What’s new at UP Food Science?

The Department of Food Science at the University of Pretoria originated in 1920 as the Department of Dairying, made possible through a sponsorship of the Union Castle Shipping Line. This article serves to highlight two current research projects at the Department of Food Science.

Despite advances in food preservation techniques, bacterial spoilage remains the leading cause of global food loss. Research estimates that about one-third of all food produced worldwide is lost post-harvest. Dairy products constitute one of the leading sectors affected by food loss. ESL milk fills the gap between high-temperature, short-time (HTST) and UHT methodology. Over the past years, several processing alternatives for ESL milk production were developed. The objective of these processes is achieving similar sensory characteristics as pasteurised milk, as well as extending the shelf-life. Currently, the widely used method is a combination of pasteurisation and a non-thermal method that reduces microbial load. Endospore-forming bacteria are microorganisms that are able to exist as a dormant, non-reproductive structure. They use the endospore form to survive harsh conditions, and, as soon as conditions become favourable, they revert back to their normal vegetative form in a process called germination. After germination, these bacteria can cause spoilage to milk owing to enzyme activity. Researchers hypothesise that the recent emergence of some heat-resistant strains of spore-forming bacteria can be attributed to increased adaptation of these microorganisms to toxin production. The approach of this study was to determine the microbial diversity of ESL milk during processing as well during chill storage (4°C and 7°C). Samples were collected from raw, pasteurised and packaged milk from a dairy processing plant in South Africa. The samples were analysed for mesophilic, psychrotrophic and thermophilic bacteria. Figure 1 indicates that, overall, B. pumilus had the highest isolates in ESL milk. The ability of B. pumilus to dominate at both 4°C and 7°C shows that the species has some psychrotrophic strains and can adapt well to cold environments. To improve shelf-life, understanding the adaptation mechanisms of endospore-forming bacteria is important. It is also vital for ESL milk processors to understand the extent and mechanism of spoilage and pathogenicity potential of each individual microorganism.
A biofilm may be defined as a community of microorganisms attached to stainless steel surface, producing extracellular polymeric substances (EPS) and interacting with each other. Bacteria in biofilm formed in dairy processing environments are more resistant to cleaning and sanitisation procedures. The closed systems such as pipes, valves and pumps are regularly found to be contaminated by Bacillus spp, E. coli, Micrococcus spp or Listeria monocytogenes. Therefore, dairy processing equipment surfaces are recognised as source of microbial contamination.

There is limited information available on factors limiting the shelf-life of extended shelf life (ESL) milk. Biofilms are of concern in dairy manufacturing plants, as bacteria with biofilms are more difficult to eliminate than free-living cells and, once established, can act as a source of contamination of product and other surfaces. The increased ability to adhere to the surface by new bacteria is not the only advantage of biofilms. It also provides a protective barrier for the bacteria within it by providing a physical barrier from stresses, as well as a chemical barrier.

This study was performed on bacteria associated with biofilm in aseptic filling machines. Isolates from swabs taken from nozzles were studied for their ability to form biofilm on stainless steel surfaces. Among the isolates, Bacillus, Staphylococcus and Micrococcus bacteria were encountered and showed the ability to form biofilm. Therefore, we can say that Bacillus cereus and Micrococcus luteus detached from the nozzles of aseptic filling machines and contaminated the final milk product as it passed through the filling machines. Our findings indicated that B. cereus, S. epidermidis and M. luteus can attach and form biofilm on stainless steel surfaces, indicating that these strains can be the main source of contamination of ESL milk.

DESMOND MUGADZA is a lecturer at the Midlands State University Department of Food Science and Nutrition and a PhD candidate at the University of Pretoria in the department of Food Science working under the supervision of Prof Buys. SANDILE KHOZA is a master’s student at the University of Pretoria, also under the supervision of Prof Buys. PROF ELNA M BUYS is the head of the Department of Food Science at the University of Pretoria. Contact the authors at mugadzad@gmail.com, misandi@tuks.co.za or elna.buys@up.ac.za for information.