New Tools to Assure Food Safety?

Peter Raspor*  
Univerza v Ljubljani  
Biotehniška Fakulteta

Thematic International Conference on  
Bio-, Nano- and Space Technologies,  
E U & Science Centers Collaboration  
Ljubljana, Slovenia, March 10-12, 2008

*Profesor Dr., DDr.H.C.  
Predstojnik katedre za biotehnologijo,  
http://www.bf.uni-lj.si/zt/bioteh/katedra/index.html
The food law in EU

Definition of the term “food” in EU legislation:
Food means any substance or product intended to be, or expected to be ingested by humans.

Novel Food Regulation

Novel foods are only allowed to be distributed in the EU if they fulfil three requirements:
1. The products may not be dangerous to consumers;
2. The consumers may not be misled;
3. The products may not be different from conventional products as to cause deficiencies in certain nutrients.
**Novel Food Regulation**

Substantial equivalence of the novel food to conventional foods is therefore important.

Where is the source of novelty?
- in substrates
- in technologies
- in nutrition practices

Selective breeding led to higher-yielding varieties.

Novelty is in many constituents like:
- Proteins profile
- Polysaccharide profile
- Fatty acid profile
- Vitamins profile
- Mineral profile

Teosinte
Modern corn

Global area of biotech crops

We are reducing numbers of staple foods
- We are losing diversity of foods as basic ingredients in food production
- Just corn, rice, wheat, cover more than 50% of our diet calories.
- 50 Species of plants and animals become extinct every year

But we get novel compounds in our diet
- Not just DNA

We are loosing numbers of staple foods
- We are reducing numbers of staple foods
- We are loosing diversity of foods as basic ingredients in food production
- Just corn, rice, wheat, cover more than 50% of our diet calories.
- 50 Species of plants and animals become extinct every year

The novelty is in many constituents like:
- Proteins profile
- Polysaccharide profile
- Fatty acid profile
- Vitamins profile
- Mineral profile

Eurobarometer 2006
But we get novel compounds in our diet also with other non-GMO technologies.

The new spectrum of residua...

Classes of applied chemicals commonly used in agriculture
(adapted from Ropkins et al 2003)

<table>
<thead>
<tr>
<th>Vegetables and fruit</th>
<th>Herbicides, Insecticides, Fertilisers, Nutrients, Desinfections*, Detergents*, Pesticides*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>Herbicides, Insecticides, Fertilisers, Nutrients, Growth Regulators, Desinfections*, Detergents*, Antioxidants*, Pesticides*</td>
</tr>
<tr>
<td>Milk and raw meat</td>
<td>Antibiotics, other veterinary drugs, mineral supplements, vitamin supplements, protein supplements, Growth Factors, Digestion enhancers, Antioxidants*, Desinfections*, Detergents*</td>
</tr>
<tr>
<td>Raw fish</td>
<td>Antibiotics*, Desinfections*, Detergents*</td>
</tr>
</tbody>
</table>

Where is the source of novelty?
- In substrates
- In technologies
- In nutrition practices

Pushing the technology over hill
- High pressure pasteurisation
- Microwave pasteurisation
- Super chilling
- Irradiation
- Ohmic/aseptic processing
- Chilling
- Freezing
- Canning
- Dehydration
- Pickling
- Smoking
- Biotechnology extended storage
- Robotic assemble in sterile environment
- Microwave sterilisation
- Antimicrobials natural or engineered
- Pressure sterilisation
- Combination fields
- Pressure/electrical/magnetic

Functions of Food
- First function (to exist: survival)
  - Nutrition: supply of nutrients
- Second function (to experience: pleasure)
  - Sensory and/or Sociocultural properties
- Third function (to enjoy: live)
  - Added value: health benefit
Increase use of convenience products

Meal preparation – acceptable duration
30 min (1980) → 15 min. → 8 min. (USA growth of ready prepared meals/ingredients
(Albert Heyn 1996 → 2006 30% → 65%

Increased availability of production need new approach to consumers:

New food supply channels
- decreasing role of ‘classical’ supermarket concept
- growth of food service

More individual and pressurised life is fueling demand for convenience

- In USA 40-50% of food dollars are spent on food prepared away from home.
- In Europe food expenditure on foodservice is 26%.

Allergies / Intolerances

- Increasing problems with food allergies & intolerances
  - 4-5% children have severe food allergies
  - 20% of population have a food intolerance or allergy
  - nuts, wheat, milk, eggs, shellfish, soy, sulphites etc.
- Allergy = extreme immune system response to a potentially harmful substance
  - e.g. Anaphylactic Shock
- Intolerance = caused by many different conditions e.g. lack of key enzymes, etc
  - e.g. Coeliacs disease

Food Safety Considerations

<table>
<thead>
<tr>
<th>Micro)biological Food zoonoses</th>
<th>Incidence per 100,000 population</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Europe</strong></td>
<td><strong>USA</strong></td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>51</td>
</tr>
<tr>
<td>Campylobacteriosis</td>
<td>53</td>
</tr>
<tr>
<td>VTEC infections</td>
<td>0.7</td>
</tr>
<tr>
<td>Listeriosis</td>
<td>0.1</td>
</tr>
<tr>
<td>Yersiniosis</td>
<td>4.0</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Systemic tools to reduce risk

- Technological tools
- Regulatory tools

Selection potential techniques used for managing microbial growth in foods of animal or plant origin

- Destructive techniques
- Prevention techniques
- Combination of destructive and prevention techniques

Selection of techniques used in food processing to create hurdles for microbial growth is based on:

- Aw (water activity)
- Eh (redox potential)
- pH (acidity/alkality)
- Decomposition of nano/microstructure
- Preservatives in food and/or Modified atmosphere
- Temperature

To produce and preserve food there are so many ways...

Conventional like:
- Draying
- Salting
- Fermenting
- Cooking/Pasteurising/Sterilising
- Cooling/freezing

....

Modern like:
- Antimicrobial packaging
- Chemical combinations
- Cold plasma
- Electron beam
- Gamma radiation
- High pressure ultrahigh pressure
- Magnetic fields
- Nano-thermo-sonication
- Microwave heating
- Ohmic heating
- Pulse electric field PEF, electroporation
- Pulsed light
- Submerged arcing
- Ultrasound
Systemic tools to reduce risk
- Technological tools
- Regulatory tools

HACCP system is mandatory
- In USA since July 1996
- In Slovenia since January 1st 2003
- In Australia since January 1st 2002
- In EU member states since January 1st 2006

PARADOX ??
- Emphasizing on effectiveness of HACCP
- Food poisoning affairs; Rising of food-borne diseases

Estimation of food illnesses annually
(extracted from Redmond E, Griffith CJ; 2003, WHO reports)
- 130 million Europeans
  (480 million population)
  27%
- 767 million Americans
  (277 million population) 27%
- 4.7 million Australians
  (20 million population) 24%

Estimation of food illnesses annually
(WHO report 2002)
- WHO surveillance programme for Control food borne diseases
  for Europe investigated more than 30 000 outbreaks in 42
countries and allocated (traced and identified) origin of 17 960
outbreaks between 1993 and 1998

PARADOX ??
- What is wrong ?
Today's food supply chain paradigm

Producer
From farm to the fork

RESPONSIBILITY

Consumer
From table to stable

Weakness of HACCP approach
(Jevsnik, Raspor, 2006)

Factors involved in foodborne diseases outbreaks
(P. Raspor, M. Jevšnik, in publication)

Factors related to contamination
Factors related to survival of microbs
Factors related to microbial growth
Other

Contributing factors to foodborne diseases outbreaks

Barriers / misunderstanding

Human behaviour and attitudes toward food safety shows that the levels of understanding, motivation and trust needs to be further cultivated and raised.

It has been shown that present maintenance of food safety in food chain can be easily broken down, because of:

- By accidents
  - No suitable equipment
  - No knowledge about potential consequences
  - No skills/suitable good practice (GMP, GAP, GCP, GSP, GHP, GLP,... HACCP) in respecting standards

- Or/Either
  - Ignorance
  - Carelessness
  - Inconsequentiality

- By purpose
  - Bio terrorism

Who can control this?
We see Micro-biological Hazards... which can not be ignored.

People in less developed and in more developed countries die from very different causes.

Examples of new pathogens recognized in the past decade:

<table>
<thead>
<tr>
<th>Year</th>
<th>Microbe</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>Guanethidine virus</td>
<td>Venezuelan hemorrhagic fever</td>
</tr>
<tr>
<td>1991</td>
<td>H5N1 influenza</td>
<td>Congo influenza, dengue</td>
</tr>
<tr>
<td>1992</td>
<td>Ebola virus</td>
<td>New variant of ebola</td>
</tr>
<tr>
<td>1992</td>
<td>Marburgella hemorrhagic</td>
<td>Cut scratch disease</td>
</tr>
<tr>
<td>1994</td>
<td>Ebola virus</td>
<td>Marburgella hemorrhagic</td>
</tr>
<tr>
<td>1996</td>
<td>Hepatitis A &amp; B</td>
<td>Acute hepatitis transmited non-A,non-B</td>
</tr>
<tr>
<td>1996</td>
<td>Human herpes virus B</td>
<td>Karposi's Sarcoma</td>
</tr>
<tr>
<td>1996</td>
<td>Lassa fever</td>
<td>Variant Creutzfeldt-Jakob Disease</td>
</tr>
<tr>
<td>1996</td>
<td>Hepatitis C virus</td>
<td>Parenterally transmitted non-A, non-B</td>
</tr>
<tr>
<td>1994</td>
<td>Brazilian haemorrhagic fever</td>
<td>Parenterally transmitted non-A, non-B</td>
</tr>
<tr>
<td>1993</td>
<td>SARS Coronavirus (new?)</td>
<td>SARS (Severe Acute Respiratory Syndrome)</td>
</tr>
<tr>
<td>1992</td>
<td>Karposi's Sarcoma</td>
<td>Human herpes virus B</td>
</tr>
<tr>
<td>1992</td>
<td>New variant of cholera</td>
<td>Vibri ob cholerae 0139</td>
</tr>
<tr>
<td>1991</td>
<td>Conjunctivitis</td>
<td>Encephalitozzon hellem</td>
</tr>
<tr>
<td>1990</td>
<td>Venezuelan hemorrhagic fever</td>
<td>Guanirito virus</td>
</tr>
</tbody>
</table>

How can this be controlled?

- By Administration
- By Technology
- By Inspection
- By Consumer
- And even more...
- By R&D
- By education and training (knowledge and skills)

Understanding the concept of good practices

In classical food chain strategy all relevant activities are taken for benefit of human being but locating consumer outside the system.

Understanding the concept of good practices (Raspor 2004)

- The importance of restoring the systems based on analysis of all relevant practices contributing to food safety has been stressed along the principles:
  - From stable to table
  - From farm to fork
  - From spring to drink
Understanding the concept of good practices (Raspor 2004)

- Consumer should be part of food safety systems
- Consumer is vital link between retail and home
- It has to obey “good housekeeping practice”

Good practices (Raspor, TFST 2007)

- In all of mentioned practices are HACCP elements that compose HACCP system as main system in food practice today.
- All practices are partial and are not connected in comprehensive system.

A new approach is offering new platform: “Good Nutritional Practice” (GNP)

- GNP should be adopted to balance food safety.
- It is important to reshape the existent food safety systems with GNP which would cover subsystems from other relevant good practices.
**A new platform:**

"Good Nutritional Practice" (GNP)

(Raspor, Jevšnik, 2008)

**FOOD WILL Stay A COMPLEX ISSUE**

**TECHNICALY - IN FOOD CHAIN:**

(Food framing, Food processing, Food preservation, Food storage and distribution, Food consumption...)

**SOCIOLOGICALY - IN THE SOCIETY:**

(Food security, Conception of the world; Philosophy of life, Religion, Policy making...Life style)

**Research**

New safety questions

Microbial, Nutritional, Toxicological, etc.

Appropriate Validated Biomarkers

New principles for tracking

Analytical

Compliance, Standards

Consumer perception and understanding

Development includes effective scientific and social knowledge as well as holistic risks/benefits analysis.

**Healthier Consumers**

Food Processing

Food Safety

Nutrition

New products, e.g. biotech enhanced foods, dietary supplements, new formulas, etc.

We will need new knowledge!!!

**Food safety issues - How far we can go?**

All consumers should have access to food that is safe, nutritious, of good quality and good value, and should be able to make healthy lifestyle choices.

Research and development has to support this with all means and technology and society should also support this activity.

Technology changes our methods but not our problems in achieving better and safer tomorrow.

**Growth of EU food research budget**

**Europe lab**

We have hardware

Do we have critical mass of human resources?
We should take an active part in research

- At least:
- Agronomist
- Food technologist
- Nutritionist
- Veterinary
- Physician
- Consumer scientists
- Economist
- Microbiologist

Can we add something to this story?

The food: Raspor; 2006

Thank you Hvala lepa!

Univerza v Ljubljani
Biotehniška fakulteta
Jamnikarjeva 101
1001 LJUBLJANA
SLOVENIJA
Tel.: +386 (0)1 423 11 61
Fax: +386 (0)1 256 57 82
http://www.bf.uni-lj.si/
Peter.raspor@bf.uni-lj.si

There are different faces of food. This is a permanent evolution and will stay this way. Newborns are always facing new food and just like seniors face novelties. There are many links to fashion and to lifestyle of particular persons. This process will continue side by side with our development and our desire to experience something new or at least innovative. The consumer will keep food quality and food safety in focus, but food security should not be kept aside either. Unfortunately, food reserves are diminishing and price of energy is rising. In spite of this or because of this, the technology has many possibilities; nutrition has many opportunities and food sciences many challenges. All of them for better tomorrow.