using phenotypes and DNA from independent cattle populations that adequately represent the commercial marketplace.

5. Has the validation process supported the claims for the product made by Pfizer Animal Genetics?

Third-party validation studies resulted in the conclusion that tenderness MVPs were validated across all cattle groups as well as feed efficiency for *Bos Taurus* populations. Additional information for feed efficiency is on file for *Bos Indicus*.

In the case of marbling MVPs, third-party validation studies in the U.S. substantiated a significant association with % IMF estimated by ultrasound 60 days prior to harvest. Additionally, a significant relationship was observed between marbling MVP and USDA Quality Grade in a *Bos Indicus*-influenced population.

Applying the New GeneSTAR MVP Information

- 1. How will the results get reported to me, and am I able to contact Pfizer Animal Genetics for additional technical advice on how to use the individual animal results?**

GeneSTAR MVPs are reported either electronically or in hard copy, depending on the customer's preference. As a full-service genomics provider, Pfizer Animal Genetics offers consultative technical services to customers to ensure that maximal value from the application of their results in their production-marketing system can be achieved.

- 2. Where do the results of my tested animal reside and who will own the results?**

Results are stored in the Pfizer Animal Genetics database in a secure system. The results are owned by customers and are only released to any outside party with their full consent.

- 3. How do I optimally utilize the information from all three GeneSTAR MVPs in my operation?**

Pfizer Animal Genetics Technical Services welcomes the opportunity to assist clients in creating a multiple-trait selection index weighted appropriately to their specific objectives.

- 4. How do I use the GeneSTAR MVPs to predict phenotypic performance?**

GeneSTAR MVPs are also a prediction of phenotypic performance, based on genetic potential that can be expressed in the production environment. The results quantify an animal's ability to perform for a particular trait.

- 5. Can I use the GeneSTAR MVPs in designing and implementing improved management?**

GeneSTAR MVPs provide the background genetic profile information that can be employed to make decisions about how the animal should be managed and what specific supply chain endpoints will maximize the animal's ultimate value. Simply put, GeneSTAR MVPs provide a powerful tool to enable precision management.

- 6. I have heard that GeneSTAR MVPs can only be used for genetic selection in seedstock programs, but I am in the commercial cow-calf business. Is there any value in the GeneSTAR system for me?**

GeneSTAR MVPs are powerful tools for making genetic improvements in both seedstock *and* commercial cow-calf operations through improved bull selection. Additionally, by having GeneSTAR MVPs available on the cow herd, producers can now make important improvements in their selection of replacement females.

- 7. Are there applications for using GeneSTAR MVPs in feedlot production systems?**

Yes, in particular by sorting animals into feeding regimens to more consistently achieve end-product specifications more efficiently. Additionally, application of tenderness and marbling MVPs has high value within supply chains seeking to differentiate product based on eating quality.

- 8. Does Pfizer Animal Genetics offer additional services I can utilize for my operation?**

Beyond GeneSTAR MVPs, Pfizer Animal Genetics offers other tests including parentage identification, animal traceability and specialized tests such as coat color and tests for genetic defects.

- 1 Validated in *Bos Taurus* populations only, additional information available on file for *Bos Indicus*. Feed Efficiency is measured as Net Feed Intake.
- 2 In NBCEC validation, the marbling MVP is significantly associated with Ultrasound as % IMF at 60 days prior to harvest.

The logo for GeneSTAR, featuring the word "GeneSTAR" in a bold, blue, sans-serif font. The letter "A" is replaced by a red five-pointed star with a white outline. A registered trademark symbol (®) is located to the upper right of the "R".

GeneSTAR®



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Animal Genetics

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