



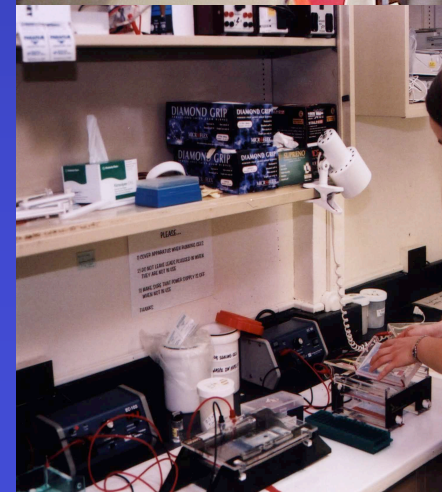
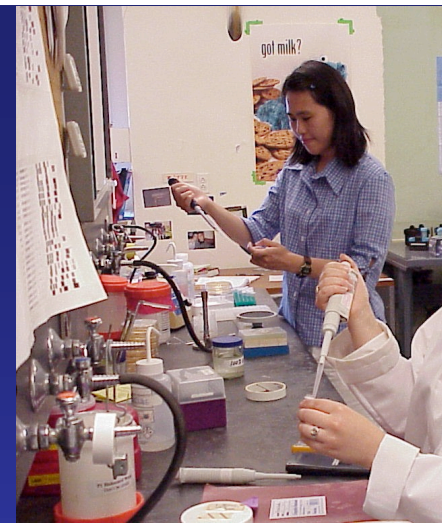




**What's lurking in  
your refrigerator?  
New tools for  
protecting the safety  
of your food.**



**Kathryn Boor, PhD  
Food Science Department**





# Foodborne illnesses in the news...

Aug. 1 2006 – Feb. 2, 2007



September 2006



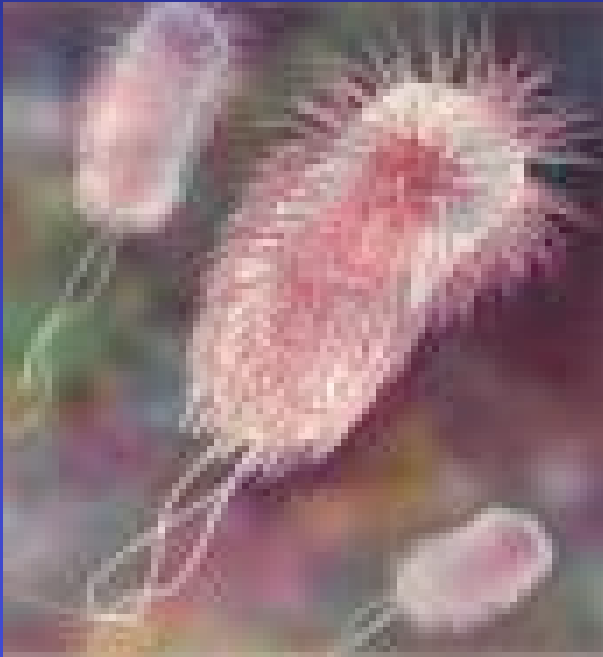
Dr. Scott M. Lieberman / AP



November 2006



# *E. coli* O157:H7





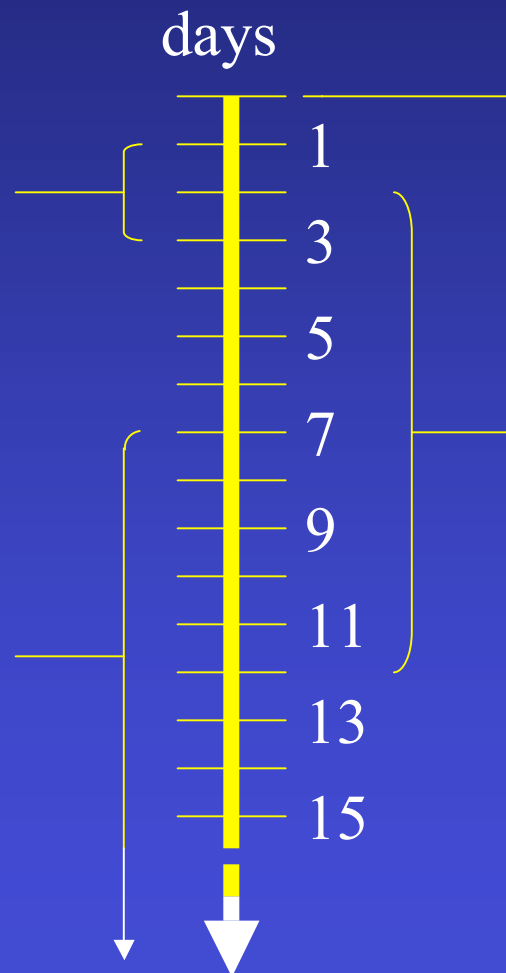
# Disease Characteristics

## Initial Symptoms

- diarrhea (no blood)
- abdominal cramps
- short-lived fever (?)
- 1 - 2 days

## Hemolytic Uremic Syndrome Related Symptoms

- red blood cell destruction
- lack of urine production
- acute renal failure



Consume  
contaminated food

## Hemorrhagic Colitis

- overtly bloody diarrhea
- moderate dehydration
- severe abdominal pain
- 4 - 10 days



# **Foods Associated with *E. coli* O157:H7**

- spinach
- shredded iceberg lettuce
- undercooked ground beef
- raw milk
- unpasteurized apple juice/cider
- dry cured salami
- lettuce
- radish sprouts, alfalfa sprouts
- produce from manure fertilized garden
- water





# Reservoirs of *E. coli* O157:H7

- Cattle
  - dairy and feedlot
  - calves > adults
  - prevalence of fecal shedding varies among herds
- Deer
- Sheep
- Water
- Wild pigs



# Foodborne diseases

- Centers for Disease Control and Prevention (CDC; 1999) estimated the following annual burdens due to foodborne diseases in the US:
  - 76 million cases of gastrointestinal illnesses
  - 325,000 serious illnesses resulting in hospitalizations
  - 5,000 deaths

# **Food protection is a moving target...**

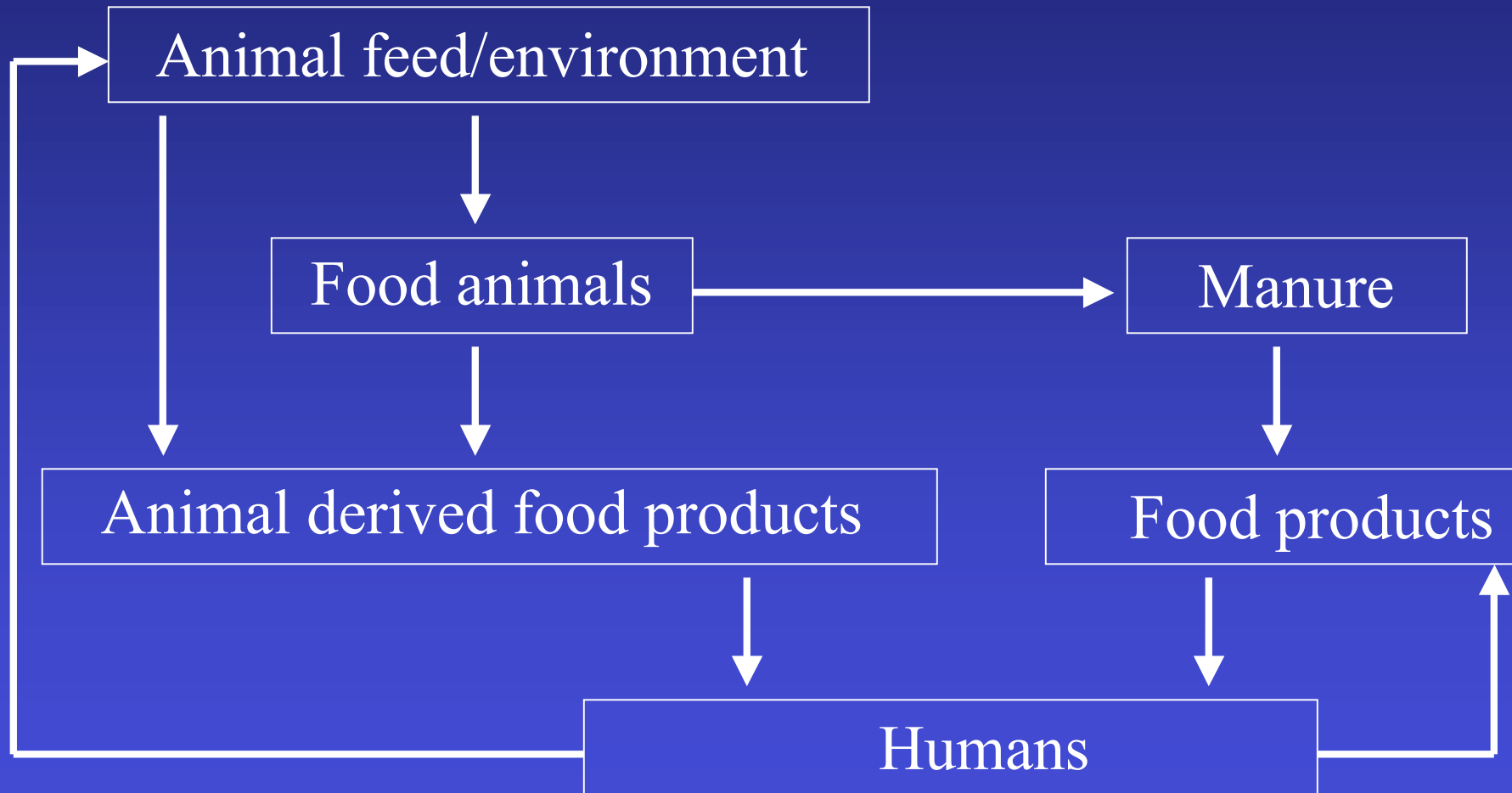
Challenges in protecting our food supply



Live Production	Slaughter & Processing	Distribution	Preparation	Consumption	Value

Source: Adapted from McCapes et al. 1991. JAVMA 199:873

# Transmission of foodborne zoonotic diseases



# **Food system factors affecting the presence and persistence of foodborne pathogens**

- Expansion of international trade
- Consumer demand for “lightly processed” foods
- Unknown limits for refrigerated perishable foods
- Mass production of foods
- Changes in eating habits



**Bush vs. Gore: The Lessons of the Primaries**

**U.S. News** & WORLD REPORT  
MARCH 20, 2000 [www.usnews.com](http://www.usnews.com)

# Turning 40



**More Americans hit middle age this year than ever before. A survivor's guide to the changes ahead—in your health, job, and home**

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# Our changing population

- The median age of our population is increasing
  - % of US population in their 40's
    - in 1975: 10.6%
    - in 2000: 15.5%
- Medical advancements have enabled survival of patients with immune system-compromising illnesses
- Result:
  - more than 30 million US citizens are already in a “high risk” category





# Potential long-term sequelae associated with some foodborne illnesses

- Miscarriage -- *Listeria monocytogenes*
- Hemolytic uremic syndrome -- *E. coli* O157:H7
- Reactive arthritis -- *Salmonella*, *Shigella*, *Yersinia*

# What are we looking for?

- Strategies for:
  - Identifying harmful biological substances in foods
  - Identifying species composition of food product (esp. important in meat products)
  - Identifying the presence of genetically modified organisms and food materials

Whole cell

Toxins and other Metabolites

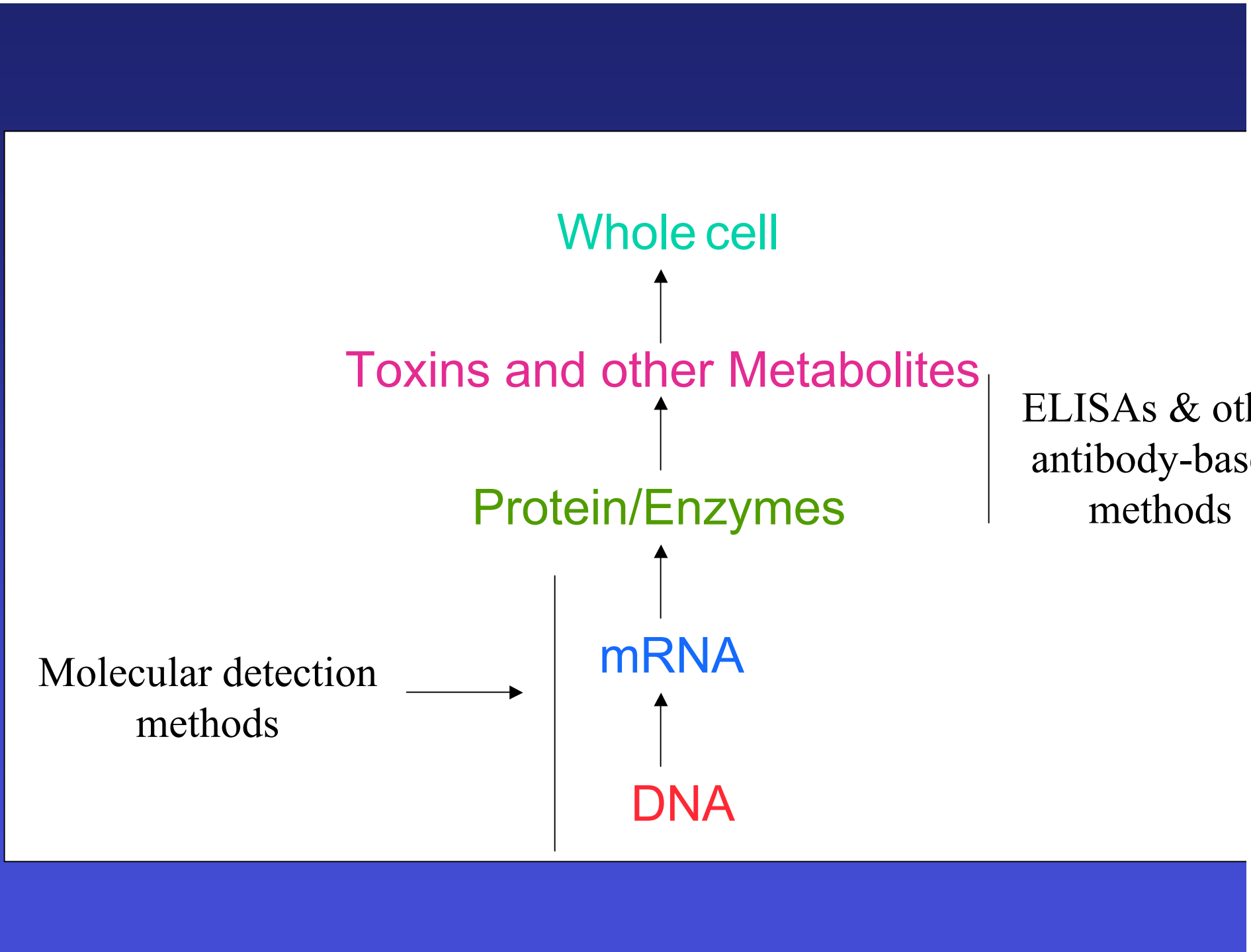
Protein/Enzymes

mRNA

DNA

Molecular detection  
methods

ELISAs & other  
antibody-based  
methods





# Theme

Molecular methods allow detection of relationships among microbes. These new tools enable:

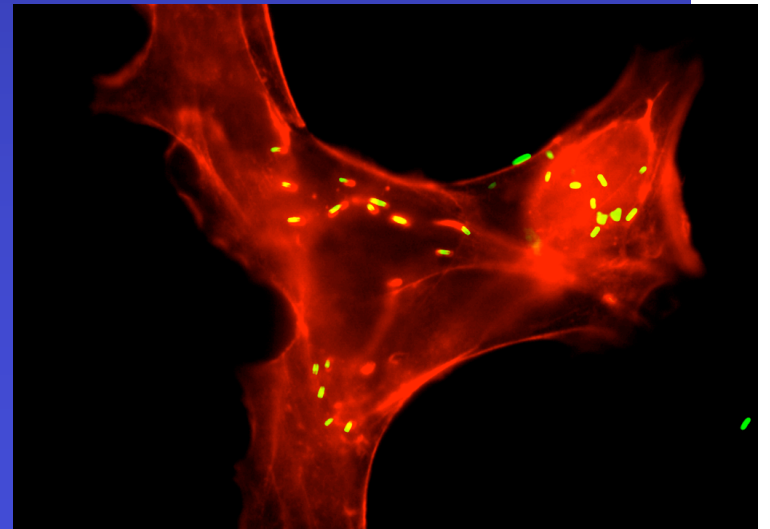
- Identification and elimination of contamination sources during manufacture
- Removal of contaminated foods from the market
- Identification of foodborne illness outbreaks

# Methods for differentiating among groups

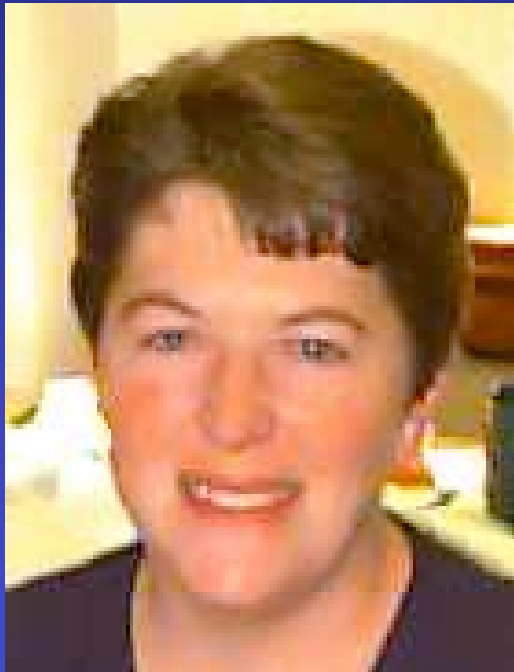
- Visual appearance
- Behavioral/mating characteristics
- Metabolic differences
- Genetic differences
  - Tools are also referred to as “molecular methods”

# All bacteria with the same name look alike under the microscope

- But, not all bacteria with the same name are equally likely to cause disease
- *E. coli*: some strains are harmless, some are very dangerous (e.g. *E. coli* O157:H7)



**Relatively high degree of genetic similarity, but visually different**





**Bacteria grouped within a species may have as little as 70% genetic identity, but are visually indistinguishable**

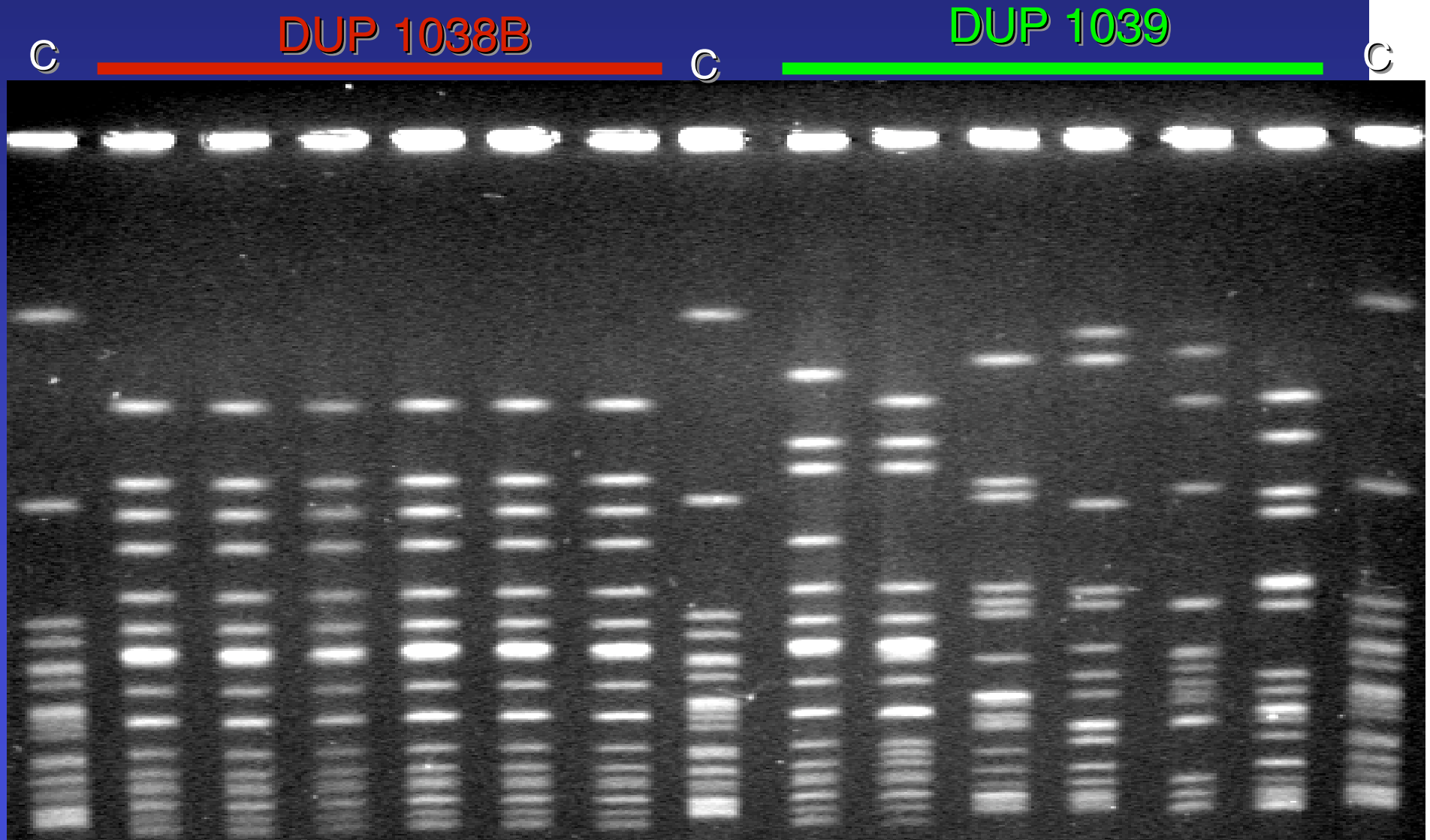


# Using genetic diversity among bacterial pathogens to our advantage...

To develop tools for rapid identification and differentiation among bacterial pathogens

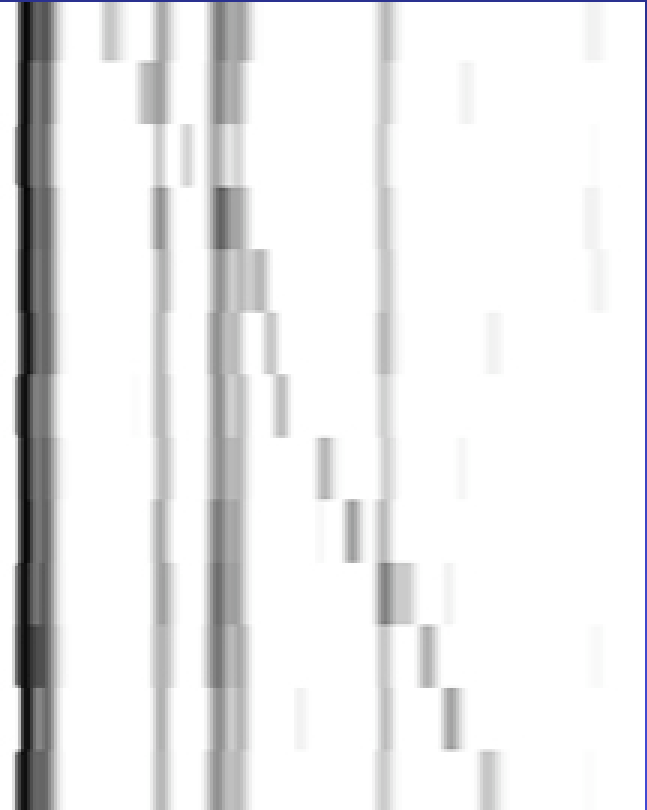


# Pulsed Field Gel Electrophoresis Results



# Examples of different *Listeria monocytogenes* ribotypes

Listeria monocytogenes  
Listeria monocytogenes  
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Whole cell

Toxins and other Metabolites

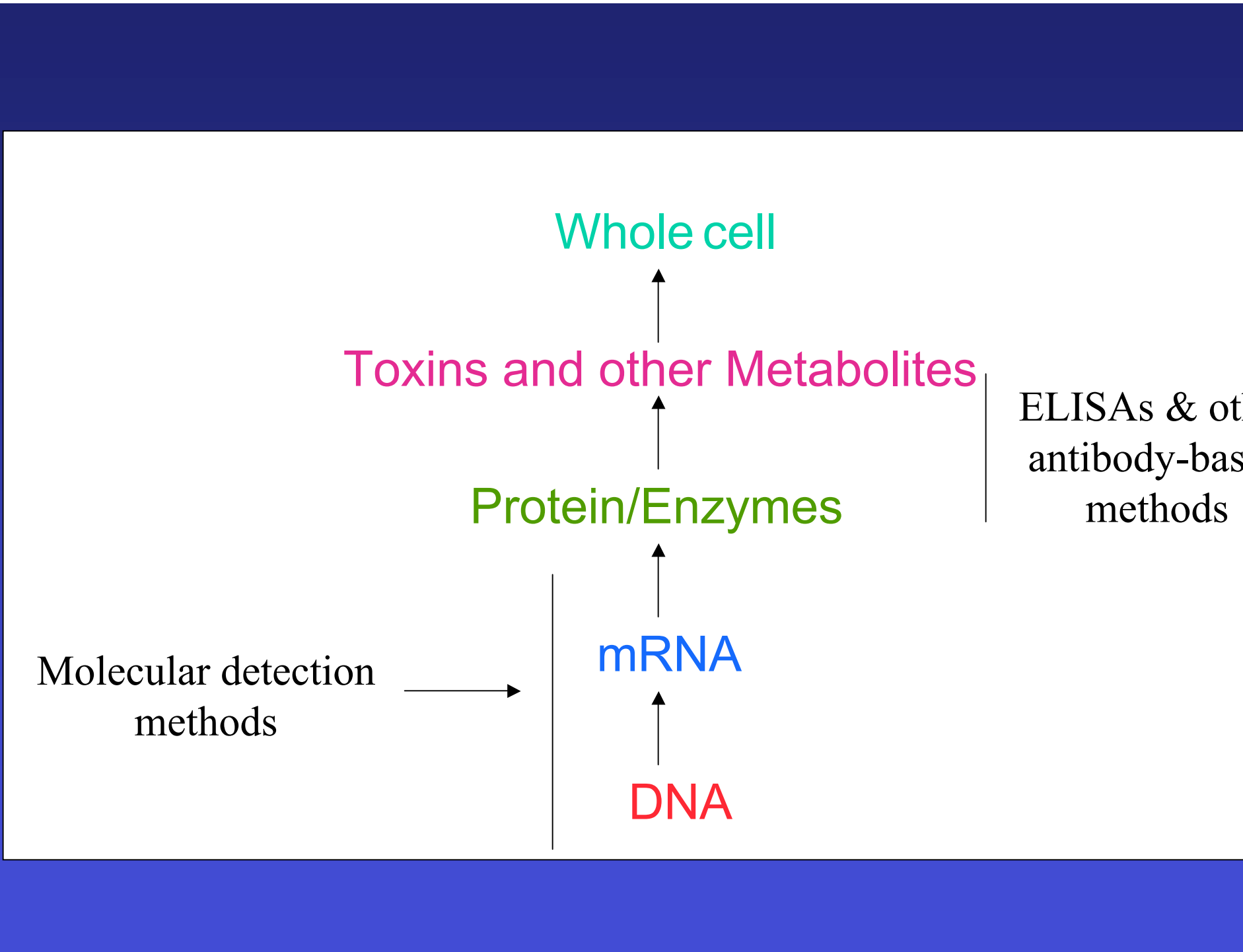
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Molecular detection  
methods

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antibody-based  
methods



# Summary



- Molecular detection and subtyping methods are emerging for bacterial foodborne contaminants and pathogens
  - Interpretation requires understanding of bacterial physiology, evolution, and genetics
- Molecular subtyping provides unique opportunities to track foodborne pathogens throughout the food chain and to improve the safety of our food supply



