



**BioCop**

New Technologies to Screen Multiple Chemical Contaminants in Foods

# **BioCop - The Solutions**

*“New approaches for the determination of contaminants in foods”*

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Food Contaminants Workshop Budapest May 06



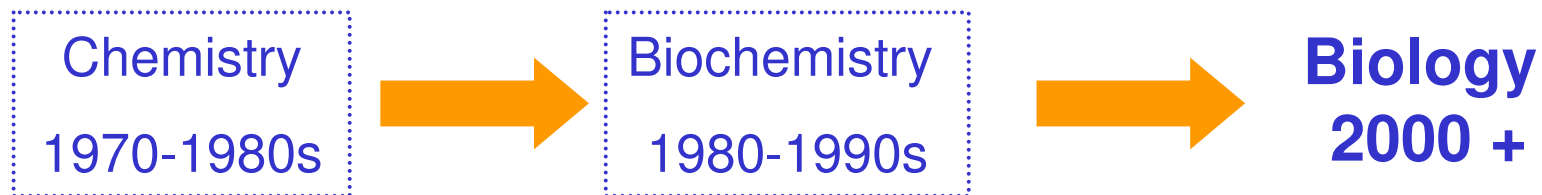
# Presentation Overview

New Technologies to Screen Multiple Chemical Contaminants in Foods

- ❑ **Introduction and background**
- ❑ About BioCop: contaminants and the technologies
- ❑ Focus on mycotoxins workpackage –  
Electrochemical biosensor
- ❑ Focus on pesticides workpackage –  
DNA microarray technology
- ❑ BioCop activities 2005 – 2010
- ❑ Summary



The requirement to rapidly test chemical contaminants has become a necessity...



***Emerging life science technologies:***

- Biomarker fingerprints
- “omics” technologies
- Production of unique binding partners
- Portable biosensors
- Biosensor coupled to mass spectrometers





# The Birth of BioCop....

New Technologies to Screen Multiple Chemical Contaminants in Foods



# BioCop

## Project Aim;

*The fundamental objective is to utilise emerging bioscience technologies to create a powerful new approach to detect & control chemical contaminants in foods*

[www.biocop.org](http://www.biocop.org)





## The Birth of BioCop -2

New Technologies to Screen Multiple Chemical Contaminants in Foods



- ❑ Project consortium includes 32 European and International partners
- ❑ Recognised international experts
- ❑ Universities, biotechnology companies, SMEs, government laboratories



## Food Contaminants

1. Veterinary drugs
2. **Pesticides**
3. Heavy metals
4. **Mycotoxins**
5. Endocrine disruptors
6. Shellfish toxins

## Technologies

- ✓ Transcriptomics
- ✓ Biosensors (optical & electrochemical)
- ✓ Molecular engineering





# Presentation Overview

New Technologies to Screen Multiple Chemical Contaminants in Foods

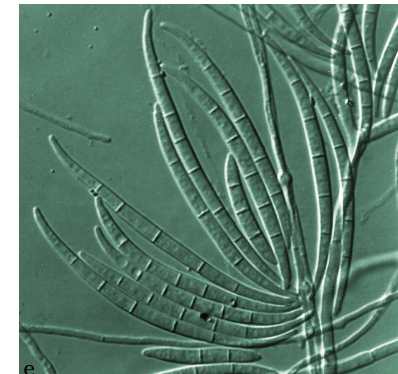
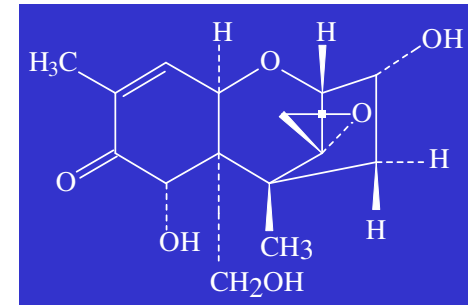
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- Metabolites of fungi, that may exert acute or chronic toxic effects in man and animals
  - *some known carcinogens!*
- Included in BioCop because they form a significant food safety issue in Europe
- Many classes of mycotoxins are known
- BioCop focus on: **Trichothecenes**



- Large group of mycotoxins, deoxynivalenol (DON) most well-known
- Vomitoxin (nausea, gastrointestinal disturbances in sensitive animals)
- Produced by *Fusarium* species
- Worldwide occurrence in cereals
- EU: regulations and limits coming soon,
- Need for rapid analytical methods!
  - Commonly used methods; GC/MS, HPLC/UV, HPLC/MS.
  - European concern: many activities taking place



- ❑ Focus: trichothecenes
  - Group A and B compounds (DON, NIV, T-2, HT-2)
- ❑ Matrices: cereals and baby food
- ❑ 7 partners involved - *links with international committees including CEN and AOAC*

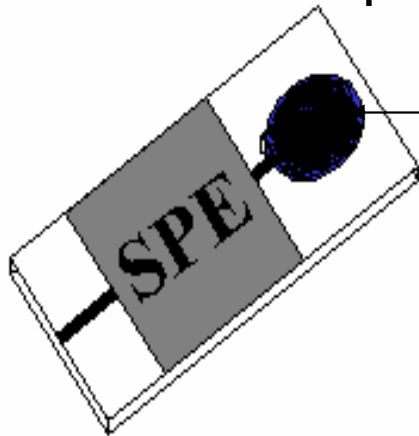
➤ **Technology platform; Electrochemical (bio)sensor**

- ✓ Low cost, portable system
- ✓ In-situ testing



## Overview of Screen printed electrodes;

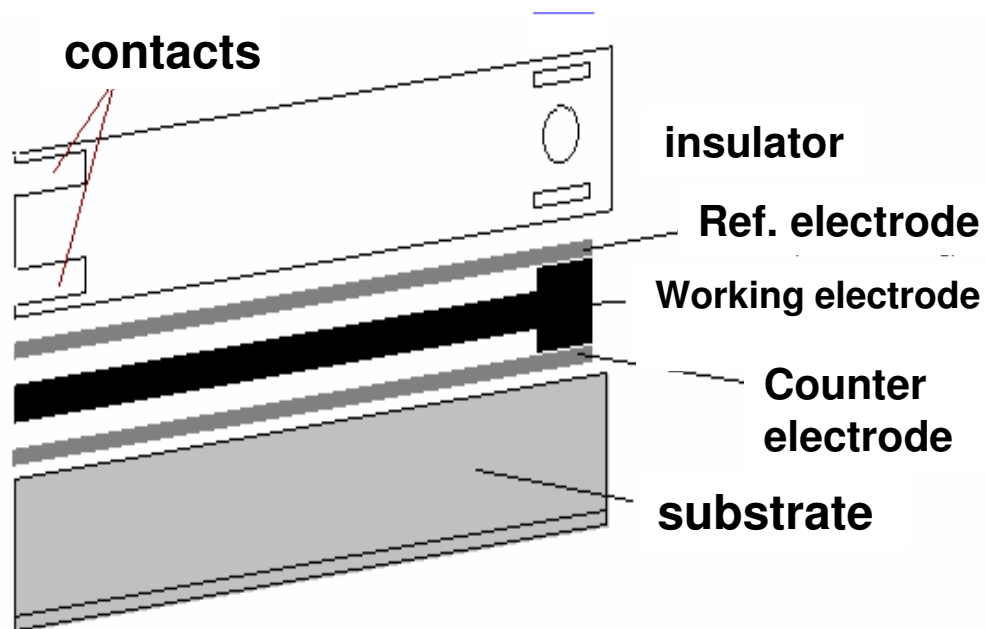
1. Low production cost / possible mass production
2. Disposable sensors
3. Easy to use
4. Low volume ( $\mu\text{L}$ ) of sample needed
5. Suitable for “in situ” application
6. Low detection limits achievable
7. None specific detection



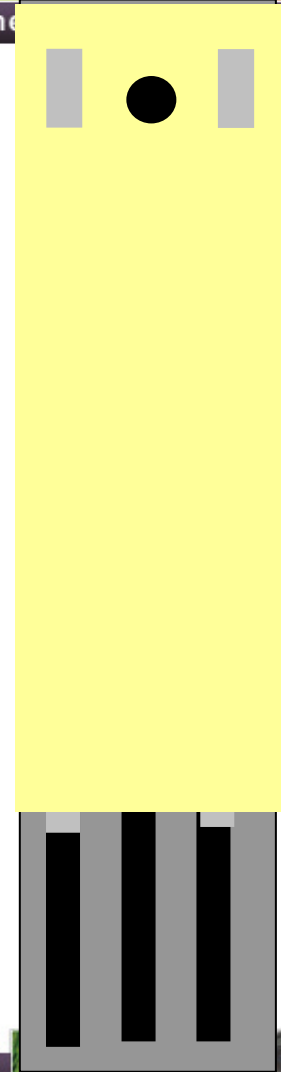
**Graphite ink acting as working electrode**



## Electrochemical sensor Components



Simple and easy to produce!

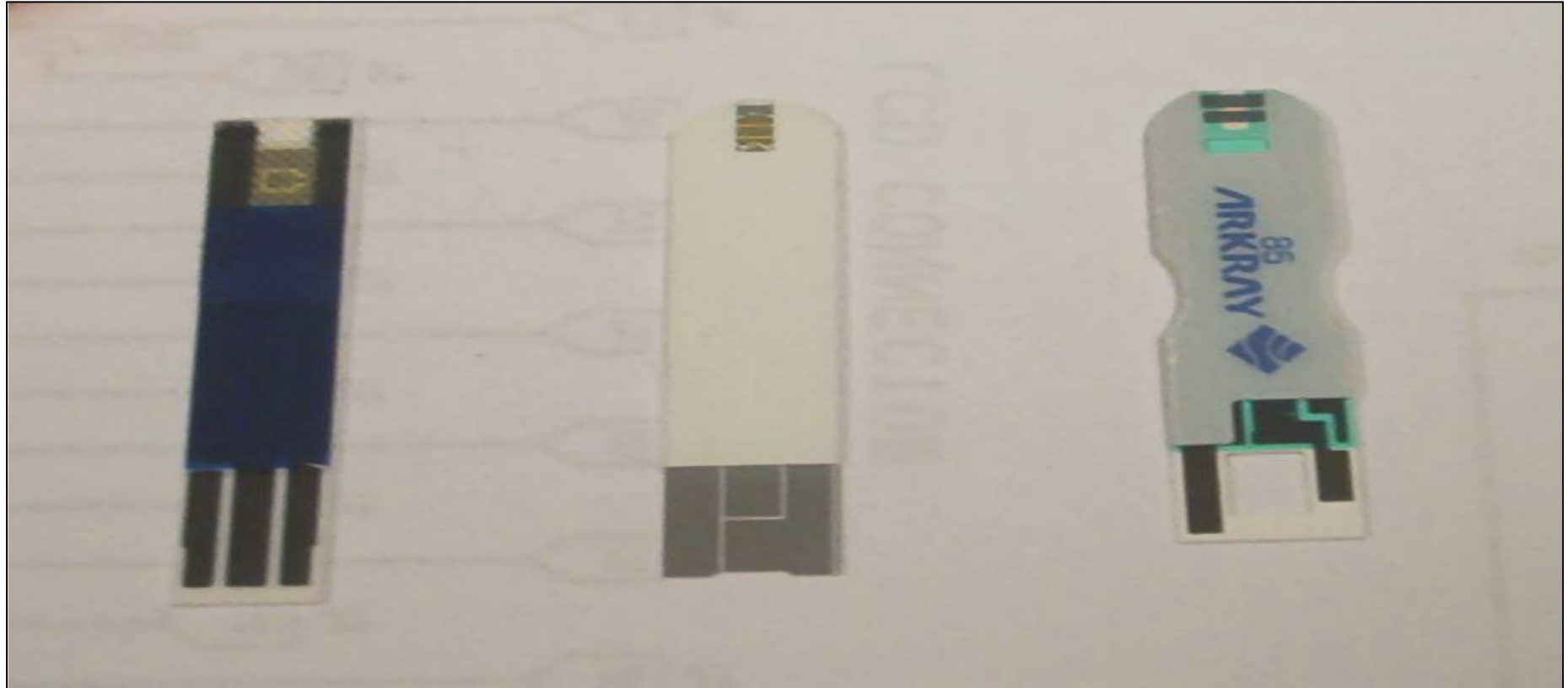




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## Screen Printed Electrodes -2

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[www.biocop.org](http://www.biocop.org)



- Type B trichothecenes are NOT electroactive compounds

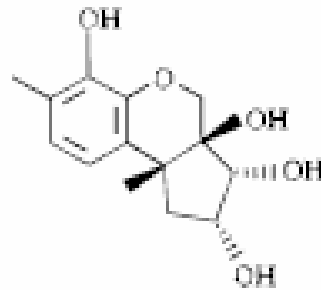
➤ No native signal with electrochemical methods!

**BUT**

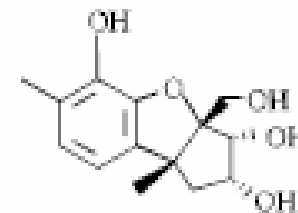


After an hydrolysis step in basic solution tricothecenes give electroactive compounds

Hydrolysis  
→



norDON-C

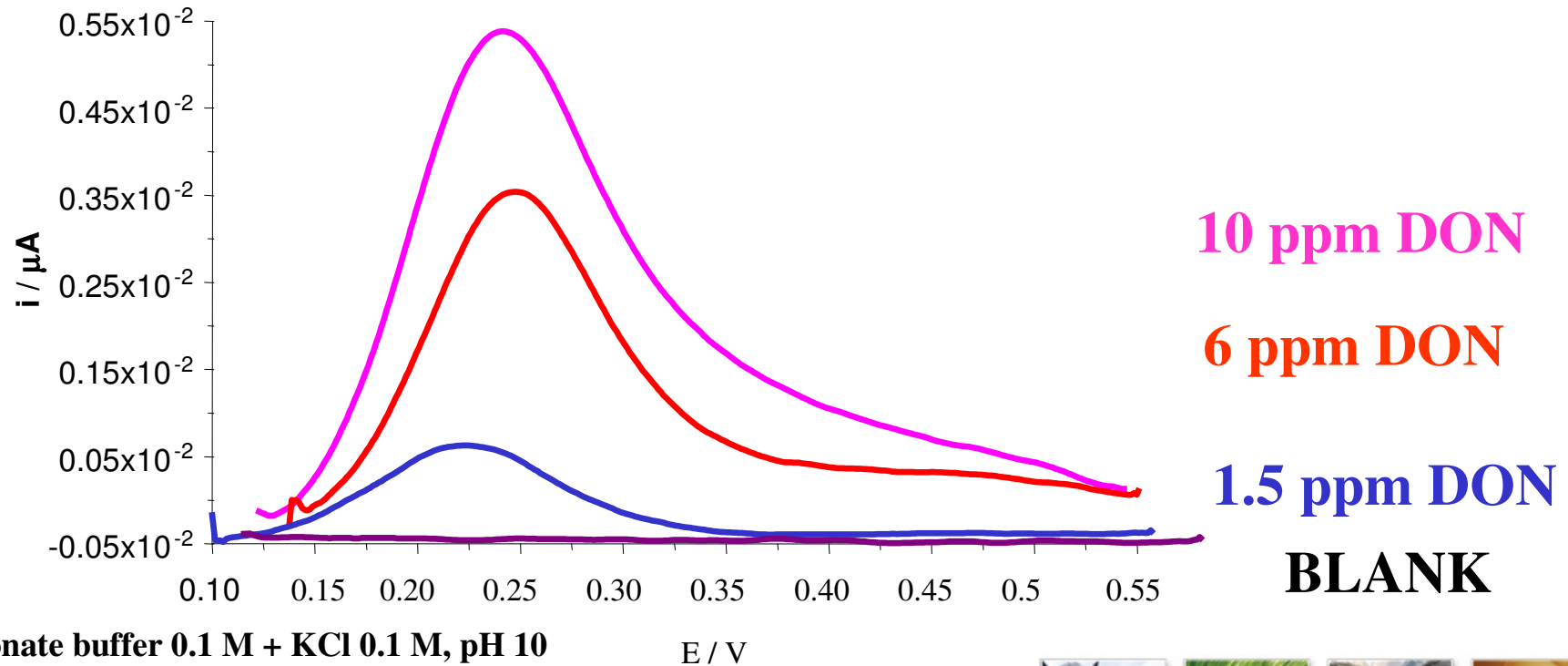


norDON-B

**Electroactive compounds**  
**Measured with DPV technique**



*Differential Pulse Voltammetry (DPV) recorded after hydrolysis of DON standard (80 °C for 1 h) using graphite SPE*

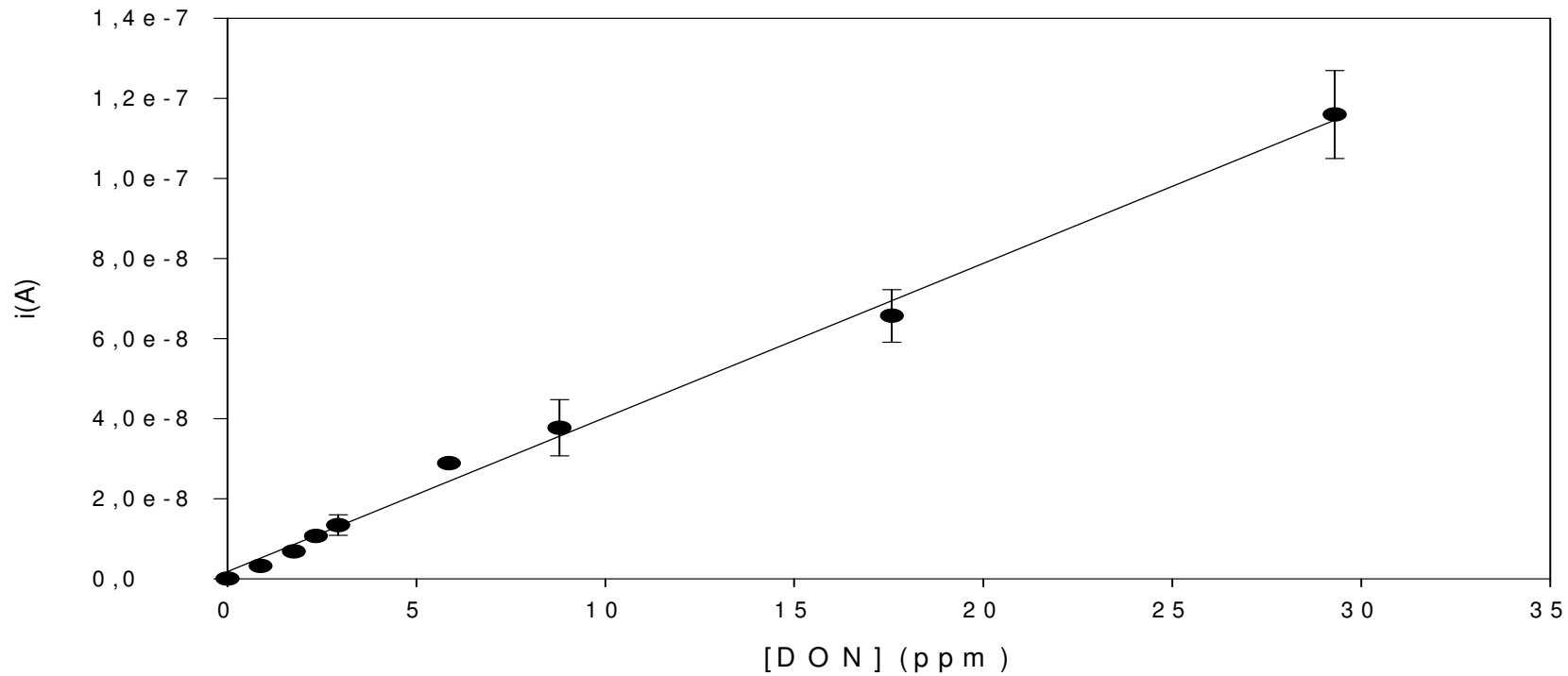




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# Calibration Curve – DON

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**Detection limit**

**0.3  $\mu\text{g/ml}$**

**Linearity range**

**0.5 – 30  $\mu\text{g/ml}$**





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- Organochlorine pesticides – *endocrine disrupting, toxic and highly biopersistant compounds*
- Matrices: cereals and baby food
- 6 partners involved
  
- ✓ Technology platform – transcriptomics (DNA microarrays)



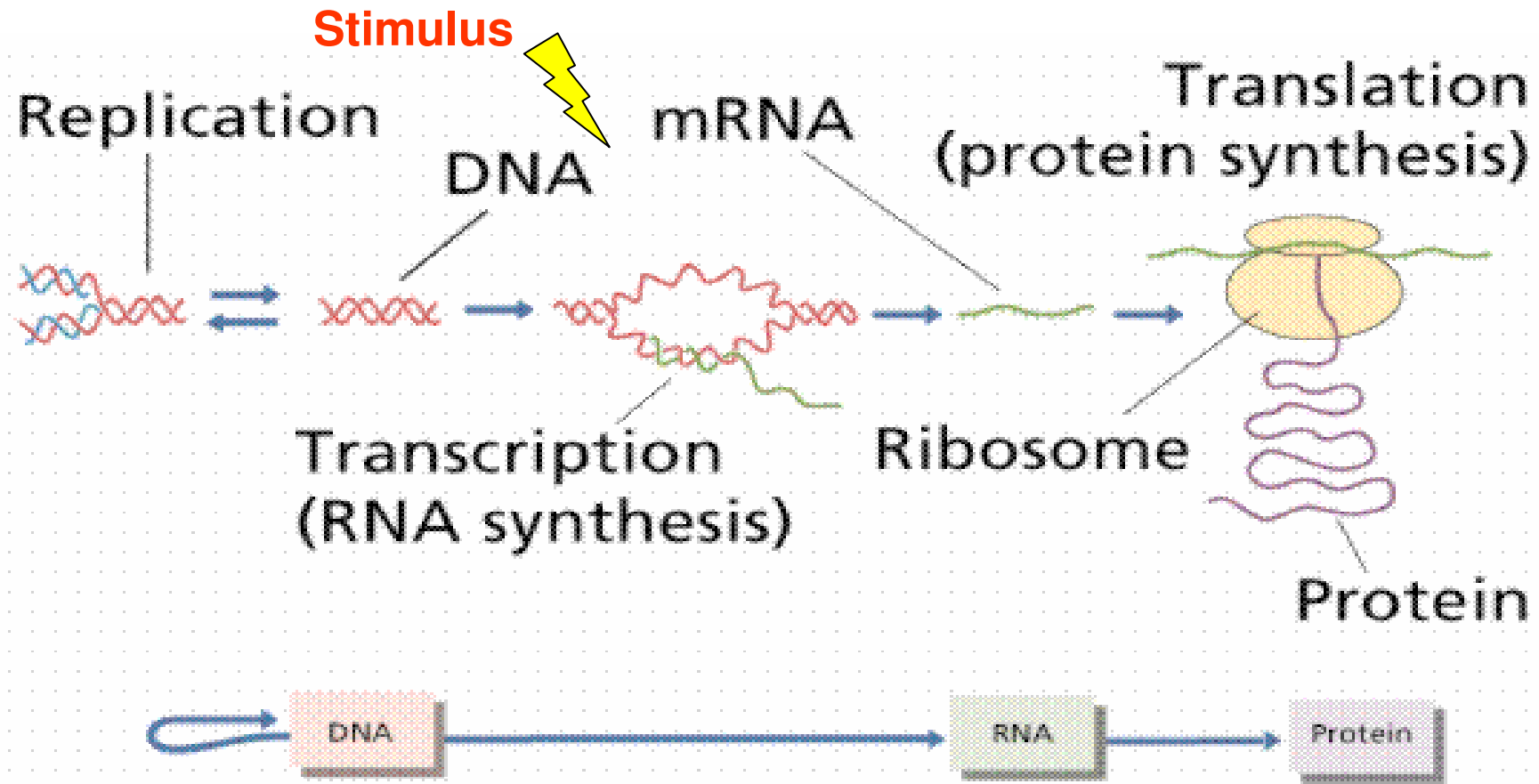


# Transcriptomics Overview -1

New Technologies to Screen Multiple Chemical Contaminants in Foods

- **DNA micro-array** technology is being developed
- “Identification of chemical residues through genomic fingerprints”
- Measurement of total biological effect
- Novel approach to screening foods
  - *technique pioneered in clinical/ pharma research*







BioCop

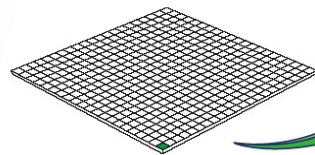
# DNA Microarrays

New Technologies to Screen Multiple Chemical Contaminants in Foods

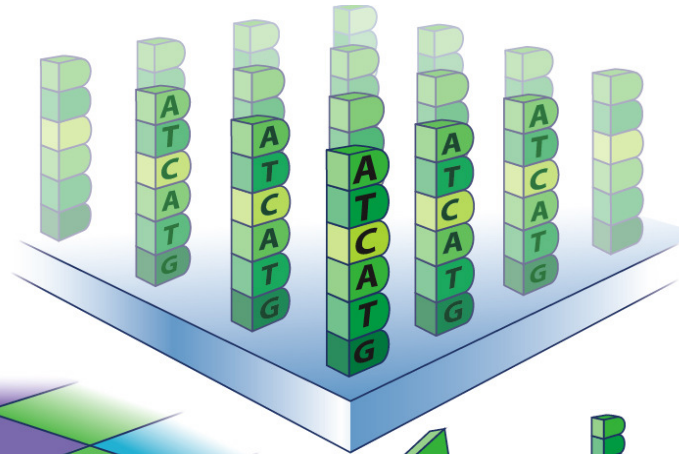
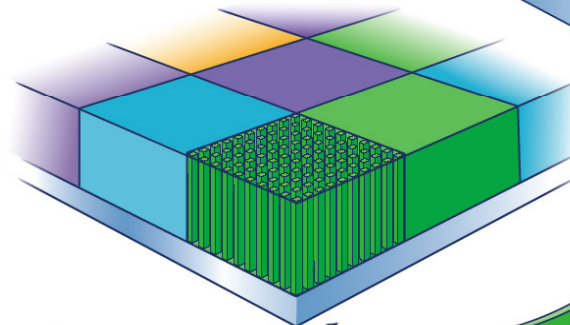
AffyMetrix Chip



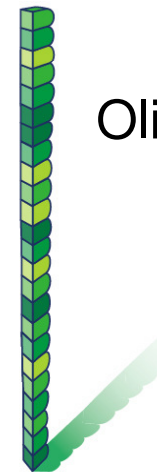
1.28 cm  
1.28 cm  
Actual size of  
GeneChip<sup>®</sup> array



500,000 locations on each GeneChip<sup>®</sup> array



Millions of DNA strands built up in each location



Oligonucleotide  
Probe

Actual strand = 25 base pairs

*Image courtesy of Affymetrix*

[www.biocop.org](http://www.biocop.org)

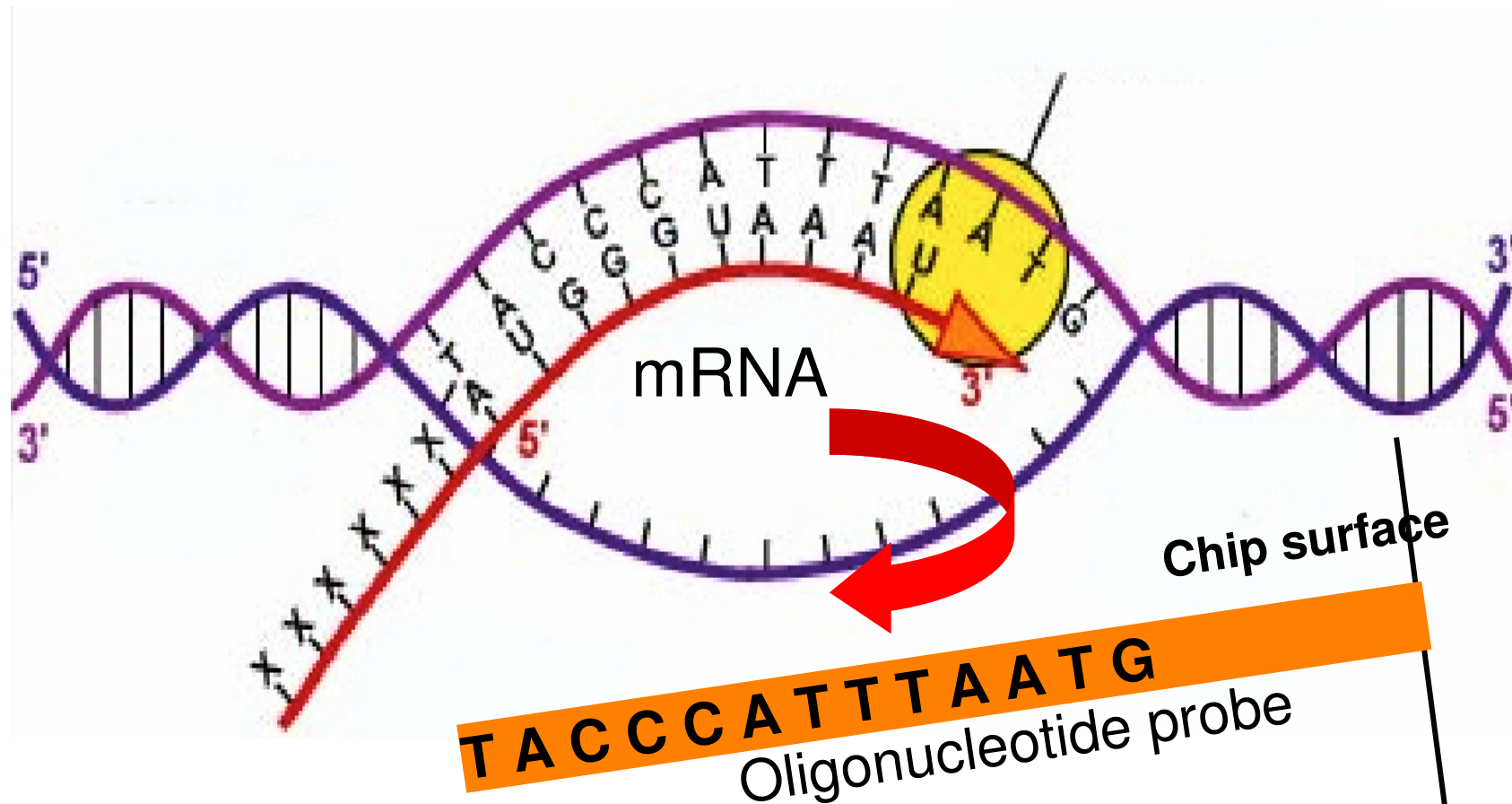




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# Oligonucleotide Probe Construction

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Exposure of Target Cells



Total RNA isolation



Reverse transcription

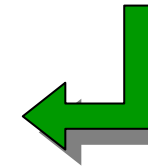
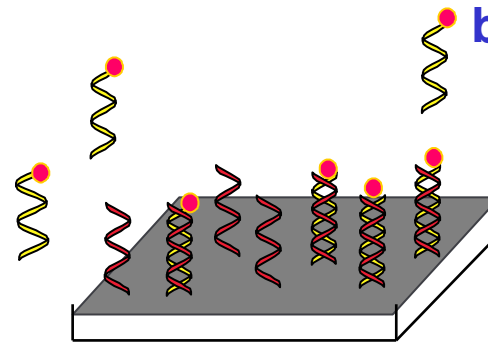


cDNA

In vitro  
transcription



biotin-labeled cRNA



Hybridization to the Affymetrix®U133 GeneChip  
(sequences of 33,000 human genes)

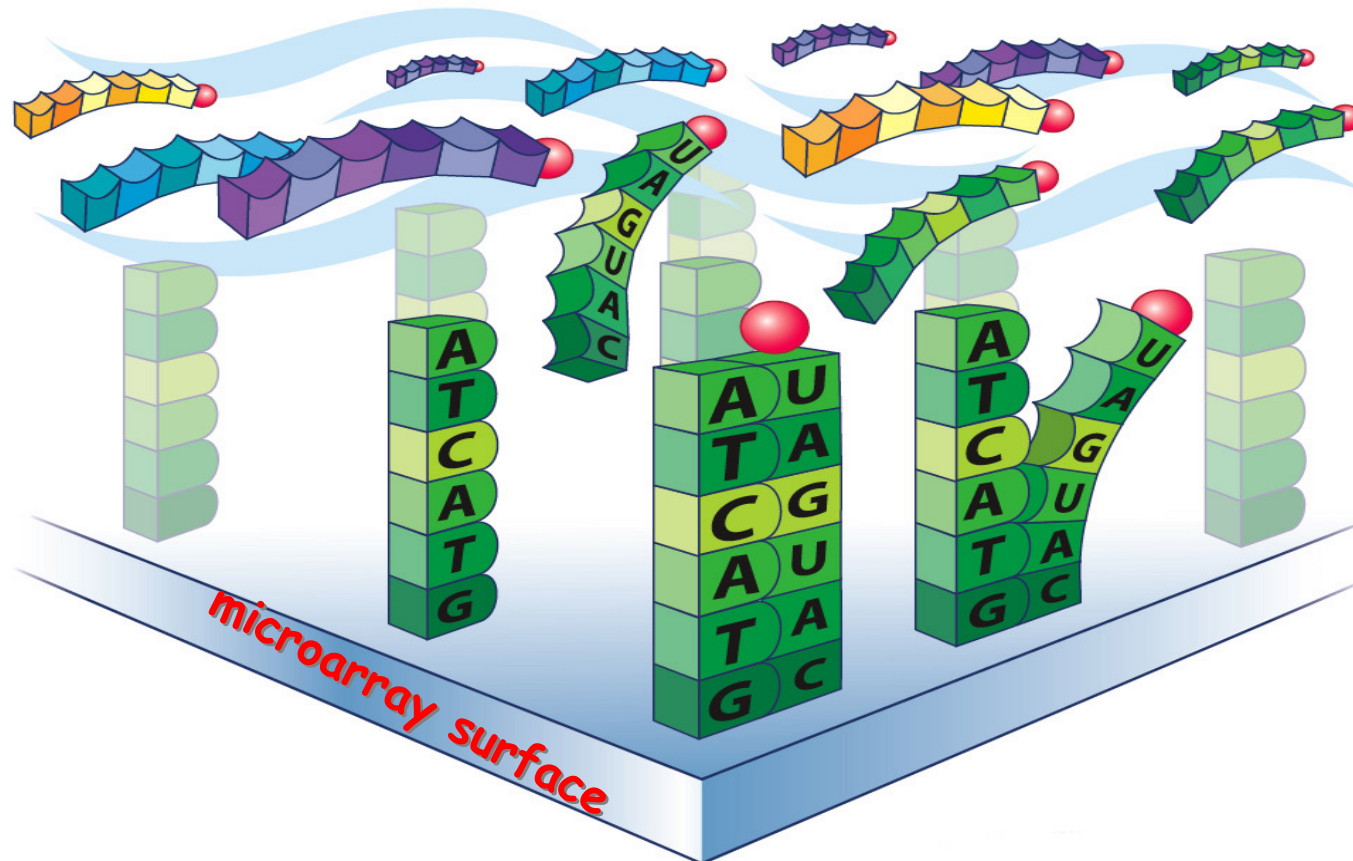




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# Hybridisation

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*Image courtesy of Affymetrix*

[www.biocop.org](http://www.biocop.org)





# Transcriptomics: Assay Outline-2

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Exposure of Target Cells



Total RNA isolation



Reverse transcription



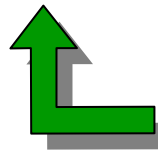
cDNA

In vitro transcription

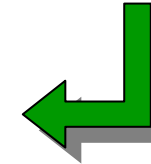
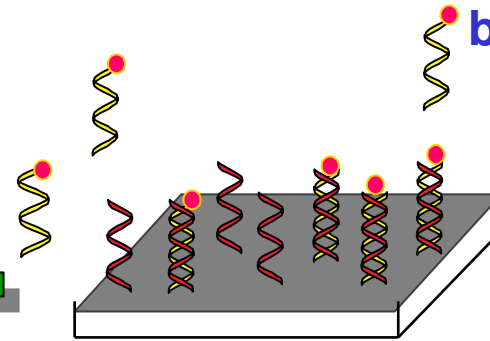


biotin-labeled cRNA

Scanning & Data Analysis



SAPE Staining



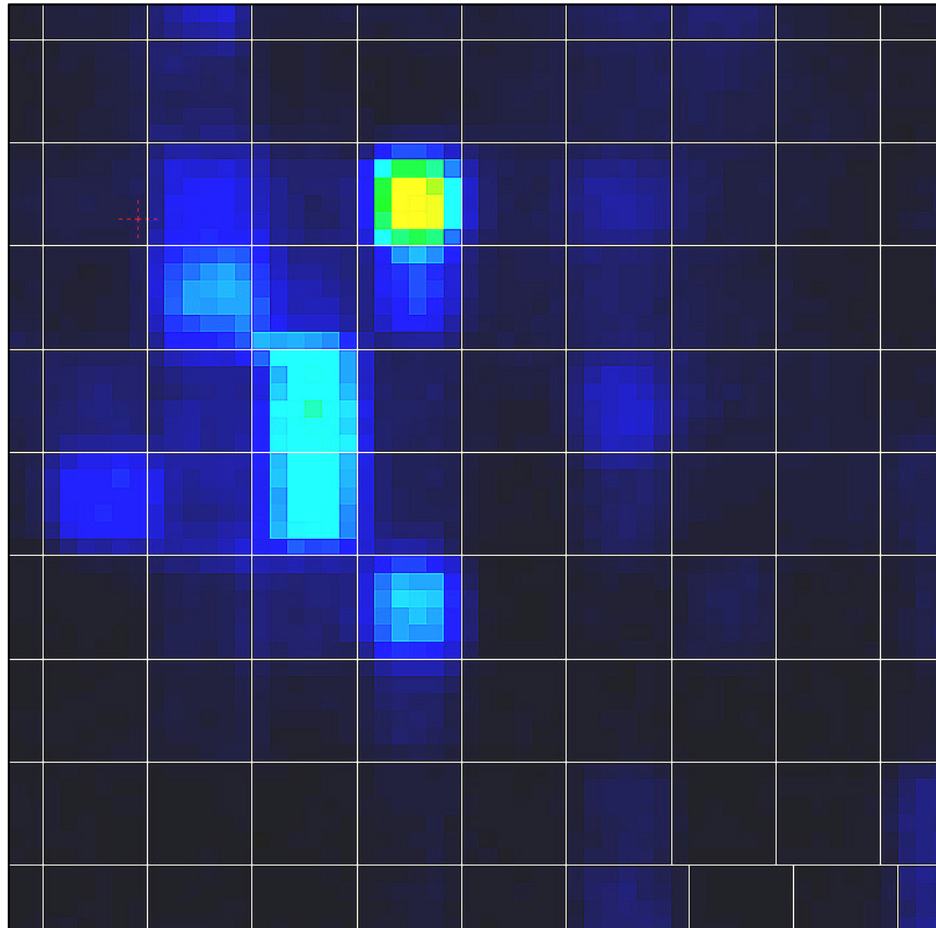
Hybridization to the Affymetrix®U133 GeneChip  
(sequences of 33,000 human genes)





# End-point: Visualisation of BioCop binding

New Technologies to Screen Multiple Chemical Contaminants in Foods





# BioCop Phases

New Technologies to Screen Multiple Chemical Contaminants in Foods

- ❑ 5 Year project, started March 2005
- ❑ **Years 1-2 Technology development**
- ❑ Year 2-3 Technology implementation and validation
- ❑ Years 3-5 Technology transfer (dissemination and training activities)





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[www.biocop.org](http://www.biocop.org)



- ✓ Technology developed within the life sciences area is being employed to rapidly screen foods
- ✓ Multiple contaminant classes can be detected simultaneously
- ✓ Goal - low cost high throughput screening assays
- ✓ Measurement of total biological activity –*data mining*
- ✓ Global approach to food safety





# Questions? and köszönöm!

New Technologies to Screen Multiple Chemical Contaminants in Foods



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Hanspeter Naegeli  
Giuseppe Palleschi*

Further information: [www.biocop.org](http://www.biocop.org)

