VIRTUAL EXPERIMENTS FOR FOOD SCIENCE-TECHNOLOGY-ENGINEERING EDUCATION

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Significance

- Hands-on lab experiments are the most effective tools in teaching new concepts and testing novel hypothesis in engineering education.

- They are
-

  typically organized around groups of students

  follow the paradigm of students spending a long time clustered around workbenches.

Significance

- Due to the limited time
  - students receive an uneven exposure time,
  - it is difficult to design an experiment to examine the effects of various variables on the outcome, and
  - this leads to demonstrate only one set of processing condition for a given process.

Significance

- With this approach we might not achieve a functional understanding of process performance.
- Personal observations indicate that only a few active learners actually perform the required tasks in a typical lab exercise,
  - leaving many of the remaining students to only observe or daydream.
- In addition, many universities cannot afford to maintain up-to-date labs with the latest instrumentation.

Objectives

- to develop virtual labs for various food processing operations,

- to improve understanding of food processing principles, and

- to reduce the cost and time required for lab experiments.

Implementation

- Virtual labs were created using a computer **programming language** (*Microsoft VB6.0*)

  to write the numerical simulation codes.

- The numerical codes were accompanied by
  - **Active-X programs** for extended graph abilities, visualization and spreadsheet abilities, and
  - **Animated picture technologies** to give the taste of an actual hands-on lab experiment.

Implementation

- The use of virtual labs involved the users to interact

  by setting operation parameters,

  observing changes and

  recording data for further analysis.

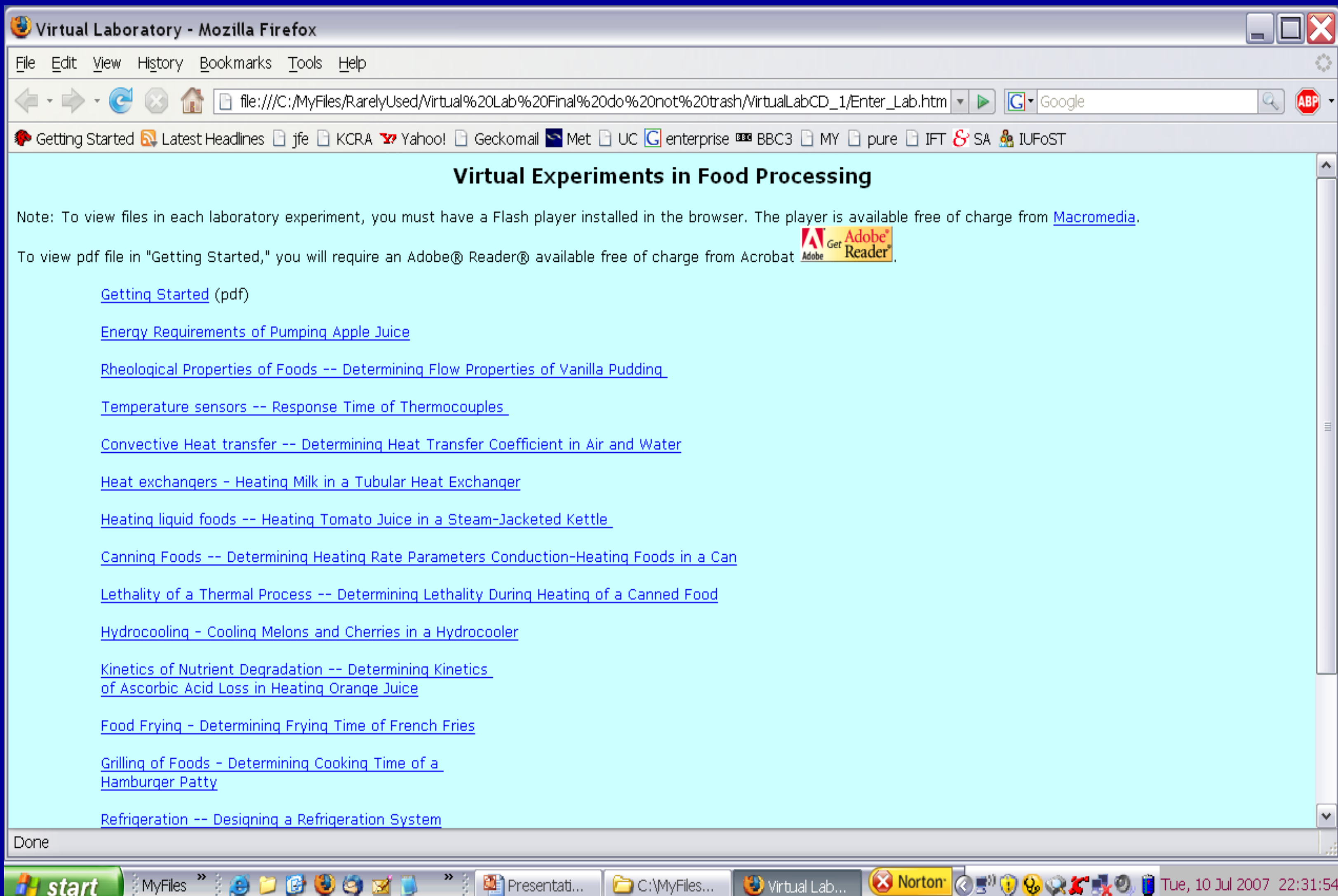
Implementation

- In a lab, students run an actual process using a limited number of operating conditions.

- Using the virtual labs, this might be followed by each student generating a set of additional data.

- The output from the simulation is analyzed as if it were actual data *(obtained from a hands-on lab experiment)* so that students can determine the effects of operating conditions on the results.

Virtual experiments in food processing – 27 experiments

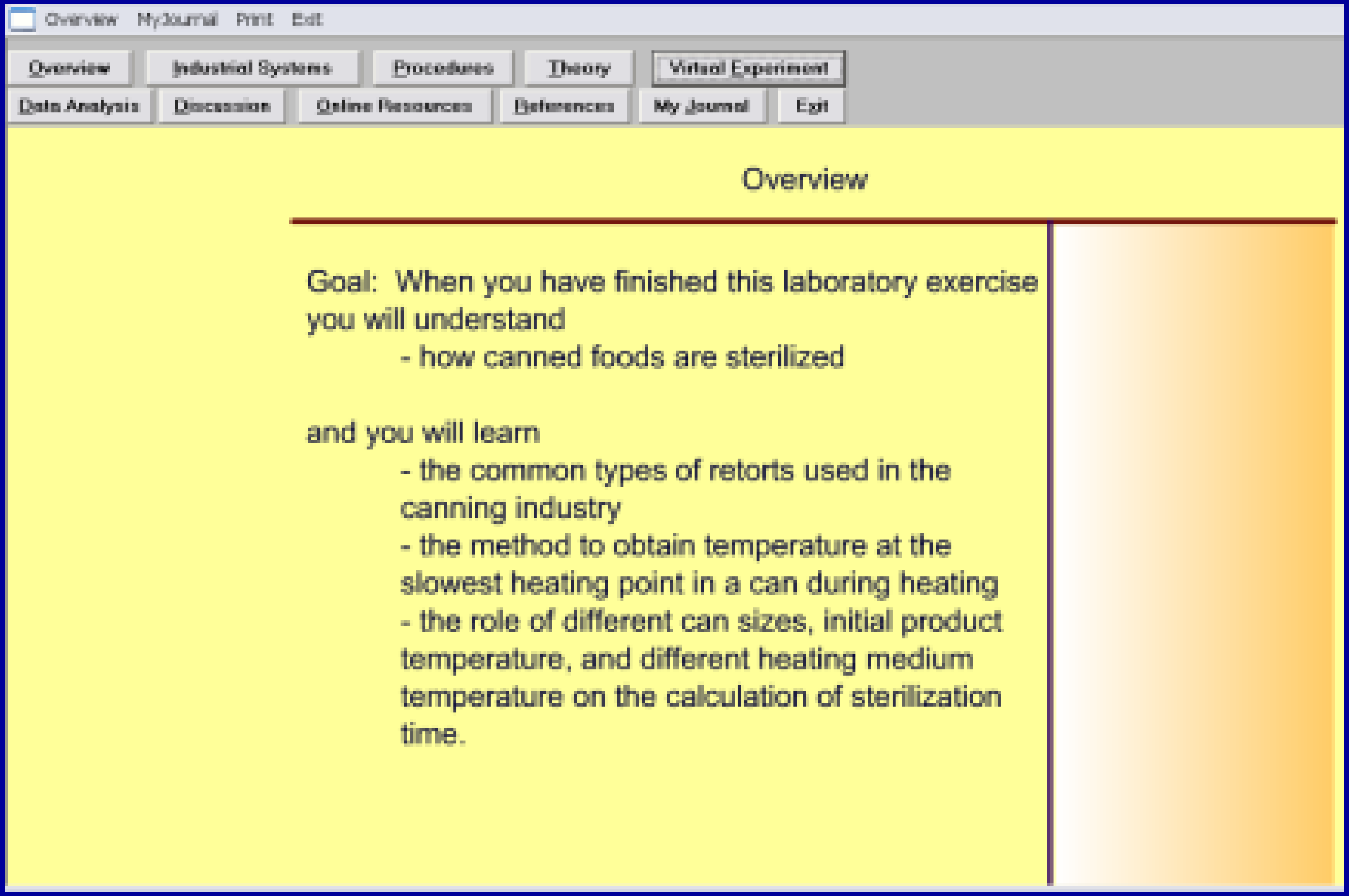


Virtual experiments in food processing – 27 experiments

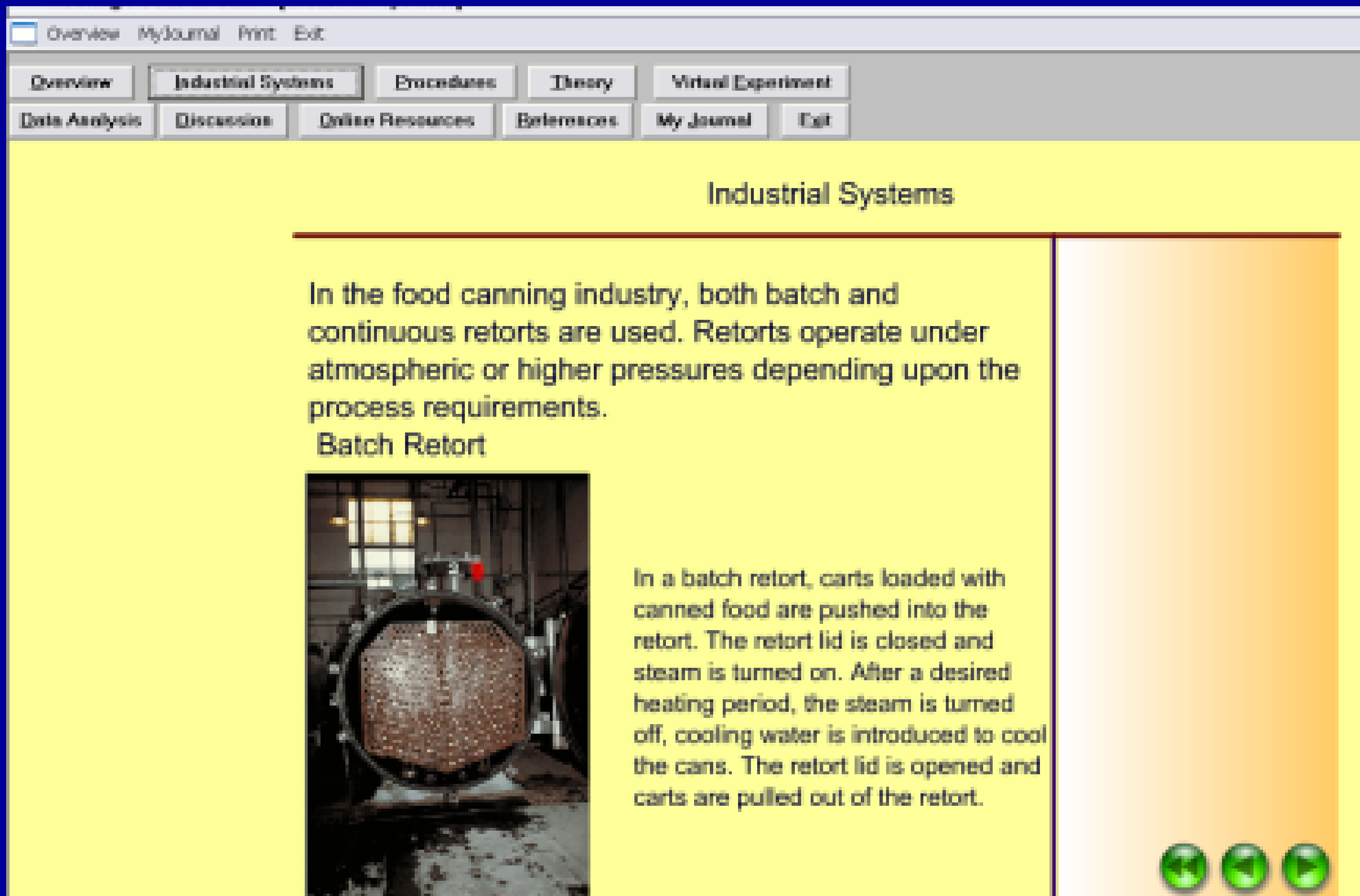
- Fluid flow,
- Heat transfer fundamentals,
- Food processing operations,
- Mass transfer operations,
- Food storage and distribution.

Navigation bar used in each experiment

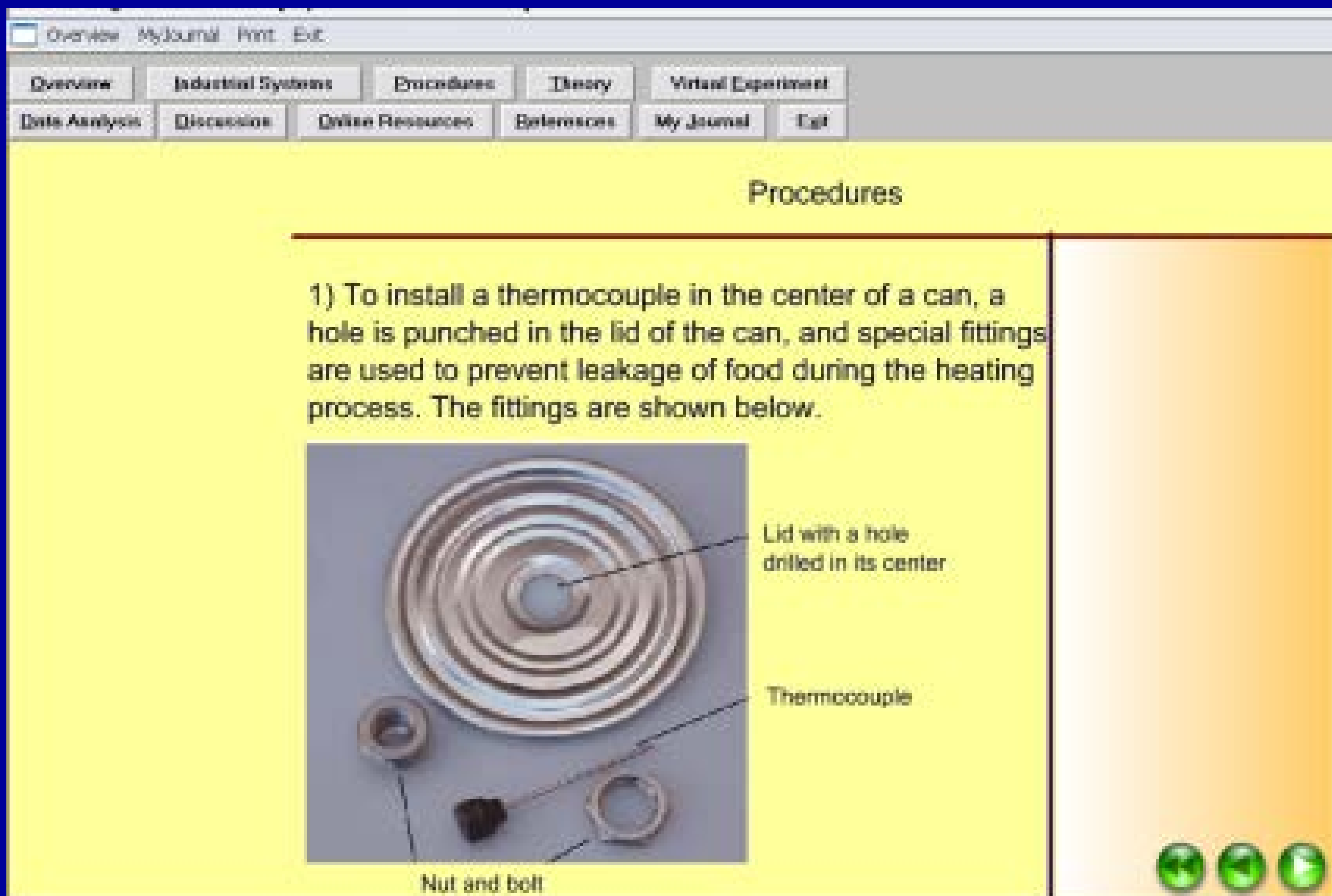
Overview of a virtual lab exercise



Industrial applications relevant to each exercise



Photographs and diagrams how an exercise is conducted in a lab



Theoretical considerations

Overview MyJournal Print Exit

Overview | Industrial Systems | Procedures | Theory | Virtual Experiment

Data Analysis | Discussion | Online Resources | References | My Journal | Exit

Theory

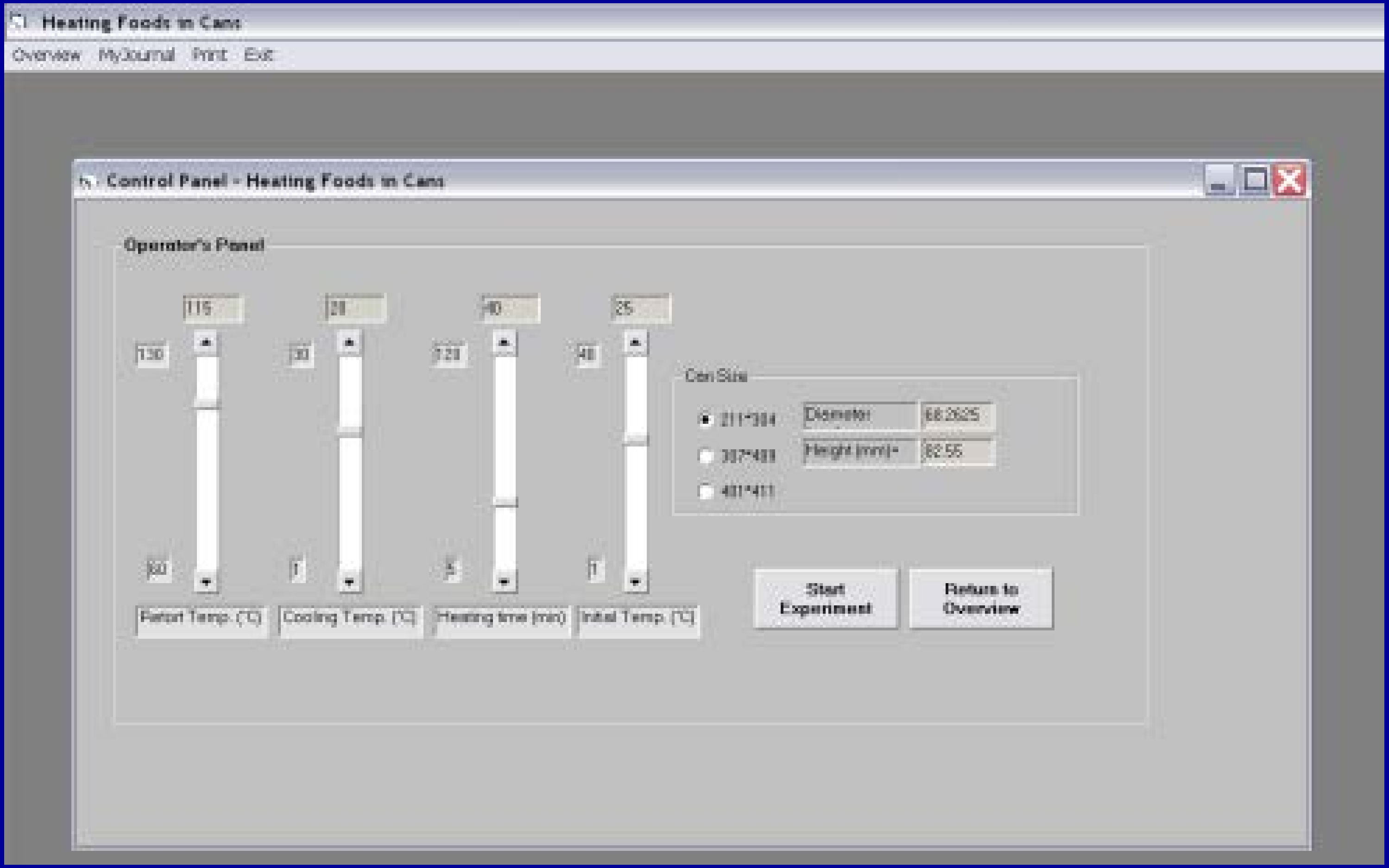
The heating and cooling curves are described by the following equations:

$$\log(T_m - T) = -\frac{1}{f_h} t + \log(T_m - T_{pih})$$

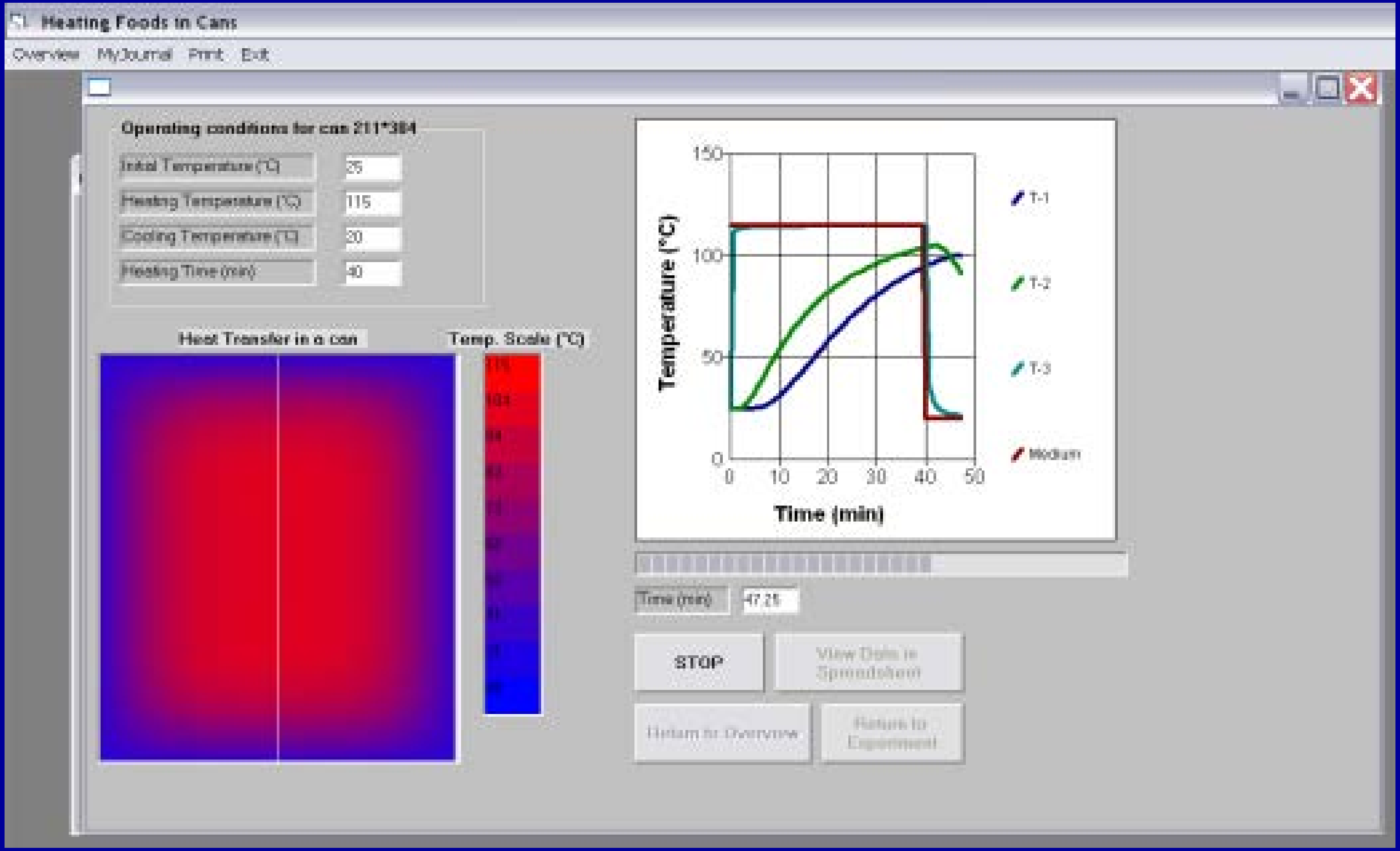
$$\log(T - T_w) = -\frac{1}{f_c} t + \log(T_{pic} - T_w)$$, respectively.

where T_m is the heating medium temperature, T is temperature at any time, t is time, f_h is the heating rate parameter, T_{pih} is the pseudo initial temperature for heating curve, T_w is the cooling medium temperature, T_{pic} is the pseudo initial temperature for cooling curve, f_c is the cooling rate parameter.

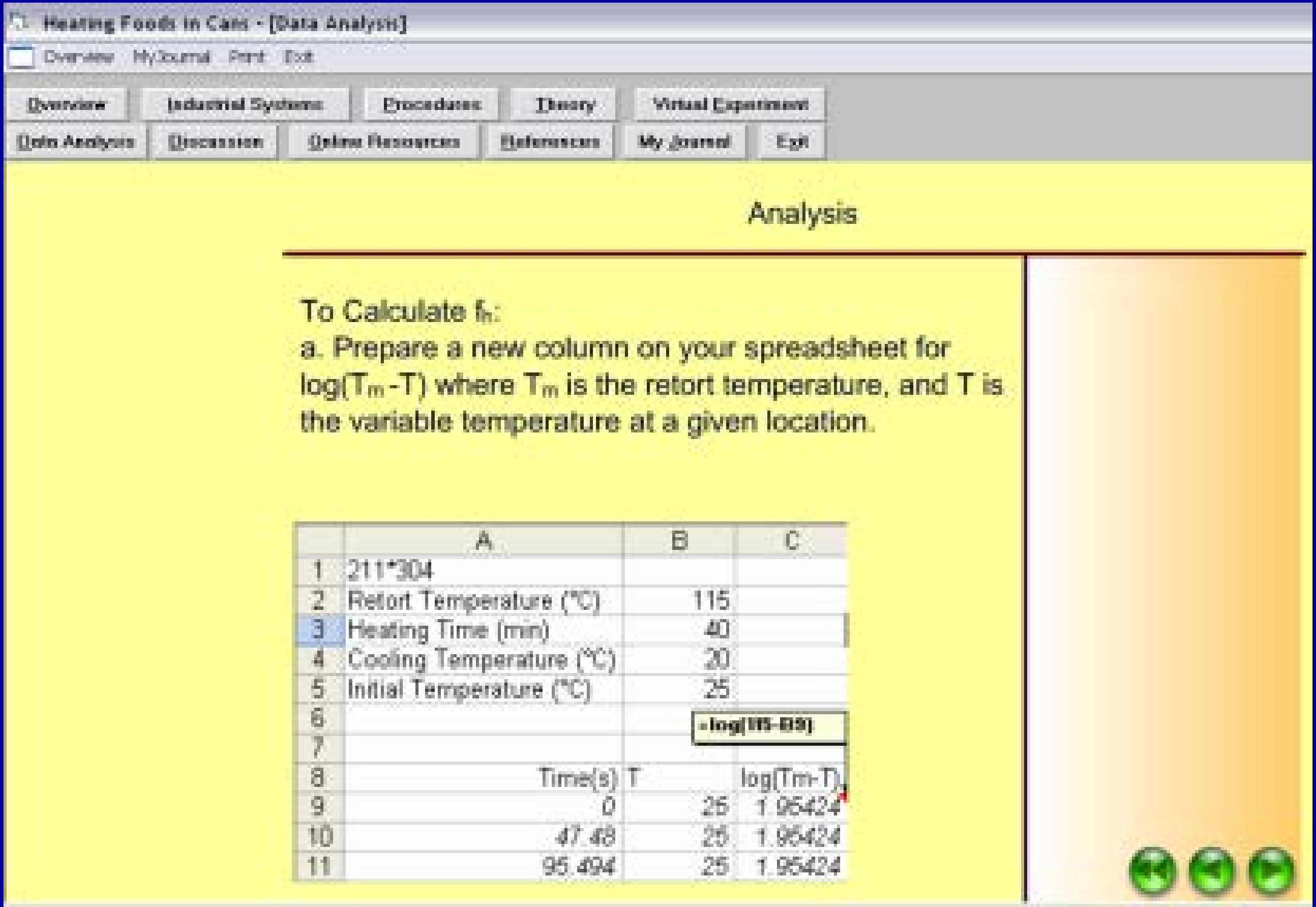
Operator`s panel for users to select operating conditions



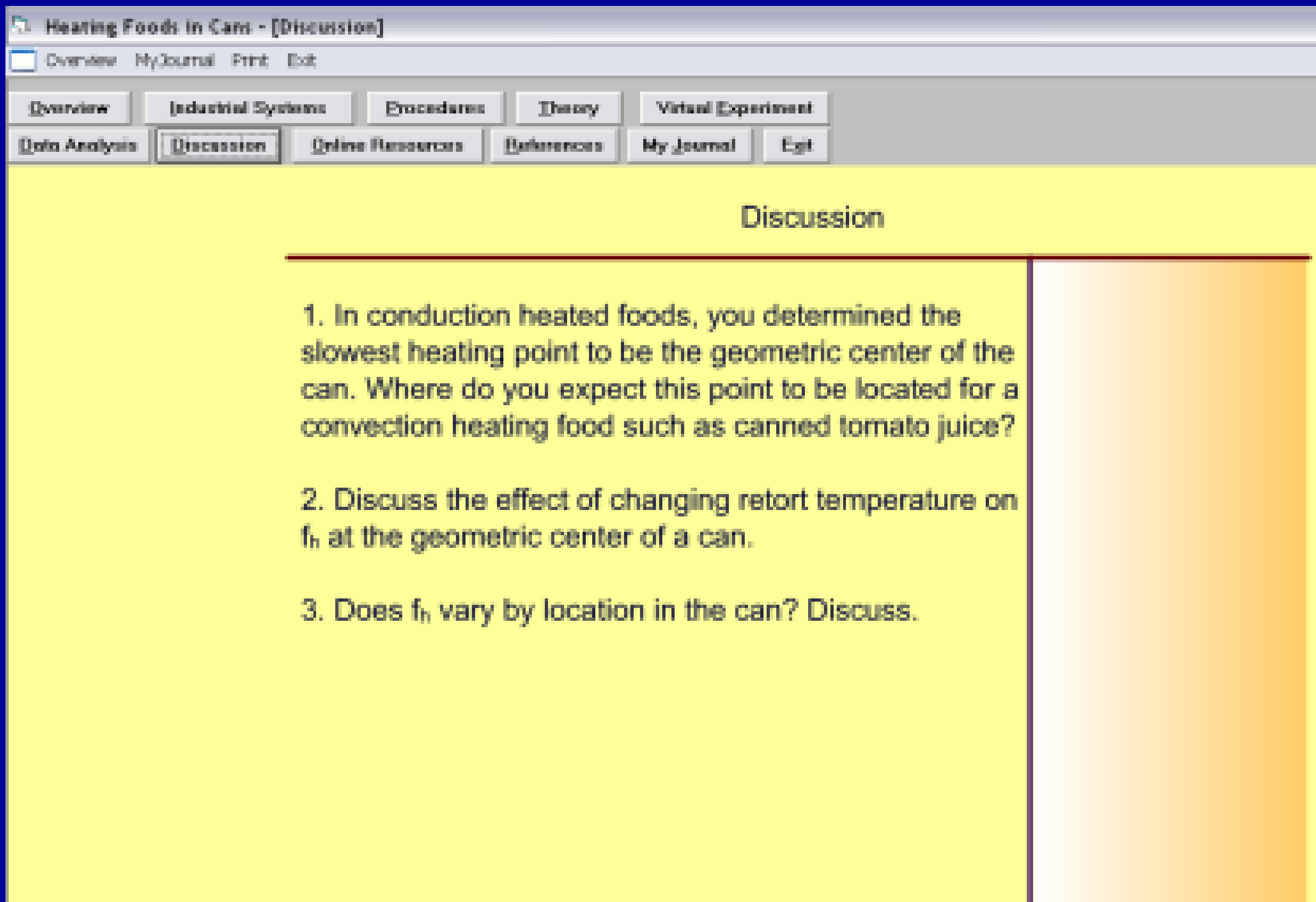
Results of a virtual experiment



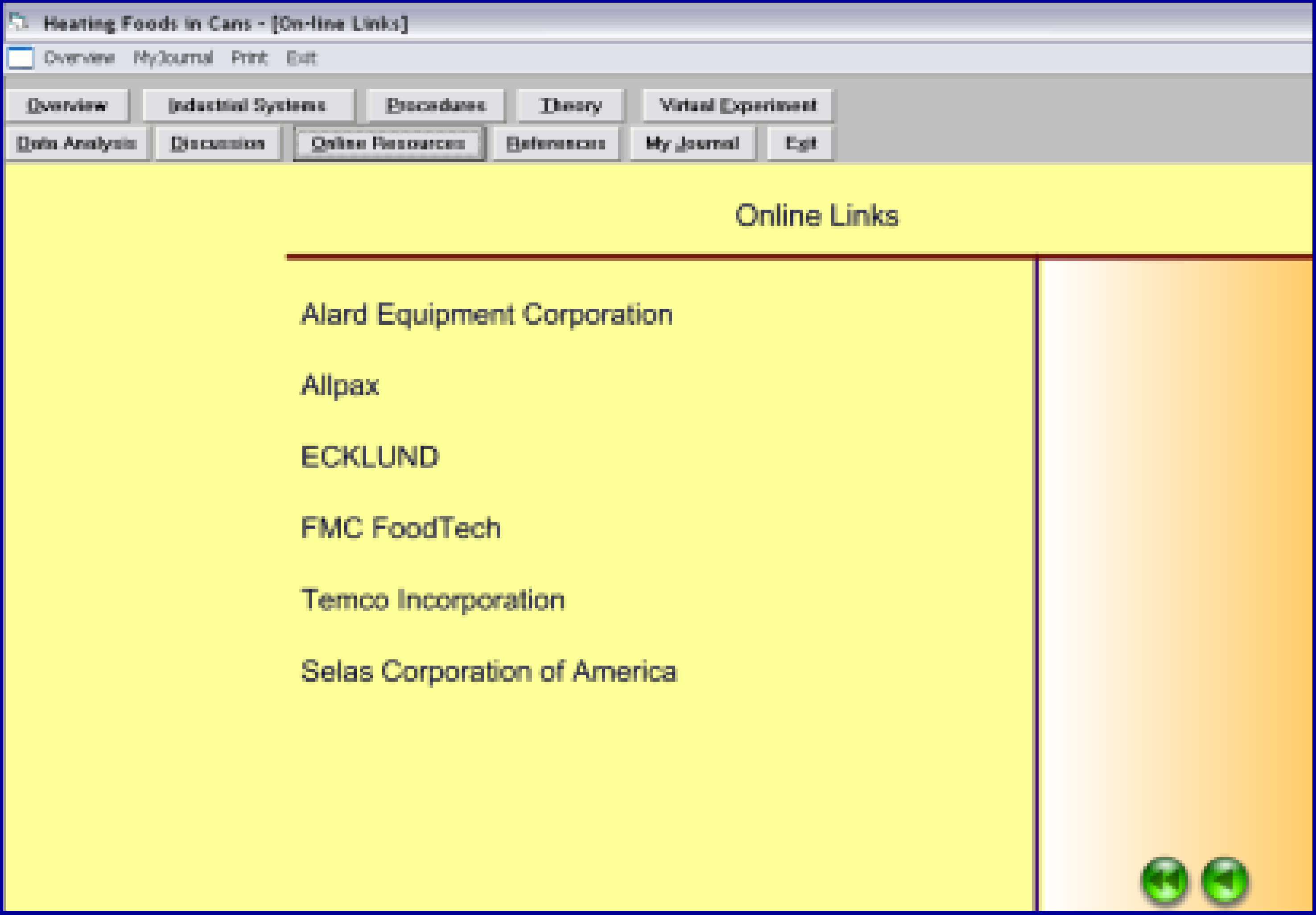
Description of how to analyze data



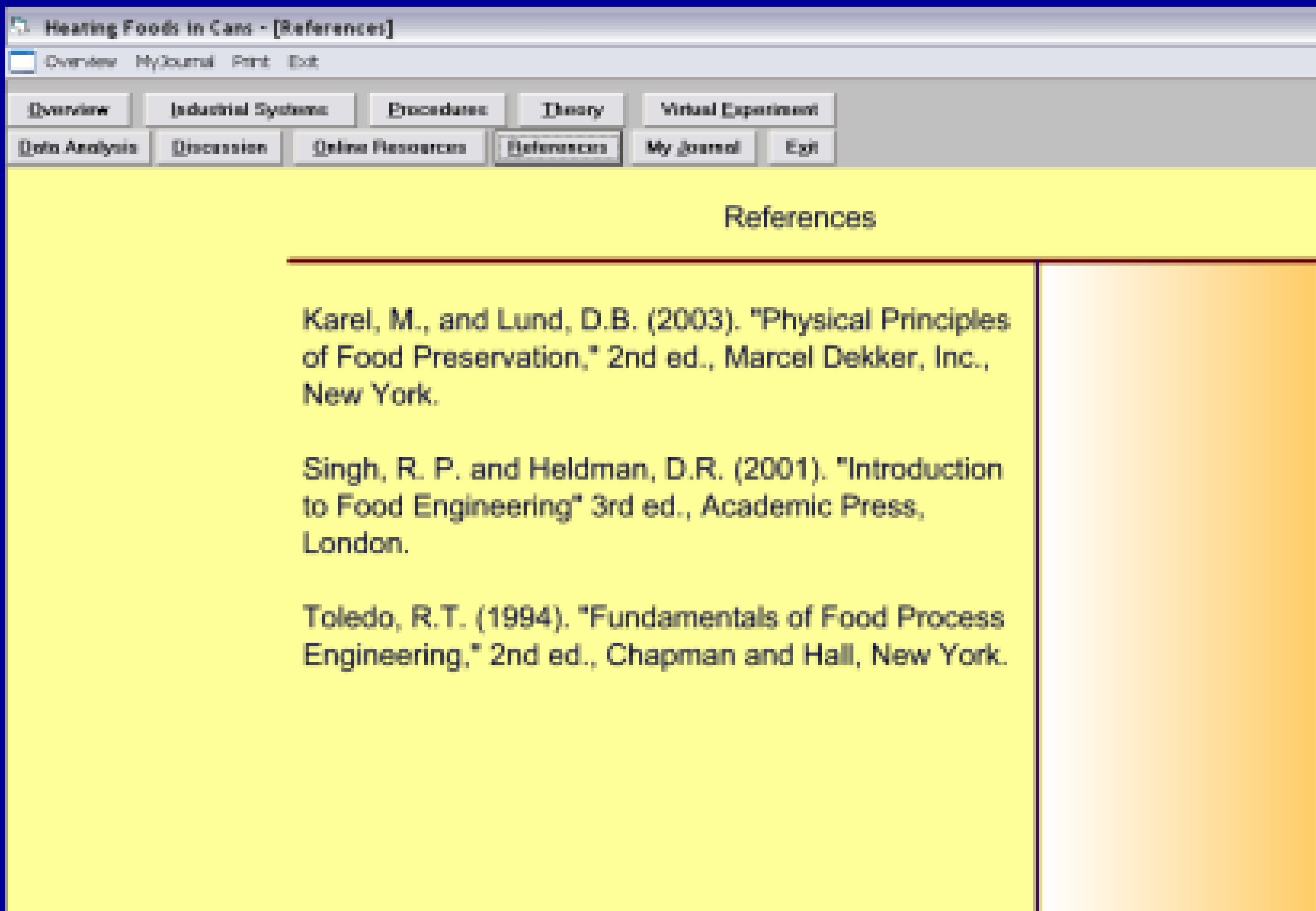
Discussion questions



Links to industrial sites for more information

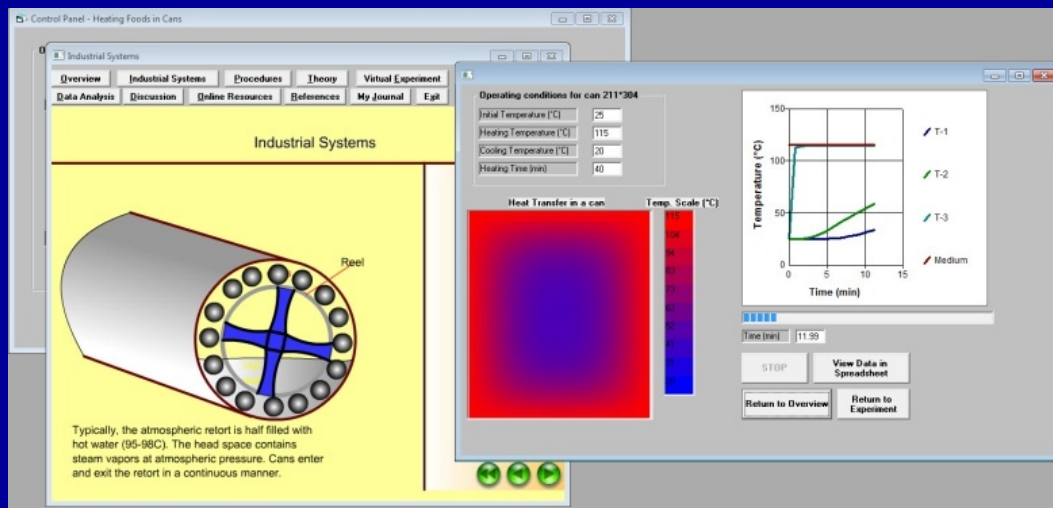


References to consult for writing a report



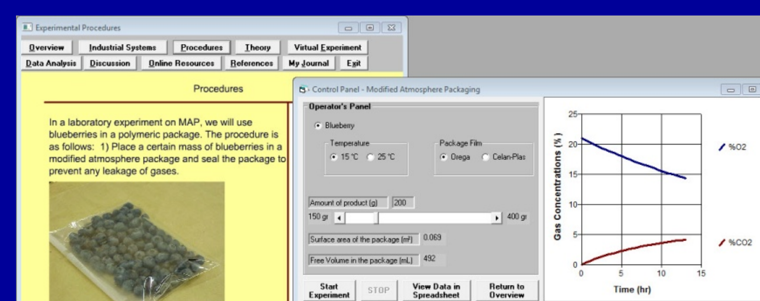
Examples

- **Canning**



- **MAP**

(modified atmosphere packaging)



Use in various universities

- Virtual experiments of individual food processing operations have been routinely used in different universities for the past ten years.

- The following universities have introduced new courses/ laboratory exercises using Virtual Experiments described in this webinar:

Use in various universities

- University of California, Davis
- University of Mersin
- Ohio State University
- University of Illinois
- Oregon State University

Use in various universities

- Purdue University
- California State University, Pomona
- University of Newfoundland, Canada
- Iowa State University

In addition, instructors from 31 countries have acquired the computer software from us to enhance their teaching.

Conclusions in summary

- **Personal observations revealed that the virtual labs**
  - **led students get engaged more in the hands-on lab experiments,**
  - **encouraged the students to explore what-If scenarios in the process,**
  - **eliminated the obstructive effect of not having the appropriate equipment to conduct various hands-on lab experiments,**
  - **allowed the students to develop higher level cognitive skills to analyze and evaluate processing parameters,**

Conclusions in summary

- **It was also demonstrated that the integration of advanced technology tools *(interactive visualization* and *simulations*)**
  - **enhanced student learning, and**
  - **improved the quality of education changing the learning environment to student-centered case.**
- **Virtual labs are also expected to improve the quality of instruction in distance learning courses.**