DNA-sequencing is the future of microbial process control in the food industry

Lene Meinert, Birgit Groth Storgaard, Anette Granly Koch

Danish Meat Research Institute, Taastrup, Denmark

Introduction: Classic microbial testing are used in the meat industry for documentation of hygiene levels and product shelf-life. Classic microbiology is based on culturing of microorganisms using selective and non-selective growth media. It takes days before the number of bacteria in a sample can be determined and the results are predetermined due to the choice of media.

In contrast, DNA based methods identifies all bacteria present in the sample, also those bacteria, that are usually un-culturable, you have the results within hours - this is the true game-changer in microbial analyses.

The aim of the present studies was to demonstrate the applied use of DNA-sequencing in relation to process control in the food industry.

Materials and method:

Collection of samples:

Samples of meat products and environment swabs were collected at commercial food production facilities. The meat or the swab sample was placed in stomacher bags added 20-225 ml of saline and homogenized by stomaching at full speed for 1 minute. Subsequently, 2 ml from the liquid phase was withdrawn for DNA extraction.

DNA extraction and analyses:

In general, DNA was extracted using A&A Biotechnology Gravity DNA extraction kit and sequenced using Oxford Nanopore Minion instrument. Sequencing data was processed using e.g. Guppy-basecalling.

Results: The following examples show the applicability of DNA sequencing in different situations in the meat industry.

Identification of bacteria in blown packs

CO2 production in e.g., packages of deli meat, vacuum packed meat sauces or canned food is caused by different spoilage microorganisms. DNA sequencing was used to identify the total microbial community in blown packs. Based on the identification, it was possible to suggest preservation to inhibit growth of the spoilers and targeted search for routes of contamination.

Exploring the effect of new types of packaging material on the microflora composition during storage

Beef steaks were stored in three different types of packaging: PP-plastic-, PET reusable plastic- and cellulose-based packaging, respectively. In general, the microflora was initially a diverse mix. During 14 days of storage, the PP- and PET-based packaging selected predominantly for Leuconostoc and Lactobacillus whereas the cellulose-based material selected for predominantly Brochothrix. No overall differences in shelf life were observed. The meat producer can now navigate among new or conventional packaging materials.

Identifying the point of entry of unwanted microorganisms.

One specific and unwanted spoiler bacteria, Brochotrix, was present in a marinated meat product but not in the fresh product. A screening of the production-environment using sequencing revealed the entry of Brocotrix in the marinated meat product, and these locations were subjected to intensified cleaning.

Conclusions and future perspectives:

DNA sequencing technologies are continuously optimized and upgraded, which prove that DNA techniques are still under development. However, the time for implementation in the food industry is getting closer, and the presented studies demonstrated the applicability of DNA-methods in the meat industry.

Acknowledgements and Financial support statement: The studies were financed by the Danish pig levy fund, The Danish Environmental Protection Agency (GUDP) under The Ministry of Environment of Denmark and, Danish Agency for Higher Education and Science, under The Ministry of Higher Education and Science Denmark. The sequencing devises were financed by Norma & Frode Jacobsens Fund.