Genes that could lead to improvement of beef cattle are identified

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Researchers identify 35 genes associated with reproduction, milk composition, growth, meat and carcass, health or body conformation traits in Gir cattle (specimens from herds with selected traits for beef and milk production). Credit: Anibal Eugenio Vercesi Filho and Sertãozinho Animal Science Institute)

Beef cattle improvement programs have focused for decades on promoting the rapid growth of calves. Now, the goal is to improve other traits, such as meat tenderness or ribeye muscle area.

Researchers at São Paulo State University (UNESP) in Brazil who are studying the genome of the Gir breed of Zebu cattle have identified 35 genes associated with reproduction, milk composition, growth, meat and

carcass, health or body conformation traits. This identification is a key step toward the development of novel lines with traits desired by producers and consumers.

The results of the study have recently been published in the journal *PLOS ONE* by the group, which is led by Josineudson Augusto II de Vasconcelos Silva, a professor at the university's Botucatu School of Agrarian & Veterinary Sciences (FCAV-UNESP). The research was supported by São Paulo Research Foundation—FAPESP. Researchers affiliated with the University of Georgia in the United States and with Brazilian animal science institutes located in Nova Odessa and Sertãozinho, both in São Paulo State, also took part.

The Gir breed is of Indian origin and has been successfully introduced into the tropics. It is one of the main cattle breeds farmed in South American tropical countries, especially Brazil. However, the various populations have pronounced differences. Strong artificial selection in recent decades has increased the genetic differentiation among herds in countries of the region.

Gir cattle are mainly farmed for milk in Brazil today, although they were once an option for meat producers, who now prefer Nelore cattle.

To locate the genes associated with beef and dairy production in Gir cattle, the researchers analyzed the genotypes of animals from different populations, including a herd raised between 1976 and 2003 at the Sertãozinho Animal Science Institute.

During this period, the institute's scientists selected animals from the herd to develop traits associated with meat production, such as rapid yearling growth. As a result, calves born to cows in this herd became steadily larger. In 2003, however, the herd was sold in response to a change in preference among farmers, who opted to raise Gir for dairy

rather than beef.

At that time, Brazil launched its Dairy Gir Genetic Improvement Program (local acronym PNMGL). Selection for traits associated with milk production led over the years to cows with steadily larger udders that produced increasing amounts of milk.

The genotyping exercise used hair samples collected in 2003 from 173 bulls, cows and yearlings belonging to the herd selected for beef production and from 273 animals belonging to the PNMGL herd, which was selected for dairy production and raised on five farms in Minas Gerais and São Paulo State.

The researchers also recorded key lifecycle data, such as birth weight, preweaning and postweaning weight, and slaughter weight.

"We selected a Gir group for beef and another for dairy. The difference in morphology was significant. The animals selected for beef had more muscle mass and were stronger, while cows selected for dairy had very large udders," Vasconcelos Silva said.

"The results obtained are clear and consistent with the history of both populations. Because they were involved in different breeding programs, there was intentional segregation of their genes, leading to complete isolation and this significant genetic variation."

The genomes of the 173 animals selected for beef production were compared with the genomes of the 273 animals selected for dairy production with the aim of detecting the regions in which the respective genes were located.

"We found that 282 genes in the regions concerned could be considered signatures of selection in Gir beef and dairy herds. Of these, 35 were

found to be associated with reproduction, milk composition, growth, meat and carcass, health or body conformation traits," Vasconcelos Silva said.

Larger herds

The investigation funded by FAPESP showed that traits associated with fertility, milk production, beef quality, and growth were involved in the process of differentiation between the two populations, one selected for meat production and the other for milk production. Some of these 35 genes were already known to science. The rest are new discoveries.

The next steps will involve larger herds. The group will genotype at least 2,000 animals to understand how the previously known genes are expressed and more precisely how they are associated with the traits investigated.

"We may perhaps discover that some genes are more abundantly expressed in Gir than Nelore, for example," Vasconcelos Silva said.

Another possibility will be a comparison of Gir genes with those of a European breed such as Angus, which is preferred by Brazilian steakhouses.

More information: Amanda Marchi Maiorano et al, Assessing genetic architecture and signatures of selection of dual purpose Gir cattle populations using genomic information, *PLOS ONE* (2018). DOI: 10.1371/journal.pone.0200694

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