How Thermal Indicators Can Prevent Food Borne Illness

• Elena Dorr
• Charles Sizer
• Mat Dado
• Joshua James
Problem Statement

There are many perishable products requiring stringent, low temperature storage conditions

• $152 billion annually in US\(^1\)

• US and abroad\(^2,3\)

• 88% non-produce\(^4\)

References:
2. Cnn.com, Monday, Aug 18\(^{th}\), “Spoiled food behind NYC illness”.
4. Centers for Disease Control Data
Why Silver Nanorods?

Silver Nanorods: Small particles, with a physical shape that changes with **time** and **temperature**.

- Educate Consumers
  - Individual package
  - Box of vaccines
  - In transport

- Spring 2009 IPRO
  - Ideal synthesis volume
  - Estimated label to be cheaper
  - No control of color change
Objectives

- Improve procedure for optimal production
- Evaluate risks, technologies, and applications
- Process design and scale-up
- Create a prototype
- Evaluate cost and competitors
- Mentoring chemical engineering 296 students
Development and Performance

- Team logistics and communication
- Team values statement, tasks, timeline and goals
- Peer reviews, timesheets
- In-class updates
- Adapted to change
  - Created two lab groups
  - Narrowed-focus
  - Changed our groups
Team Organization

**Lab**
- Experimentation and analysis

**Prototype**
- Design a thermal indicator

**Research**
- Investigate and evaluate new applications for silver nanorods

**Scale-Up**
- Design a process for increased production

**Ethics**
- Investigate ethical issues surrounding nanorods

**Business**
- Economic analysis and design
New Team Organization

- Prototype
- Poster and Brochure
- Final Report
- Presentation
- Final Research
Project work: Lab

- Improved synthesis
- Experimentation
- Spectroscopic analysis
- Challenges:
  - Published protocols incomplete
  - Lab scheduling

First group at IIT to consistently create silver nanorods!
Project work: Scale-Up

- Academic research
- Scaled-up
- Tested and modified
- Continuous flow process
- Equipment restrictions
Project work: New Technology & Ethics

- New Technology
  - Other applications
  - Competitor research

- Ethical Considerations
  - Environment
  - Consumer
Prototype

- Design
  - Consumer
  - Manufacturer
  - Environment
- Packaging
  - Capsules
  - Gels
- Labels
Competitor Cost Comparison

<table>
<thead>
<tr>
<th></th>
<th>IPRO 348</th>
<th>Warm Mark</th>
<th>Thermax</th>
<th>3M Monitor Mark</th>
</tr>
</thead>
</table>

Nanorod Label Cost

Total Cost: $0.25
Conclusions

- Possible to control quality, time and concentration properties
- Labels are competitive
  - Future applications
  - Increased production
  - Ethical considerations incorporated
- Quantitative quality control
Recommendations

- Continued lab research and scale-up design
- Improve label design
- Test toxicity and disposal
- Market research
- Improve viability of existing prototype
Acknowledgements

- Professor Perez-Luna
- IPRO Office