

OPTICAL METHODS FOR *IN SITU* BIOFILM DETECTION

Introduction:

One of the main problems in the food industry in reference to food safety and consequent disease transmission is represented by the survival of pathogenic or altering microorganisms that form biofilms. For this reason, it is very important to detect these structures, in order to subsequently prevent their formation or in order to be able to make decisions quickly and reliably, regarding the cleaning and disinfection procedures used.

Aim:

To find analytical methods capable of detecting the presence of biofilms on surfaces in the food industry at real time (*in situ*).

Table 1. Classification of potentially applicable methods for detection of biofilms in the food industry:

In-line	Electromagnetic waves	Real time (<i>in situ</i>)	Lab-on-a-chip ^[1]	Light absorbance variations
			UV-LED sensor ^[2]	Fluorescence
			ETT-sensor ^[3]	Transmission spectrum measures
	Acoustic waves	Real time (<i>in situ</i>)	SAW sensor ^[4]	Resonant frequency shift
At-line	Electromagnetic waves	Real time (in situ)	Bactiscan™ ^[5]	Fluorescence
Off-line	Electromagnetic waves	Not real time	FISH*	Fluorescence
			CLSM*	Fluorescence

*Fluorescence in situ hybridization (FISH); Confocal laser scanning (CLSM)

Conclusions:

For the resolution of the problem of contamination by biofilms in the food industry, two trends have been highlighted:

- 1) Based on optical fiber sensors that allow automated control and continuous measurement. Used on surfaces, equipment and areas with difficult access.
- 2) Based on the use of portable and easy-to-use devices that allow large areas to be visualized by fluorescence.

All these methods allow us to verify that the cleaning and disinfection protocols have been effective against the elimination of biofilms and otherwise allow quick decision-making.

The best option to keep the problem of biofilms under control in a company would be to combine the use of at least two methods.

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[3] Kurmoo, Y., Hook, A. L., Harvey, D., Dubern, J.-F., Williams, P., Morgan, S. P., Alexander, M. R. (2020). Real time monitoring of biofilm formation on coated medical devices for the reduction and interception of bacterial infections. *Cite This: Biomater. Sci.* 8, 1464. <https://doi.org/10.1039/c9bm00875f>
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