GenoCells for dairy goats: identification of the most contributing goats to the bulk tank somatic cell count by genotyping tank milk

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Abstract

Efficient monitoring of bulk tank somatic cell count (SCC) is essential for dairy goat farmers to optimize milk price and herd's health. GenoCells® is a revolutionary technology that uses DNA analysis to determine with high accuracy the animals contributing to the bulk tank SCC. This method has already been tested with cows and found to be as accurate as traditional flux cytometry method. This new technology allows more flexibility and frequency than the traditional method of SSC on individual sample, creating great interest among dairy goat farmers. To validate the reliability of the GenoCells® method for goats, and assess its potential added value for farmers, a trial is currently led in eight dairy goat farms of the Pays-de-la-Loire French geographic zone.

Keywords: dairy goats, cells, DNA, milk tank, individual cells responsibility.

Introduction

In recent year, there has been a growing interest among dairy goat farmers in Somatic Cell Count (SCC) monitoring due to the worsening sanitary conditions on farms. It is opposite to the technical optimization that is wanted by the new farmers and necessary to respond to the contemporary's society requirement: animal welfare and sanitary security (Koop *et al.,* 2010). The milk recording operations, that allow to get the SCC of the milk, are being as binding as the herds grow. Moreover, they don't allow the frequency and the flexibility that would be useful to apply an efficient monitoring of the somatic cells. A new method was created to identify animals that contribute the most to the bulk tank SCC by the analysis of tank milk (Blard *et al.,* 2012; Georges, Blard and Coppieters, 2014). This method which uses a linear model to determine the contribution of each animal to the DNA found in tank milk, only requires that all the animals are genotyped. The GenoCells® service has been launch in France for the dairy cows by Seenovia on the 1st of January, 2018, and has since been adopted by users in the United Kingdom, Germany, the USA and Ireland (Lenormand *et al.,* 2019; Perrin and Marg-Haufe, 2019). However, it remains unclear whether it's reliable for goats and it provides any technical added value for farmers. To address these questions, a trial was conducted in eight commercial dairy goat farms.

Material and methods

Eight farms of varying sizes (50 to 700 goats) and varying levels of bulk tank SCC were selected to represent a diverse range of herd situations. Thus, the trial would be able to experience GenoCells® in numerous types of herds. The genotyping of milk (bulk tank) and cartilage (goats) samples were performed using the Goat_IGGC_65K_v2 chip of Illumina. Statistical analysis applied on genotypes was performed to determine the responsibility of each goat for the cells found in the bulk tank sample. The GenoCells® cells responsibilities are compared to the reference method: the milk recording operation using Tru-test or Lactocorder to collect and measure milk and The Fossomatic FC machine to measure somatic cell count by flow cytometry technology. The cells responsibility for each goat was calculated using the somatic cell count and milk production of the entire herd. 13 comparison were made in 2022.

Results

The linear model between the cells responsibilities determined by GenoCells® and by the milk recording operation showed a strong correlation (adjusted $R^2 > 0.9$), as shown in Figure 1 and Figure 2. Although, some differences appear between the results provided by the milk recording operation and those coming from Genocells®. This observation is more marked in the most and least contributing individuals. However, the aim of this method is to provide a powerful and flexible tool for the management of the herd. Thus, the main target of the method is not the low contributors, but rather the high contributors to the tank cell. Furthermore, this picture should be nuanced as these

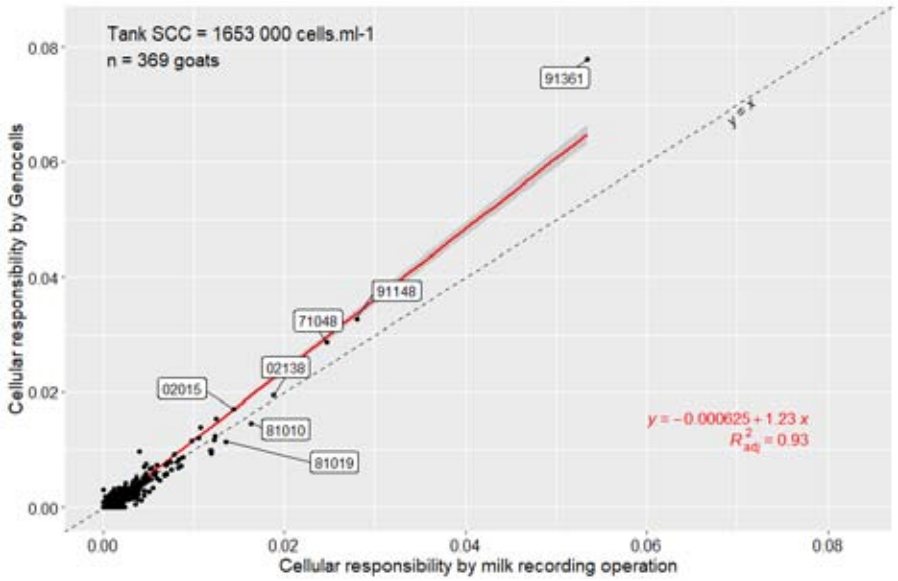

Figure 1. Scatter plot representing the relationship between cellular responsibility measured by milk recording operation and the GenoCells® service in a farm with 369 goats. Each dot represents a goat. The x-axis represents the cells responsibility determined by milk recording, while the y-axis represents the cells responsibility of each goat in the bulk tank determined by GenoCells®. Most contributing goats are highlighted by their number specified in a rectangle. The red line represents the linear regression line between milk recording and GenoCells®. The R2 value of the regression line is greater than 0.9, indicating a strong correlation between the two methods.

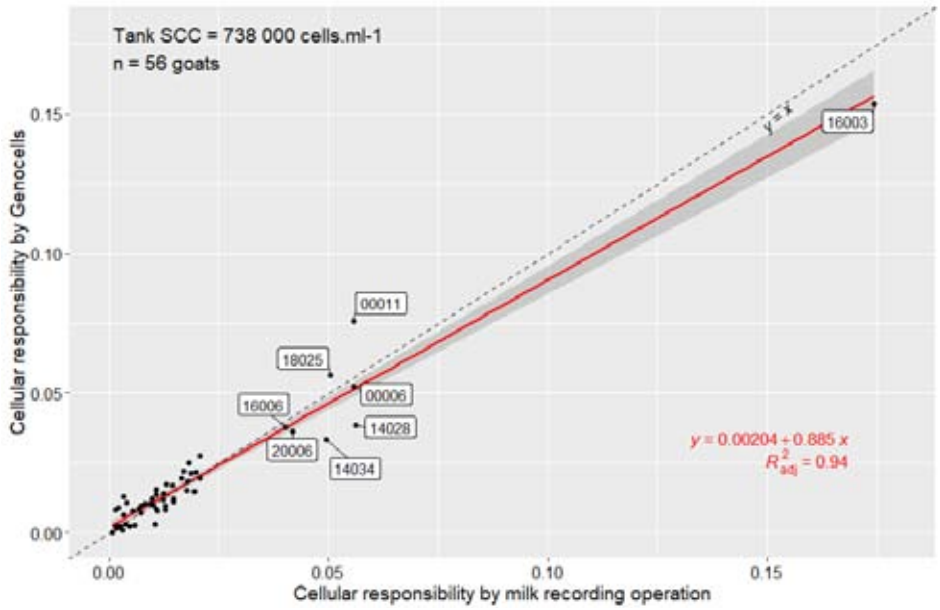

Figure 2. Scatter plot representing the relationship between cellular responsibility measured by milk recording operation and the GenoCells® service in a farm with 56 goats. Each dot represents a goat. The x-axis represents the cells responsibility determined by milk recording, while the y-axis represents the cells responsibility of each goat in the bulk tank determined by GenoCells®. Most contributing goats are highlighted by their number specified in a rectangle. The red line represents the linear regression line between milk recording and GenoCells®. The R^2 value of the regression line is greater than 0.9, indicating a strong correlation between the two methods.

differences are small and do not represent real clinical differences. Furthermore, the results were consistent across herds of varying sizes and bulk tank somatic cell count levels ranging from 738 *10^3 CE.ml^{-1} and 56 goats to 1653 *10^3 CE.ml^{-1} and 369 goats.

Evaluation of the technical added value for farmers

The eight farms of the trial represent a diversity of practices that impact directly their relation to the somatic cells: from 50 to 700 goats (from low to high sanitary pressure), from delivery farms to transformers (with or without prices penalty on somatic cell criteria) and from good sanitary level to bad one. Because the method needs all the goats to be genotyped, the genomic selection is an essential added value to appreciate

with GenoCells®. Therefore, the farmer selected are also more or less interested in genetic and genomic tools.

To allow the farmers to feel the value of GenoCells®, recurrent bulk tank samples were analyzed for GenoCells® (every 3 weeks) from June 2022 and it will last until the end of 2023 (following the processes described higher). Farmers receive a result containing the evolution of the cells responsibility of the goats who contributed the most the last two samples, as presented in the Figure 3.

Moreover, genomic information about goats (indexes) are a real value of GenoCells® for farmers. Therefore, Capgenes, the French genetic selection organism, is included in the project. To evaluate the value of genomic information, Capgenes send the genomic indexes to the farmers, including for young goats.

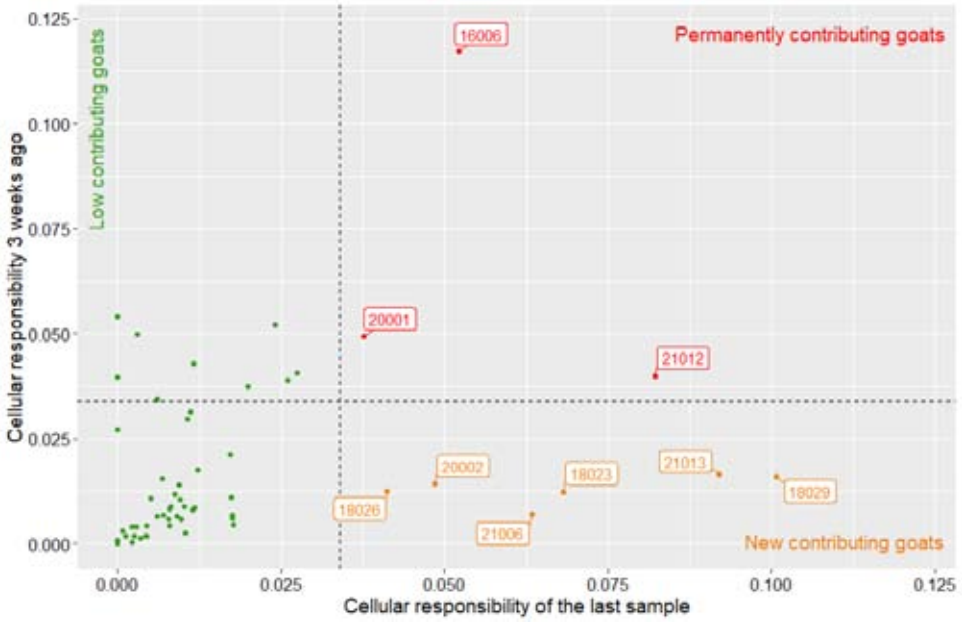

Figure 3. Scatter plot proposed to farmers at each GenoCells® analysis. It represents for each goat, the relation between the cellular responsibility measured by GenoCells in the tank sampled 3 weeks before (y-axis) and the cellular responsibility measured by GenoCells in the tank sampled the current week (x-axis). Each dot represents a goat. Goats represented at the bottom-right corner (orange points) are newly contributing to the bulk tank SCC. Goats represented at the top-right corner (red points) are still contributing for 3 weeks and are called permanently contributing goats. All other goats (green points) are not highly contributing to the bulk tank SCC in this sample. Most contributing goats are highlighted by their number specified in a rectangle. The dotted lines represent the limit to separate low-contributing from high-contributing goats.

Results

The results of two years of GenoCells® testing will be analyzed to determine the real added value of GenoCells® for dairy goat farmers and thereafter build a profitable offer for them.

Conclusion and perspectives

In conclusion the GenoCells® technology allows for efficient monitoring of SCC in dairy goat herds and the trial results suggest its reliability for dairy goats. The assessment of the technical and economic added value for farmers is ongoing and could lead to a valuable tool for herd management and optimization of milk production.

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