Somatic Cell Count in Raw Milk with Ampha Z_{32}

Author: Dr. Marco Di Berardino

Introduction

Somatic cells are white blood cells (leukocytes) of the cow that are normally present in raw milk at low concentrations. The number of somatic cells significantly increases during most mastitis infections, which are typically caused by bacteria. Somatic Cell Count SCC is an important parameter for assessing the health status of a cow as well as the quality of raw milk that is processed by dairy product manufacturers.

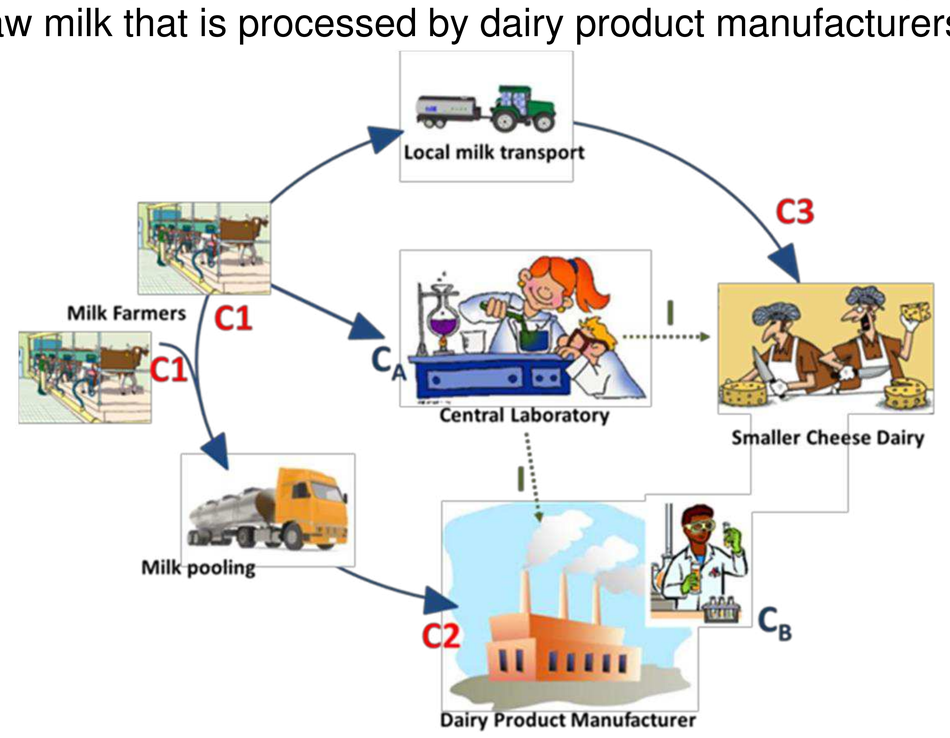

Figure 1: SSC is presently carried out only in specialized laboratories (C_A). A control of raw milk at farmers sites for herd management or before loading the milk onto the truck (C_1), as well as for incoming inspection at dairy manufacturer sites (C_2 and C_3) and/or in their laboratories (C_B) would be highly welcomed.

The Challenge

Milk contains normally much more fat particles than somatic cells. Depending on the health conditions of the cow the ratio between cells and fat particles can vary from less than 1% to over 25%. Since in raw milk fat particles and somatic cells have similar dimensions, it is quite difficult to discriminate them.

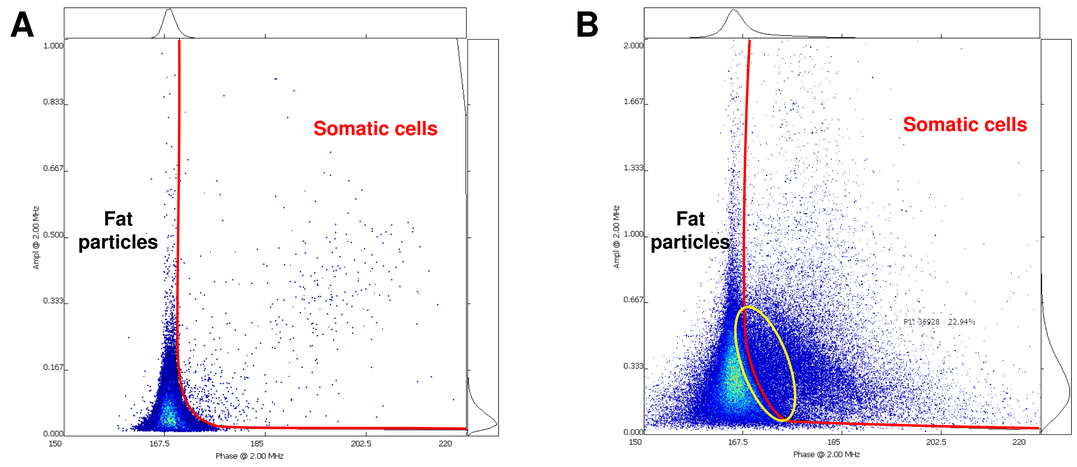

Figure 2: Measurements of raw milk at 2 MHz, milk of a healthy (A) and a sick (B) cow. Somatic cells have higher phase angle values and can be discriminated from fat particles. However, there is also an overlap region (yellow area) which contains both fat particles and somatic cells. This overlap complicates an accurate SCC.

Sample Prep and Signal Analysis

Due to the high content of fat particles, the impedance signal is characterized by overlapping individual signals deriving mostly from fat and occasionally from somatic cells.

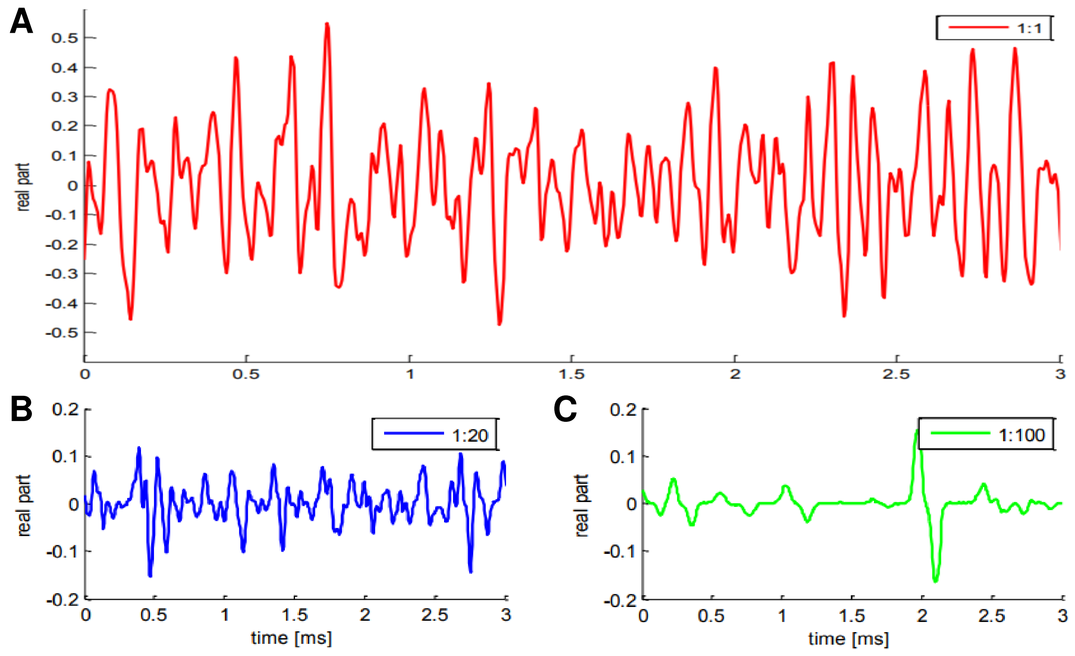

Figure 3: Impedance signal of raw milk diluted with increasing amounts of 0.5 x PBS (A–C). Only after a 100-fold dilution the signals of somatic cells become well separated.

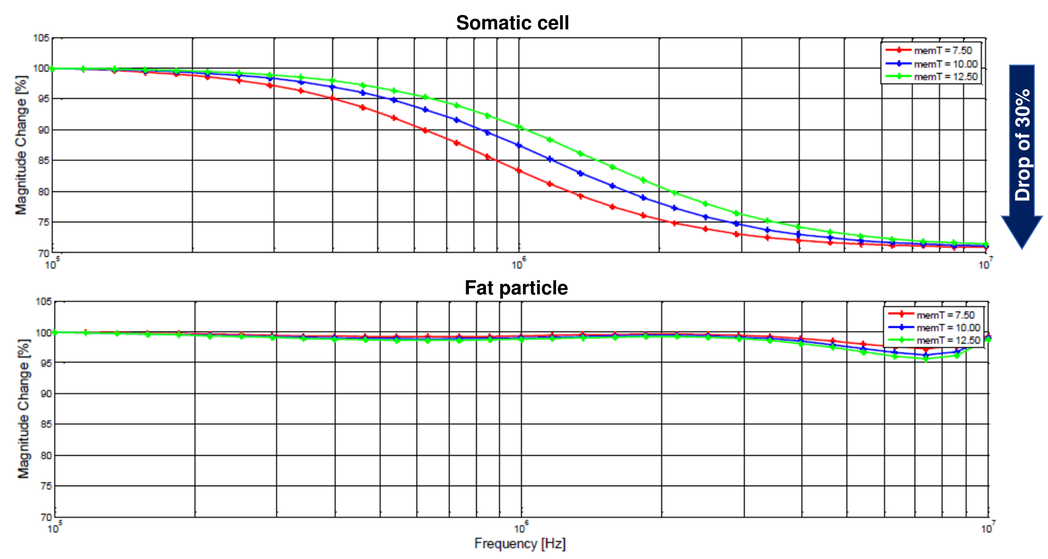

Figure 4: Simulation of the β-dispersion of 10 µm cells and fat particles with variable membrane thickness in the frequency range from 0.1 to 10 MHz. At high frequencies, the cells show a significant drop of the signal as compared to fat particles.

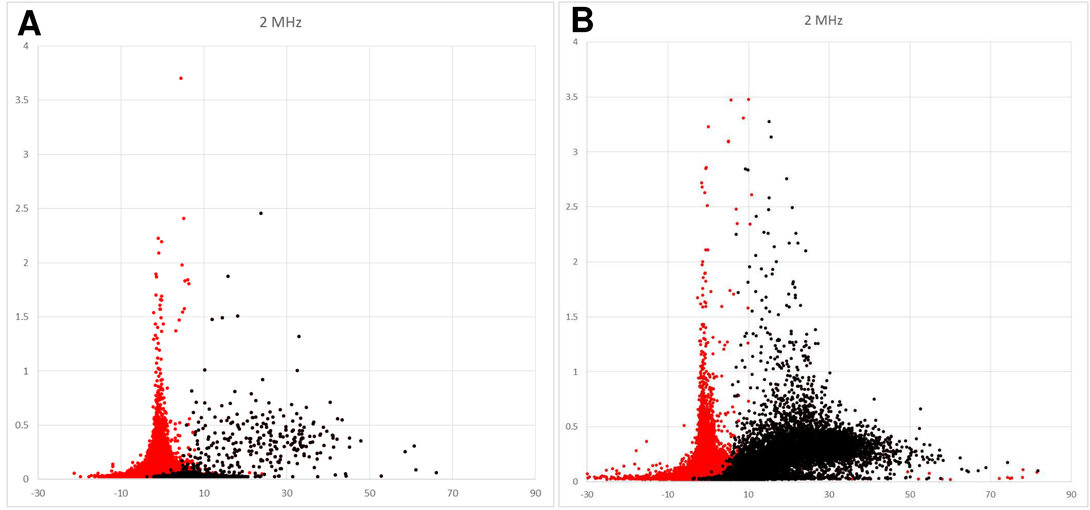

Figure 5: Data analysis of raw milk from a healthy (A) and a sick cow (B). All signals that showed a drop of amplitude between their 2 MHz and 10 MHz magnitude larger than 20% are colored in black and indicate the somatic cells.