Tunable Diode Laser Absorption Spectroscopy as an Alternative Method for Non-invasive Sterility detection in Ready to Feed Infant Milk Products

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Abstract

Background: The potential application of rapid, non-destructive, and user-friendly TDLAS technology to detect contamination in commercially sterile dairy beverages where visual inspection is not possible was investigated for the first time. The TDLAS equipment uses laser light to monitor carbon dioxide changes due to microbial growth in the container headspace which has the advantage of being rapid and non-destructive. This study aimed to provide detailed scientific evidence for the application of TDLAS technology as a method to determine product sterility in real food products.

Methods: TDLAS growth detection of *Bacillus fengqiuensis*, *Candida albicans*, *Lactococcus lactis*, *Microbacterium luteolum*, *Paenibacillus chitinolyticus* and *Staphylococcus pasteuri* was studied in various Ready To Feed (RTF) dairy matrices. Detection of growth was correlated with cell numbers and the reliability of detection was tested using multiple inoculum levels.

Results: TDLAS was capable of detecting growth of *L. lactis* within 20 h and *S. pasteuri* in 55 h when foods were contaminated with ~100CFU/ml. However, the spore former *B. fengqiuensis* was not detected after 72 h in three matrices when inoculated at low levels. The lowest cell density detected at 4.47 CFU/ml was for the yeast (*C. albicans*) after 28.99 ±1.82 h and the highest at 8.53 CFU/mL was for the Actinomycete (*M. luteolum*) at 37.02 ±1.84 h in non-hydrolysed RTF matrices. A strong linear relationship (R^2 value ≥ 0.827) between initial inoculum and Time to Detection (TTD) for multiple inoculum levels was observed.

***Conclusion*:** Therefore, the TDLAS equipment was shown to be reliable with some specific limitations in identifying microbiological contamination by typical spoilage microbes in commercially sterile RTF products.

Keywords: Tunable diode laser absorption spectroscopy (TDLAS), Rapid methods, Sterility testing, Time to Detection, Growth rates, Predictive microbiology.