

# Mobile Flow Cytometer as a Tool for Hygiene Monitoring in Broiler Farms

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## Introduction

**Environmental hygiene** plays a critical role in broiler husbandry, directly influencing health, welfare, and performance. Great emphasis is placed on maintaining **biosecurity** on poultry farms. **Hygiene monitoring** in broiler production represents a key component of farm biosecurity.

**Plate cultivation methods** are considered the gold standard for the detection of microorganisms; however, their long incubation times limit their usefulness for rapid on-farm hygiene verification. Direct on-farm environmental hygiene monitoring therefore requires **rapid, practical, and reliable methods**.

Alternative approaches include:

- **Mobile flow cytometry (MFC)** – detects and quantifies intact cells and particles using impedance and alternating current at multiple frequencies without the need for optical systems,
  - the level of microbial contamination (sanitation effectiveness)
- **Luminometry (LUM)** – bioluminogenic detection of ATP,
  - the level of organic contamination (effect of mechanical cleaning).

The aim of this sub-study was to assess the potential of a mobile flow cytometer for hygiene monitoring on a broiler farm.

## Comparison of Hygiene Monitoring Methods - Key Differences

Methods	Plate Culture	Luminometry	Mobile Flow Cytometry
Principle	Growth of bacterial colonies in medium	Measuring of ATP in Relative Light Units (RLU)	Detection of intact cells (bacteria) and residua particles by the use of impedance flow cytometry
Microorganisms	✓ Cultivable only	✗ Not detected	✓ Total counts
Organic Contamination	✗ Not detected	✓ Detected	✓ Detected
Speed of Determination	⌚ Low (24-72h)	⚡ High (seconds)	⚡ High (minutes)

## Material & Methods

### Laboratory Monitoring:

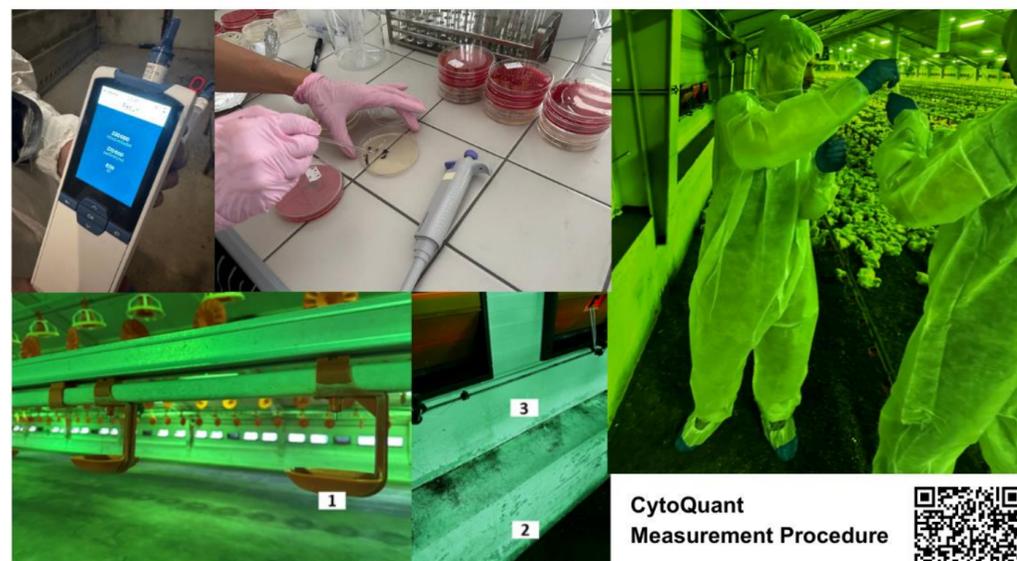
Reference culture of Escherichia coli (CCM 3988): suspension dilutions ranging from 10<sup>8</sup> to 10<sup>9</sup> CFU/ml prepared, applied onto sterilized PVC surfaces.

### Field Monitoring:

broiler house (capacity: 47 000 animals), deep litter system; sampling performed after animal removal, during sanitation procedures, and during fattening.

- **Sampling sites:** drinker <sup>1</sup>, concrete wall <sup>2</sup>, metal wall <sup>3</sup>
- **Sampling method:** swabbing (100 cm<sup>2</sup>)
- **Traditional cultivation:** Plate count agar - PCA (TMC 22°C), Blood agar - BA (TMC 36°C)
- **Rapid detection method:**
  - **Mobile Flow Cytometer (MFC) CytoQuant** (Romer Labs Division Holding GmbH), principle <sup>4</sup>
    - detection of living bacteria (IC – intact cells) and other particle (residues).
- **Statistical analysis:** Unistat for Excel 6.5 (Unistat Ltd., GB)
  - Spearman correlation (rSp), Wilcoxon test

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CytoQuant Measurement Procedure



## Differences in measured values: MFC and cultivation

Cytometer detected higher microbial counts in log IC than cultivation (log CFU):

- 1.13–2.26 log on BA (p < 0.05)
- 0.76–1.02 log on PCA (p < 0.05)

## Results

### Reference Culture Suspension:

A highly significant **very strong correlation** between **MFC** and **BA** was confirmed (rP = 0.931; p < 0.01).

### Sterilized Model Surface:

A highly significant **very strong correlation** between **MFC** and **BA** was confirmed (rP = 0.852; p < 0.01).

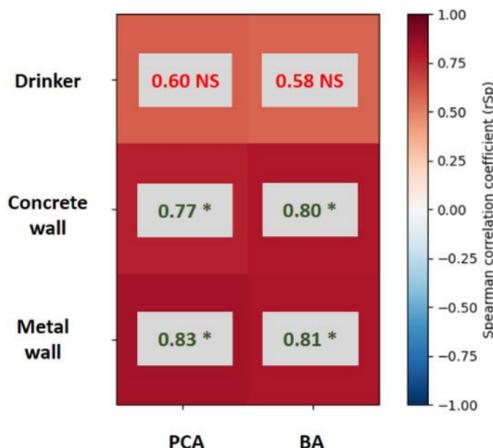
### Laboratory Monitoring

### Field Monitoring

### Correlation between methods in selected sampling sites

Statistically significant correlation between **MFC** and **plate-based methods** confirmed:

- **metal wall** (BA: rSp = 0.8117, p < 0.01; PCA: rSp = 0.8333, p < 0.01)
- **concrete wall** (BA: rSp = 0.8000, p < 0.01; PCA: rSp = 0.7667, p < 0.05)



## Take-home Message:

- ✓ **MOBILE FLOW CYTOMETER (MFC)** enables direct field detection of live bacteria (IC), suitable for evaluating **sanitation effectiveness**.
- ✓ **MFC** detect also non-culturable bacteria and the results are not affected by disinfectant residues.
- ✓ **MFC** with **LUM** (detecting **mechanical cleaning effectiveness**) and **traditional plate culture methods** (**identification of microorganisms**), enables a comprehensive approach to monitoring environmental hygiene.

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