Development of unique gold surfaces with brucella binders as a basis for the development of biosensors for monitoring and identifying brucella bacterial cells in cattle and sheep's milk

Zvi Hayouka- The Hebrew University of Jerusalem.

Shlomo Blum- Kimron Veterinary Institute

Abstract

Brucellosis is a zoonotic disease that is common in many parts of the world as well as in Israel and causes significant economic damage to the cattle and sheep farm. The disease is caused by an intracellular bacterium of the genus Brucella. There are several species of *Brucella* classified by natural host, so *Brucella abortus* is adapted to cattle while *Brucella melitensis* is adapted to sheep, Israel is endemic to *B. melitensis*. As a result of infestations with livestock, the disease is also transmitted to cowsheds and causes significant economic damage. Indeed, in recent years there have been outbreaks of the disease even in cowsheds that are usually discovered after a wave of miscarriages, a stage in which the disease is already in an advanced state. Therefore, the best way to prevent the spread of the disease is to detect it in the early stages and not with the appearance of a wave of miscarriages indicating the spread and establishment of the disease in a cowshed. The Serological Division of the Veterinary Services performs serological tests for Brucella using serum samples that come from the various farms in Israel, both routinely and in response to cases of outbreak of the disease. The duration of the serological test, from the sampling stage to absolute positive identification, is relatively long and sometimes, in light of the unexpected load and the need for an immediate response, **a faster and more available solution is required** to complement the current testing system. A tool with great potential to achieve this goal is the development of fast, efficient and accurate biosensors. The use of biosensors makes it possible to identify pathogens in their natural environment and saves time and effort in identifying them, since the process does not require the use of traditional methods, which takes time for growing and identifying the bacteria. In the literature, different biosensor systems have been reported that use antibodies , and lectins as biomarkers. However, antibodies and glycoproteins have a number of disadvantages in identifying bacteria, such as cross-reactions that cause mistaken identification and complicated procedures associated with developing a stable system over time. Unlike proteins, peptides have, in addition to biological activity, high specificity, low toxicity and great stability over time relative to proteins. Short peptides are an excellent tool for studying biological interactions because they can be synthesized relatively easily, chemically modified, and used to target specific interactions, so short peptide synthesis is already gaining importance in identifying bacteria. In the current study, we discovered short peptides that selectively bind *brucella* bacterial cells using the phage display method. These peptides were synthesized and immobilized on unique gold surfaces and were observed to be highly effective in binding Brucella bacterial cells compared to the control bacterium *E. coli*. These findings are very important and will serve as the basis for improving the binding affinities towards brucella bacterial cells. Based on this knowledge and findings, an electrochemical biosensor will be built in the future that will serve as a detector for identifying and monitoring Brucella bacterial cells in milk in Israel and around the world.