

Nellore Genotyping Allows Brazilian Beef Industry to Flourish

The National Association of Breeders and Researchers (ANCP) is speeding up the evolutionary process to enhance the Nellore breed and grow the Brazilian economy.

Introduction

In 1868, a ship headed for England stopped for provisions in Salvador, Brazil, and down its gangplank ambled the first Nellore cows to set foot in the region. With their large, iconic shoulder humps and acuity for dry, hot climates, it did not take long for ranchers to capitalize on the breed's propensity to thrive in Brazil. Flash forward to 1996, when a group of researchers and cattle breeders formed the National Association of Breeders and Researchers (ANCP)¹ with the goal of establishing a proper breeding program for the Nellore. Twenty years later, the group boasts a database with a reference population of 2.2 million animals, using an advanced Zoetis Clarifide 2.0 beadchip²—based on an Infinium™ BovineBeadChip—to accomplish their genomic selection goals.

The ANCP is led by Raysildo B. Lôbo, PhD, an expert in the Nellore breed, who has managed the program since its inception. He has been tasked to find ways to continue improving the breeding process for Nellore ranchers by identifying optimal reproductive and carcass traits in cattle at a younger age. By discovering the genotypes of young candidates to become sires and dams or donors, breeders save precious time and increase the overall efficiency and economic viability of their herds.

iCommunity spoke with Dr. Lôbo to learn how individual breeders are benefitting from this relatively new form of country-wide data sharing and what lessons they have learned while promoting the viability of the Nellore and the quality of Brazilian beef worldwide.

Q: When, how, and why was the ANCP established?

Raysildo B. Lôbo (RBL): The National Association of Breeders and Researchers, abbreviated as ANCP in Portuguese, was set up in 1996 by a group of researchers and cattle breeders. It is a nonprofit association with the mission of advancing research and establishing a Brazilian Nellore cattle breeding program as well as programs for the Guzarat, Brahman, and Tabapuan breeds. Other initial objectives were promoting optimal breeding practices and transferring skills and technology to the farmers.

Q: What is the history of the Nellore breed?

RBL: The Nellore first came to Brazil in 1868 when a ship, with cargo originally intended for England, anchored in Salvador with a Nellore breeding pair. The animals were traded and remained in the country. Ten years later, Dr. Manoel Lemgruber, a German living in Brazil, saw some Nellore cattle at a zoo in Hamburg and decided to buy a couple and import them to Brazil. As more Nellore began to be imported, a native African grass called *Brachiaria* also began to thrive in Brazil. Gradually and symbiotically, both species spread throughout the country—first to Rio de Janeiro and then to São Paulo and Minas Gerais. The last two significant imports of Nellore breeding cattle arrived between 1960 and 1962. Today, we estimate that Brazil has a herd of more than 200 million beef and dairy cattle raised on pasture, of which 80% are Nellore or Anelorado (non-purebred Nellore).



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Brazil is the largest breeder of Nellore, which possess a distinctive hump and are known for their hardiness, fertility, and longevity.

Q: What characteristics do the Nelore breed possess that are unique to the breed?

RBL: The Nelore breed is drastically different from other cattle breeds, such as Angus or Holstein. They have a high level of rusticity and resistance to endoparasites and ectoparasites. Originally descending from Ongole cattle (*Bos indicus*), the Nelore have prominent humps over their shoulders, and are well-adapted to tropical climates. They have superior longevity, strong maternal parenting instincts, and also require very minimal veterinary care during calving. They are mainly raised on pasture, sometimes being finished at feedlots, usually for about 90 days, to accelerate weight gain and carcass finishing.

“The ANCP began to include genomic information in the genetic evaluation of Nelore breed in Brazil in 2011.”

Q: How was genetic improvement of the Nelore breed achieved before breeding programs existed in Brazil?

RBL: The genetic improvement of beef cattle in Brazil before 1980 was very limited and focused mostly on weight gain. There were only a few independent initiatives focused on developing important traits such as maternal ability, fast growth, fertility, and carcass size. In 1995, the publication of the first sire summary using best linear unbiased prediction (BLUP) methodology was the turning point for the beginning of the application of selection in the Nelore breed in Brazil.

Q: How has the breed evolved since the inception of ANCP?

RBL: In the early 2000s, farmers started to come around to the idea of using the results of genetic evaluations provided by the ANCP. Now we publish genomic evaluations six times a year for a total of 27 genomically enhanced expected progeny differences (EPDs) for the following traits: sexual precocity and finishing, maternal ability, weaning weight, weight at 365 and 450 days, mature weight, scrotal circumference, stayability, marbling, hot carcass weight, carcass finishing, ribeye area as measured by ultrasonography, and morphologic traits obtained by visual evaluations. The genetic gains we have seen in the last 25 years are consistently moderate to high for all the above traits.

Q: When did you first hear about genetic merit testing, and what made you decide to use it?

RBL: I first heard about the incorporation of molecular markers in genetic evaluations in the early 2000s at international conferences. Because molecular markers manipulate genetic material without being influenced by the environment, it is valuable information for us to increase accuracy in genetic evaluation. Moreover, it enables the inclusion of important genetic sources of information in the models.

The ANCP began to include genomic information in the genetic evaluation of Nelore breed in Brazil in 2011. Along with Zoetis, we launched the first genomic EPD in Brazil. The initial chip was 0.2K imputed from 50K, and based on Illumina technology. After 2 years of

research, we had the 12K chip, and then upgraded to 17K chip in 2015. The current model we're using is being manufactured by Zoetis as Clarifide 2.0.

Q: How did establish your partnership with Zoetis?

RBL: In December 2008, Pfizer Animal Health invited us to attend a meeting to examine the possibility of developing a genetic marker for Nelore. Afterward, the Genetic Evaluation Technical Centre (CTAG) worked with the Pfizer development team to launch the Clarifide product over the next 3 years. The value in this partnership for ANCP is that we have access to more reliable genetic evaluations for our breeders. We can use this material to increase genetic gain and profitability.

Q: Are you aware that the Clarifide product is based on Illumina technology?

RBL: Yes, we are! While many of the farmers might not know all the details behind the development of Clarifide, I believe that many on the board of directors and our associates are familiar with Illumina.

Q: What is the most important advantage that genomics has brought for ANCP and the herds that participate in the program?

RBL: With genomics, the ANCP is able to keep Brazilian cattle breeders at the forefront of applying new technology. Secondly, the increase in accuracy of young animals compared with traditional EPDs is incredibly valuable. We also benefit from being able to pinpoint low heritability traits, such as reproductive and maternal quality.

Q: Since different traits pass down paternal and maternal lines, how does genotyping bulls and dams help to create desirable offspring?

RBL: With genomic tools, it is possible to know the exact alleles that the offspring receive from their parents. We can then select the offspring with the best combination of alleles.

“We most benefit from genomic selection in the low heritability traits, where the genetic gain through traditional selection is small, as well as in traits that are difficult or not easy to assess.”

Q: What traits are being improved more efficiently by using genomics?

RBL: We most benefit from genomic selection in the low heritability traits, where the genetic gain through traditional selection is small, as well as in traits that are difficult or not easy to assess. The former would include reproductive and maternal traits like age at first calving, and the latter relates to qualities related to feed efficiency, and carcass and meat attributes. Being able to select for these traits is highly beneficial as the reproductive traits

have a huge importance on the ANCP bioeconomic selection index (MGTE).

Q: How does genotyping contribute to maintaining necessary genetic diversity when breeding animals for similar traits?

RBL: Through genotyping, we can estimate the ultimate proportion of alleles that two animals are sharing, basically their genomic relationships. It's then possible to obtain better estimates of parentage and apply a better control of inbreeding (ie, mating schedules) to maintain genetic diversity in future generations.

“With genomics, the ANCP is able to keep Brazilian cattle breeders at the forefront of applying new technology.”

Feed efficiency, as well as meat quality and carcass traits, will drive the Nellore breed in the future. Controlling feed efficiency will allow breeders to reduce the impact of livestock production on the environment, and to increase the profitability of meat production. Brazilian breeders are also very concerned with sustainability issues related to raising cattle and learning how to increase performance without monopolizing natural resources. Having the ability to select for traits that will help us to fulfill those goals is vital.

Q: What are EPDs, and how does knowing their value enable breeders to enhance the quality of the herd?

RBL: EPDs allow us to identify animals that have a higher capacity for, or merit to transfer, their superiority to their progeny. That way we can obtain better animals in the next generation.

Genomics, IVF, and ultrasound all have had a great impact on genetic improvement with regard to carcass merit and EPDs. We can increase the accuracy of selection in young animals, for example, and in traits with a low number of records or those that are hard to measure, such as carcass traits. In other words, IVF enables breeders to use young animals identified as having high carcass merit more intensively and reliably.

Q: How do the breeders in the ANCP program use the genetic information?

RBL: They use the genetic information to select young sires and heifers, and also to cull poor candidates in their herds. The genetic information is also used for selective mating. The ANCP offers a genetic mating software for breeders that maximizes genetic gain and mating results. Breeders also use the gEPDs to select young bulls for future use in artificial insemination and sell others as seedstock or for commercial herds. Females are selected in a similar manner.

Q: What are your customers looking for in the ideal Nellore bull and dam?

RBL: Customers want bulls and dams with high genetic potential for precocity, fertility, growth, maternal ability, carcass merit, and a suitable functional conformation.

Q: What are the challenges of raising Nellore cattle, and how does genomics help you overcome them?

RBL: The Nellore breed is well adapted to the tropics and can survive in high temperatures and poor pasture. That said, selecting them to minimize age at puberty and age at first calving can be hard. Genomics helps us select for these traits, as well as carcass traits, with high accuracy.

Q: What is the value of being able to evaluate the genetics of the Nellore cattle from a specific herd and compare them to the entire Nellore population versus just a contemporary group?

RBL: There is no advantage to analyzing a specific herd alone. Using the ANCP database allows breeders to create larger contemporary groups with greater competition. Another advantage is being able to make use of the relationships among animals, which in turn generates greater accuracy in the overall genetic evaluation.

The ANCP database now has about 2.2 million animals, and its growth in the last decade has been around 5% per year. The quality of information has exponentially grown since we began, making the ANCP the most important genetic evaluation program in Brazil because of the quality of our data.

Q: How do genomics contribute to better economic stability for ranchers?

RBL: One primary benefit of genomic information is that it can be collected earlier in an animal's life than phenotypic records can, almost allowing us to predict the future. This in turn saves us time and ultimately reduces the cost of genetic evaluation. Moreover, traits that depend on progeny testing—like maternal and female reproductive traits—can be evaluated with high accuracy without the need for progeny testing.

Secondly, we can increase the accuracy of a young animal's EPD with genomics. This decreases the guesswork about an animal's genetic potential, which in turn increases the use of these younger animals in seedstock systems. Again, the generation interval decreases and the genetic gain increases, contributing to better economic stability for ranchers.

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Q: What is the economic gain for the Nellore herd using genomic selection?

RBL: Genomic selection can definitely increase economic gain for the Nellore herd for most traits. Through genomics, we can increase the EPD accuracy of young animals and also reduce inbreeding in the next generation, since better relationships between animals can be obtained. Moreover, for traits difficult or expensive to measure—like carcass, meat, and feed efficiency traits—there is an unprecedented opportunity to improve these traits and also to identify quantitative trait loci—sections of DNA that correlate with phenotype variation—associated with them.

Q: What is your vision for global marketing of Nellore cattle?

RBL: There is a growing demand for the production of beef products that satisfy consumers' needs in terms of meat quality and food security. Moreover, the society and public institution are concerned about the impact of livestock production on environment. In this scenario, the genomic information could contribute to improve the Nellore cattle in these issues.

“In the future, the ANCP will take full advantage of genetic information from genomic evaluation through decreasing generation intervals, increasing EPD reliability, decreasing the inbreeding coefficient, and allowing the genetic evaluation of new traits.”

Q: What is more important: overall fertility or quality of offspring, and how do you use genotyping to balance the two?

RBL: Reproductive traits are the most economically important in beef cattle production systems. We think that the improvement of overall fertility should in turn increase offspring quality since more intense selection can be applied in the herds. Genotyping will increase genetic gain for both traits.

Q: What has been the impact of genomics on the genetic achievement of the Nellore herd thus far?

RBL: As of now, the impact of genomics on the whole population is still small, but the number of genotyped animals (both bulls and cows) is growing each year and the use of sires with EPDs obtained with genomic information is also increasing. In the future, the ANCP will take full advantage of genetic information from genomic evaluation through decreasing generation intervals, increasing EPD reliability, decreasing the inbreeding coefficient, and allowing the genetic evaluation of new traits.

Q: What is your vision for Nellore herd genomics?

RBL: Going forward, genomics will enable breeders to make better selection decisions, especially with regard to specific environmental, market and management conditions. Traits related to beef quality and feed efficiency are gaining importance as well. However, in the near future, reproductive and growth traits will be the priority in the meat production system.

Epigenetics data will be important as well. This will enable us to infer differential gene expression when animals are submitted to divergent environmental conditions. Brazil has several large territories with vast differences in environment and management conditions. This scenario predisposes us to several genotypes as driven by environmental interactions for most of the relevant traits evaluated in the ANCP program. Integrating genotyping and epigenetics data will allow better selection of animals producing to a specific marker and under particular environmental conditions.

Q: What are the most important challenges the Nellore and Brazilian beef industry faces today and in the future?

RBL: It is going to take time for Brazil to build and modernize its infrastructure to comply with international standards regarding disease control, global traceability, product certification, and food safety. To help out, the government should develop public policies and strategies to support the breeders and beef industry to attain these endeavors. Genomic and reproductive technology should help resolve some of these challenges in terms of lowering the age of puberty, increasing milk production to the calf, bettering feed efficiency, and improving tenderness and carcass finish. Progeny testing young bulls will also help reduce the average age of parents and increase annual genetic gain.

Q: Is genomics now a standard part of university Agricultural Science curriculums?

RBL: Because the genomics revolution has and will continue to provide vital tools that address issues related to global food security, Agricultural Science will be vastly dependent on this technology in the future. Genomics has already been incorporated into curriculums at some universities, although, as far as I know, it has yet to be incorporated into livestock breeding. It should soon be mandatory in all of them. Molecular techniques also need to be integrated into a quantitative genetics framework. I would emphasize that we need to train professionals with such expertise. Those same proficiencies are necessary to guide adoption of genomic-enhanced tools within animal agriculture.

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Q: Do you think the next generation of ranchers will fully depend on genomics?

RBL: I think that new generations of producers will fully depend on genomics to select animals with higher accuracy, better meat quality, and adequate nutrition to the various production systems.

Learn more about the Illumina product mentioned in this article:

Infinium BovineLD BeadChip,
www.illumina.com/products/bovineld-genotyping-beadchip.html

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