Current Status and Options for Biotechnologies in Food Processing and Food Safety in Developing Countries

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Biotechnology

“any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use.” Convention on Biological Diversity.
Biotechnology in Food Processing

- The fermentation bioprocess:
  - Is the major biotechnological application in food processing
  - Is one step in a sequence of food processing operations
  - Makes use of *microbial inoculants* to enhance
    - Taste
    - Aroma
    - Shelf-life
    - Texture
    - Nutritional Value
Schematic of Steps of an Ideal Fermentation Process

1. Raw Material → Pre-Treatment → Bioreactor → Incubation → Fermented Product
2. Inoculant
3. Product Separation → Final Product
4. Downstream Processing
Dried soybeans

1. Grading
2. Dehulling
3. Gravity separation of hulls
   - 1st Soak cotyledons for overnight at room temperature
   - Boil 60 minutes in soak water
   - 2nd Soak cotyledons for overnight at room temperature
   - Place into the net - plastic bag and tight
   - Steam or boil for 30 minutes
   - Drain and cool

- Inoculation with powdered "ragi tempe"

- Pack into perforated plastic bag (about 200g) and seal
- Incubation in the bamboo rack for 36-40 hr

Product: Tempeh
From Art to Science: Levels of Technology

- Household Level
- Village Level
- SMEs
- Industrial/Large Scale

Levels: Sanitation, Technology, Process Control, Product Quality & Consistency
Types of Inoculants

- "Appropriate" Starter Cultures
  - Back-slopping
- Defined Starter Cultures
  - Propagated and maintained under sterile conditions
- "Chance" inoculation of fermentation processes is also widely employed
“Appropriate” Starter Cultures

Mould Starter Cultures
Defined Starter Cultures
Bioreactor Technology

Soy Sauce Fermentation (Asia)

Earthenware Pots used as Bioreactors
Bioreactor Technology

Traditional Koji Chamber

New Koji Chamber
Bioreactor Technology

Traditional Sorghum Beer Production
Role of Biotechnology in Starter Culture Development

- Enhancement of starter culture safety
- Tailoring of cultures to achieve desirable products.
- Improve yields, quality and consistency of product

All of the above are possible with the appropriate bioreactor conditions
Biotechnological Tools For Starter Culture Improvement

<table>
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<th>Biotechnological Tools</th>
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<td>I. Diagnostics</td>
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<td>Characterization of microorganisms</td>
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<td>PCR Specific and Non Specific Gene Amplification</td>
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<td>Genome sequencing</td>
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## Biotechnological Tools For Food Safety Assurance

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<th>Food Safety</th>
<th>Biotechnological Tools</th>
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<td>Specific Gene PCR Amplification</td>
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<td>Specific protein identification by Immunoassays</td>
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<td>Biosensors</td>
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<td>II. Detection of chemical and</td>
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<td>biochemical hazards</td>
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<td>III.Traceability of Food</td>
<td>DNA Bar code</td>
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<td>- Unique DNA Polymorphism</td>
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Changing Socio-economics a Driving Factor for Improvement

- **Traditional Consumer**
  - Affordable staples
  - Taste
  - Shelf-life
  - Food Security and Safety

- **Mid-High Income**
  - Health food
  - Quality
  - Convenience
  - Food Safety
  - Shelf-life
From Art to Science: Levels of Technology

- Levels of Sanitation
- Level of Technology
- Process Control
- Product Quality & Consistency

- Household Level
- Village Level
- SMEs
- Industrial/Large Scale
Lessons from the Past

Success has been achieved where:
- An enabling environment has been provided by Governments
  - Governmental support facilitates the adoption of improved technologies
- Development of technical skills has been prioritized
- Funding support exists for research
- Industry-institutional linkages have been developed
- North-South, and South-South collaboration has taken place
- Industry has adopted proactive approaches
- Production of fermented foods is market driven

Attention must be paid to intellectual property issues
- Starter culture development is a driving force for upgrading bioreactor technology
Country Level - Priorities for Action

- Regulatory and policy issues
  - Food Safety
  - Food and nutritional security
  - Technology transfer and innovation
  - Business policy

- Education Policy
  - Consumer education
  - Academic and vocational education on food biotechnology - fermentations

- Institutional Strengthening and Capacity Building
  - R&D support targeted to the food bio-processing sector
  - Dissemination of improved technologies
  - Strengthening of food safety management systems
Country Level - Priorities for Action

- Infrastructure Development
  - Transfer and adaptation of technology

- Intellectual Property Rights

- Information, Networking and International Cooperation
  - Access to specialized technical information
  - Networking and exchange among institutions and across regions
Role of the International Community

- Policy Development and Planning
- Regulatory Frameworks
- Capacity Building on Technical and Regulatory Issues
- R & D Technology Transfer
- Infrastructure Development
- Networking Information & Awareness Raising
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THANK YOU

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