Cheese Tracking System

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Contents

Purpose

The Penn State Extension Cheese Tracking System is designed to help cheesemakers track the quality and consistency of their cheese. By defining and monitoring measurable parameters, cheesemakers can understand how variation in raw materials and processes can impact the sensory characteristics and quality of their cheese. This information can help cheesemakers adjust their practices to consistently make better cheese and troubleshoot problems.

System Overview

The Penn State Extension Cheese Tracking System was developed for small-scale cheesemakers because they often have multiple responsibilities and a small staff, which leaves little time to develop their own comprehensive record-keeping system. The system is designed to be adaptable, and it may be of use to larger-scale cheesemakers and manufacturers of other dairy products that wish to modify the tracking templates for their products and processes.

The Penn State Extension Cheese Tracking System consists of documents and spreadsheets to record, track, and evaluate data for:
- Milk composition and quality
- The cheesemaking process
- Processing after the initial cheese make day
- Cheese chemical composition
- Cheese sensory characteristics

The system was created using Microsoft Word and Excel to provide templates that can be customized by each cheesemaker based on their needs. The format of the templates vary depending on their purpose. Some of the Excel worksheets contain columns that automatically calculate measurements of interest, and some have tables that automatically create graphs to aid in visualizing data trends.

Milk Tracking

The Milk Tracking component tracks raw milk quality and composition parameters over time. Milk quality parameters include somatic cell counts (SCC) and bacterial counts (standard plate count [SPC], total plate count [TPC], or aerobic plate count [APC]). Milk composition parameters include fat, protein, milk solids non-fat (MSNF), and total solids.

Cheesemaking

The Cheesemaking component tracks information related to the primary manufacture of a cheese. This includes tracking raw materials and process data usually found on a batch sheet, such as times, temperatures, and pH measurements observed during cheesemaking steps. In order to facilitate visual evaluation of data trends, these worksheets are designed to capture processes that occur within an 8- to 24-hour period, typically from vat to unhooping.

Post-Make Day Processing

The Post-Make Day Processing component tracks processes after the initial make day that can take several days to months, such as brining, washing, turning, aging, and mold development. These lengthy processes are separated from the activities that occur during the primary make day in order to facilitate interpretation of data and graphs from the time-intensive make-day processes. The cheesemaker has the option to use separate workbooks or multiple sheets within one workbook to follow different processes in the manufacture of a cheese from unhooping to sale.

Cheese Composition

The Cheese Composition component tracks chemical composition parameters of a cheese by age. These parameters are moisture, salt, fat, protein, and pH.

Sensory Evaluation

The Sensory Evaluation component tracks the cheesemaker's choice of sensory attributes for their cheese over time. Sensory evaluation of cheese involves a visual assessment, followed by an assessment of the flavor, aroma, body, and texture. The evaluation can be done for specific attributes or more generally for overall quality. A program that documents sensory properties in measurable terms is helpful for monitoring cheese quality, developing new cheeses, and assisting in troubleshooting problems that may be traced back to raw material or processing issues.

Cheese Tracking Data Summary

The Cheese Tracking Data Summary component is a checklist for the convenience of the cheesemaker that wants a quick overview of what data has been recorded for each cheese.

Using the Cheese Tracking System

This section contains the detailed information on each component in the system, including:
- Description of the component
- List of the files associated with the system component
- List and description of the data fields and graphs for each workbook and worksheet
- Step-by-step instructions for using the documents

Before You Begin

This system consists of Word and Excel files as templates. The intent is for each cheesemaker to customize the templates to meet their needs. It is a good practice to save the original file as a clean template for future use or in case of problems with the working document.

This system assumes some familiarity with computers and the Microsoft programs Word and Excel. Appendix A contains a primer on how Excel is used for this tracking system and contains tips for people who are less familiar with the software.

Graphs have a horizontal x-axis and a primary vertical y-axis on the left. The worksheets in this system contain tables in which to enter the data to allow the graphs to be generated automatically. The graph axes will automatically adjust scale to fit the data. Some graphs may use two different y-axes, one on the left and one on the right, to allow for different scales to be used for multiple variables shown on the same graph.

1. Milk Tracking

The Milk Tracking component tracks raw milk quality and composition parameters over time in tabular and graphical formats.

Associated Files

- 1-1-MilkDataPSU.docx
- 1-2-MilkTrackingWorkbookPSU.xlsx

Milk Data Document

The Milk Data document (1-1-MilkDataPSU.docx) can be used to record data and comments for each lot of raw milk. Alternatively, the data from coop or other milk test reports can be entered directly into the tracking worksheet.

Data Columns

- Date
- Cheese Lot #
- SCC (×1000)
  Somatic Cell Count. See the description below under "Milk Tracking Workbook" for how to enter data.
- SPC, TPC, APC (×100)
  Standard Plate Count (SPC), Total Plate Count (TPC), or Aerobic Plate Count (APC). See the description below under "Milk Tracking Workbook" for how to enter data.
- Fat (%)
- Protein (%)
- MSNF (%)
  Milk solids non-fat. See the description below under "Milk Tracking Workbook" for how to calculate data.
- Total Solids (%)
  See the description below under "Milk Tracking Workbook" for how to calculate data.
- Comments

Milk Tracking Workbook

The Milk Tracking Workbook (1-2-MilkTrackingWorkbookPSU.xlsx) has one worksheet, and all data is entered into one data table. There is a column in the worksheet that automatically calculates the fat-to-protein ratio. There are three automatically populated graphs:
- Milk Quality
- Milk Chemical Composition
- Milk Fat-to-Protein Ratio

Data Fields
- Header Data
  - Date Updated
    - Date of the most recent change to the workbook.
  - Name
    - Person who performed the most recent update.
- Data Table
  - Date
    - Date of milk testing.
  - Cheese Lot #
  - SCC (×1000)
    - Somatic Cell Count, usually reported in thousands. Example: the lab report says "50," which represents "50,000" somatic cells. "50" should be entered into the data cell.
  - SPC, TPC, or APC (×100)
    - Standard Plate Count (SPC), Total Plate Count (TPC), or Aerobic Plate Count (APC), usually reported in hundreds. Example: the lab report says "100," which represents "10,000" colony forming units. "100" should be entered into the data cell.
  - Fat (%)
  - Protein (%)
  - MSNF (%)
    - Milk Solids Non-Fat. Some milk testing labs report fat, protein, and "Other Solids" or may just report "Total Solids." Other Solids is the sum of lactose and mineral (ash) content. To calculate the MSNF (%):
      - MSNF (%) = Protein (%) + Other Solids (%)

      OR
      - MSNF (%) = Total Solids (%) − Fat (%)
  - Total Solids (%)
    - If the lab does not report Total Solids, it can be calculated:
      - Total Solids (%) = Fat (%) + Protein (%) + Lactose (%) + Ash (%)

      OR
      - Total Solids (%) = Fat (%) + Protein (%) + Other Solids (%)
  - Fat-to-Protein Ratio (Calculated)
    - This field is automatically calculated from the Fat (%) and Protein (%) entered into the table.

Graphs
- Milk Quality
  - Displays SCC (×1000) and SPC, TPC, or APC (×100) by date.
- Milk Chemical Composition
  - Displays Fat (%) and Protein (%) on the left y-axis and MSNF (%) and Total Solids (%) on the right y-axis by date.
- Milk Fat-to-Protein Ratio
  - Displays the calculated Fat-to-Protein Ratio by Date

Instructions for Use

1. Save 1-2-MilkTrackingWorkbookPSU.xlsx as a new file, giving an appropriate name to the working document.
2. For the first use and as data collection dictates, copy and rename the Milk Quality and Composition worksheet by month or year, as appropriate. It is good practice to leave the worksheet template clean.
3. When adding the first row in a new table, add data directly below the thick black line of the header border of the data table.
4. Add additional data below the thick black line on the bottom of the table border. The table borders will automatically adjust to incorporate the new data.
5. If milk data is not entered in chronological order:
   - Highlight the Date header.
   - Right click.
   - Under "Sort," select "Ascending."
   This will resolve graphing issues due to dates that are out of order.

2. Cheesemaking

The Cheesemaking component tracks information related to the primary manufacture of a cheese. This includes tracking raw materials and process data usually found on a batch sheet, such as times, temperatures, and pH measurements observed during cheesemaking steps.

This component relies on having a well-defined make procedure and batch sheet so that the Cheese Make Workbook can adequately reflect the correct steps and target measurements in the cheesemaking process being tracked. Make procedures are specific to each cheese and should be clearly described and written down before data tracking can occur. If you need to develop detailed procedures and make sheets, there are two example batch sheets in this section, and Appendix B contains information on developing detailed make procedures.

Associated Files

- 2-1-GenericExampleMakeSheetPSU.docx
- 2-2-CheddarExampleMakeSheetPSU.docx
- 2-3-WashedRindExampleMakeSheetPSU.docx
- 2-4-CheeseMakeWorkbookPSU.xlsx

Cheesemaking Documents

These documents are provided as a starting point to develop a detailed batch, or make, sheet. They are designed to be customized for your processes. If you currently have a make sheet that meets your needs, you can enter the data directly into the workbook for data tracking and analysis.

- 2-1-GenericExampleMakeSheetPSU.docx
- 2-2-Cheddar ExampleMakeSheetPSU.docx
- 2-3-WashedRindExampleMakeSheetPSU.docx

Data on a make sheet should include:
- Date
- Cheese lot # and other ID
- Cheesemaker ID
- Raw material manufacturer ID, lot #, and amount added
- Processing notes and target sources
- Cheesemaking steps
- Target and actual time, temperature, and pH at key cheesemaking steps

Cheese Make Workbook

The Cheese Make Workbook (2-4-CheeseMakeWorkbookPSU.xlsx) has five worksheets:
- Individual Day
- Multiple-Day pH by Time
- Process Time Comparison
- pH Comparison
- Temperature Comparison

The Individual Day worksheet is the electronic record of the make or batch sheet and contains all the data pertinent to the cheese make. The remaining worksheets are designed to allow comparison of data from multiple batches of cheese in graphical and tabular formats.

Individual Day Worksheet

This is the main data-entry worksheet for this workbook. It contains information on the cheese lot, raw materials, sanitation and calibration checks, and processing notes. The Data table records the target and actual time, temperature, and pH measurements for each step in the make process. This table automatically calculates the process time based on the clock time at each step, using the time of culture addition as time zero. Two graphs are automatically populated:
- pH by Elapsed Time
- Temperature by Elapsed Time

Data Fields

- [Cheese Name]
    Enter the Cheese Name in the title of the worksheet. This should be done as part of the customization of the template and saved as the working document.
- Header Data
    o Date
    o Cheesemaker
    o Cheese Lot #
    o Other Cheese ID
        An additional field for other information that may be used to identify cheese.
- Raw Material Information
    o Ingredient
        Ingredients can be added by inserting rows into this section.

- o Manufacturer ID and Lot #
  - This section is customizable for your choice of ingredient information.
- o Amount Added
- Equipment
  - o Sanitized all equipment before use [initial box]
    - A box to initial as the record that all equipment was sanitized before use.
  - o Calibrated pH meter [initial box]
    - A box to initial as the record that the pH meter was calibrated before use.
- Processing Notes
- Target Sources
  - Record the source(s) of cheese process targets for reference. Targets can be from previous experience or other sources; see Appendix B for more information.
- Make Procedure Table
  - o Step
    - These are the process steps in each cheesemaking procedure. Milk into Vat and Culture are already included, but other steps should be tailored to each cheese. **DO NOT** add additional steps before the "Culture" step or errors may result in the calculated process time.
  - o Target Time
    - Target times must be added as clock times (HH:MM) starting with addition of culture at 12:00 a.m. (for example, if step 3 occurs 45 minutes after culture, input 12:45 a.m.). They will show up as elapsed minutes (for example, 45). All target times should be calculated in reference to the addition of culture at 12:00 a.m.
  - o Target Temp.
  - o Target pH
  - o Clock Time
    - Enter the actual clock time that the step or measurement is recorded.
  - o Process Time (Calculated)
    - This is a calculated field. **DO NOT** input anything into this column. The process time will automatically be calculated based on the clock time of each step and the clock time at culture.
  - o Actual Temp.
  - o Actual pH

Graphs

- pH by Elapsed Time
  Displays Actual and Target pH on the y-axis by Elapsed Time in minutes on the x-axis.
- Temperature by Elapsed Time
  Displays Actual and Target Temperature on the y-axis by Elapsed Time in minutes on the x-axis.

Multiple-Day pH by Time Worksheet

The Multiple-Day pH by Time worksheet uses the process time and pH at each step to automatically generate a graph for pH by Elapsed Time of the whole cheesemaking process. This worksheet requires manual copying and pasting of data from the Individual Day worksheets for each batch into a data table on the selected worksheet. This worksheet is limited to four batches of cheese because the graph can be difficult to interpret if more than four batches are displayed.

Data Fields
- Header Data
  - Date Updated
    - Date of the most recent change to the workbook.
  - Name
    - Person who performed the most recent update.
- Notes
- Data
  - Step
  - [Lot #]
  - Process Time
  - pH

Graph
- pH by Elapsed Time
  - Displays the pH of four cheese lots on the y-axis by elapsed time (in minutes) on the x-axis.

Process Time Comparison Worksheet

The Process Time Comparison worksheet has one table to evaluate the process time by cheesemaking step for many batches (lots) of cheese at one time. This requires manual copying and pasting of data from the Individual Day worksheets for each batch into the data table. There are no limits on how many batches (columns) can be added to the data table.

NOTE: When copying Process Time from the Individual Day worksheet, only "values" should be copied and pasted because of the automatic calculation used in this data field. See Appendix A for more information on copying values instead of full cell contents.

Data Fields
- Header Data
  - Date Updated
    - Date of the most recent change to the workbook.
  - Name
    - Person who performed the most recent update.
- Notes
- Data Table
  - Step
  - [Lot #] Process Time

pH Comparison Worksheet

The pH Comparison worksheet has one table to evaluate the pH by cheesemaking step for many batches (lots) of cheese at one time. This requires manual copying and pasting of data from the Individual Day worksheets for each batch into the data table. There are no limits on how many batches (columns) can be added to the data table.

Data Fields
- Header Data
  - Date Updated
    - Date of the most recent addition to the workbook.
  - Name
    - Person who performed the most recent update.
- Notes
- Data Table
  - Step
  - [Lot #] pH

Temperature Comparison Worksheet

The Temperature Comparison worksheet has one table to evaluate the temperature by cheesemaking step for many batches (lots) of cheese at one time. This requires manual copying and pasting of data from the Individual Day worksheets for each batch into the data table. There are no limits on how many batches (columns) can be added to the data table.

Data Fields
- Header Data
  - Date Updated
    - Date of the most recent addition to the workbook.
  - Name
    - Person who performed the most recent update.
- Notes
- Data Table
  - Step
  - [Lot #] Temp

Instructions for Use

Customizing the Workbook for a Specific Cheese

1. Save and rename 2-4-CheeseMakeWorkbookPSU.xlsx as a new file, giving an appropriate name for the working document.
2. Customize the Individual Day worksheet.
   - Add Ingredients if needed.
     - Right click on the row number directly below the desired entry row (found at the very left-hand edge of the Excel window).

- For this section only, rows should be added **ABOVE** the black border. This is because this section is not a true data table, allowing for more customized data entry.
  - Select "Insert" to insert a row along the entire worksheet. Repeat as needed.
- Define steps in the Make Procedure table based on cheesemaking procedure.
  - Rename steps 3 through 12 as appropriate.
  - To add additional steps after step 12, type immediately below the last step.
  - **DO NOT** alter or add additional steps before the "Culture" step or errors may result in the calculated process time. Process times are all calculated in reference to "Culture" at time zero.
- Define targets based on pH and temperature curves that yield ideal cheese properties
  - Include the source(s) of target information in the space labeled "Target Sources."
  - Target times must be added as clock times starting with addition of culture at 12:00 a.m. (for example, if step 3 occurs 45 minutes after culture, input 12:45 a.m.). They will show up as elapsed minutes.
- Change the graph axes, if necessary.

3. Customize the Multiple-Day pH by Time, Process Time Comparison, pH Comparison, and Temperature Comparison worksheets
   - Copy and paste the process steps from the Individual Day worksheet to each worksheet.
4. Save the customized template.

Adding and Evaluating Data

1. Add cheese make data for a new lot:
   - For the first use and as data collection dictates, copy and rename the customized Individual Day worksheet with the lot number.
   - Add cheese make information to the new individual sheet in the available blanks. As data is added, the graphs will populate automatically.
2. Compare pH development profiles of up to four lots using the Multiple-Day pH by Time worksheet:
   - Copy and paste the values from the Process Time (Calculated) and pH columns from any individual lot worksheet.
   - Manually type in lot numbers in table headers.
3. Compare the process time, pH, and temperature at each step across multiple lot numbers using the Process Time Comparison, pH Comparison, and Temperature Comparison worksheets:
   - Copy and paste the relevant column data values into each worksheet.
   - Manually type in lot numbers in table headers.

3. Post-Make Day Processing

The Post-Make Day Processing component tracks processes after the initial make day that can take several days to months, such as brining, washing, aging and mold development. The Post-Make Day Processing component relies on having well-defined procedures and data collection sheets so that the workbook can adequately reflect the correct steps and target measurements in the processes being tracked. Appendix B contains information on developing detailed make procedures.

Associated Files
- 3-1-Post-MakeDay ProcessingDataPSU.docx
- 3-2-BrineMakeDataPSU.docx
- 3-3-AgingDataPSU.docx
- 3-4-Post-MakeDayProcessingWorkbookPSU.xlsx

Post-Make Day Processing Documents

Three example data collection templates are included that can be customized or serve as guidance documents to help the cheesemaker develop data collection sheets that accurately meet their needs
- 3-1-Post-MakeDayProcessingDataPSU.docx
- 3-2-BrineMakeDataPSU.docx
- 3-3-AgingDataPSU.docx

Post-Make Day Processing Workbook

The Post-Make Day Processing Workbook (3-4-Post-MakeDayProcessingWorkbookPSU.xlsx) is a generic template that must be customized to reflect the processes that the cheesemaker chooses to track. It is possible that a cheesemaker may choose to have different workbooks, or multiple sheets within one workbook, to follow different processes such as brining, washing, turning, aging, and mold development or to compare a process variable with a sensory variable.

The Post-Make Day Processing Workbook has two worksheets:
- Individual Variable
- Multiple Variable

Individual Variable Worksheet

The Individual Variable worksheet has a customizable table for a chosen process variable data and target, and automatically produces a graph when the data table is populated. This graph will show the data for the target and actual data if both are entered into the worksheet tables. Examples of data that might be tracked include pH at pressing or brining, and turning or washing times during the aging process.

<u>Data Fields</u>

- Header Data
  - Date Updated
    - Date of the most recent change to the workbook.
  - Name
    - Person who performed the most recent update.
  - Cheese Lot #
    - Use this field when tracking the post-make day process for one lot of cheese by process step. When tracking multiple lots at the same process step, change "Cheese Lot #" to "Process Step" and list the monitored process step.
- Targets Table
  - Process Step
    - When tracking the post-make day process for one lot of cheese, list the process steps followed. When tracking multiple lots at the same process step, change "Process Step" to "Target Day."
  - Cheese Age (Days)
    - Age of the cheese at the corresponding Process Variable Target.
  - Target Sources
    - Record the source(s) of cheese process targets for reference. Targets can be from previous experience or other sources.
  - [Process Variable] Target
    - Choose one process variable to track.
- Data Table
  - Process Step
    - When tracking the post-make day process for one lot of cheese, list the process steps followed. When tracking multiple lots at the same process step, change "Process Step" to "Cheese Lot #."
  - Evaluation Date
  - Evaluation Time
    - Clock time at the time of evaluation.
  - Evaluator
  - Cheese Age (Days)
    - Age of the cheese at the time of evaluation (in days).
  - [Process Variable]
    - Choose one process variable to track.

<u>Graph</u>

- Individual Post-Make Day Process Variable
  - Displays the target and actual process variable along the y-axis by cheese age (in days) along the x-axis.

Multiple Variable Worksheet

To allow comparisons of multiple batches over time, the Multiple Variable worksheet has a data table format only, with no graphing, similar to the Cheese Make workbook. Comparisons can be made for multiple steps in one batch or for the same step across multiple batches, however the cheesemaker wishes to fill in the table.

Data Fields

- Header Data
  - Date Updated
    - Date of the most recent change to the workbook.
  - Name
    - Person who performed the most recent update.
  - Cheese Lot #
    - Use this field when tracking the post-make day process for one lot of cheese by process step. When tracking multiple lots at the same process step, change "Cheese Lot #" to "Process Step" and list the monitored process step.
- Targets Table
  - Process Step
    - When tracking the post-make day process for one lot of cheese, list the process steps followed. Examples of process steps include pressing, brining, washing, turning, aging, and storage. When tracking multiple lots at the same process step, change "Process Step" to "Target Day."
  - Cheese Age (Days)
    - Age of the cheese at the corresponding Process Variable Target.
  - Target Sources
    - Source(s) of cheese process targets for reference. Targets can be from previous experience or other sources.
  - pH Target
  - [Process Variable 1] Target
  - [Process Variable 2] Target
  - [Process Variable 3] Target
    - Label and add [Process Variable] Target columns as needed. Examples of process variables include pH, temperature, relative humidity, cheese chemical composition parameters (moisture, salt, fat, etc.), and sensory parameters observed during aging (such as rind color, rind texture, or cheese aroma).
- Data Table
  - Process Step
    - When tracking the post-make day process for one lot of cheese, list the process steps followed. When tracking multiple lots at the same process step, change "Process Step" to "Cheese Lot #."
  - Evaluation Date
  - Evaluation Time
    - Clock time at the time of evaluation.
  - Evaluator

o Cheese Age (Days)

Age of the cheese at the time of evaluation (in days).

o Notes

o pH

o [Process Variable 1]

o [Process Variable 2]

o [Process Variable 3]

Label and add [Process Variable] columns as needed.

Instructions for Use

Customizing the Workbook for a Specific Cheese

1. Save and rename 3-4-Post-MakeDay ProcessingWorkbookPSU.xlsx as a new file, giving an appropriate name for the working document.

2. Customize the Multiple Variable and Individual Variable worksheets to include post-make day steps and key variables to monitor that are specific to individual cheesemaking procedures.

   - Add process variable targets, when available, and record the source of each target. For further discussion of targets, see Appendix B.
   - When adding more than five target process steps, insert rows into the worksheet before continuing to add to the Targets table. This only applies to the Targets table on this worksheet. For further instruction on how to do this, see Appendix A.

3. When tracking multiple cheese lots at the same processing step:

   - In the header data, replace "Cheese Lot #" with "Process Step."
   - In the Targets table, replace "Process Step" with "Target Day."
   - In the Data table, replace "Process Step" with "Cheese Lot #."

4. Save the customized template.

Adding and Evaluating Data

1. Add post-make day processing data to the Multiple Variable worksheet for a new lot:

   - For the first use and as data collection dictates, copy the customized templates and rename the new worksheets with the lot number and "Multiple" or "Individual." It is good practice to leave the worksheet template clean.
   - For the first time, add data to the Multiple Variable worksheet directly below the thick black line of the header border of the data table.
   - Add additional data below the thick black line on the bottom of the table border. The table borders will automatically adjust to incorporate the new data.

2. Use the Individual Variable worksheet to visualize one specific process variable by cheese age:

   - Copy and paste the values from the Evaluation Date, Evaluation Time, Evaluator, Cheese Age (Day), and [Process Variable] columns from the Multiple Variable worksheet.
   - Manually label the [Process Variable] header.
   - Adjust the graph scales as needed (see Appendix B).

4. Cheese Composition

The Cheese Composition component tracks chemical composition parameters of a cheese by age. These parameters are moisture, salt, fat, protein, and pH. Monitoring cheese composition will help to track cheese consistency from batch to batch, and ensure that compositional targets for cheese standards of identity are met.

Associated Files

- 4-1-CheeseCompositionDataPSU.docx
- 4-2-CheeseCompositionWorkbookPSU.xlsx

Cheese Composition Documents

The Cheese Composition document (4-1-CheeseCompositionDataPSU.docx) can be used to record data and comments for each batch of cheese by age. Alternatively, the data can be entered directly into the tracking worksheet from other cheese test reports that a cheesemaker may receive.

Data Columns

- Make Date
- Cheese Lot #
- Cheese Age
- Moisture (%)
- Salt (%)
- Fat (%)
- Protein (%)
- pH

Cheese Composition Workbook

The Cheese Composition Workbook (4-2-CheeseCompositionWorkbookPSU.xlsx) has one worksheet, and all data is entered into one data table. The table automatically calculates salt in moisture and fat in dry matter. There are five automatically populated graphs:

- Cheese Moisture by Age
- Cheese Salt by Age
- Cheese Fat and Protein by Age
- Cheese pH by Age
- Fat in Dry Matter by Age

Data Fields

- Header Data
  - Date Updated

    Date of the most recent change to the workbook.
  - Name

    Person who performed the most recent update.

- Targets Table
    - Target Day
    - Cheese Age (Days)
    - Target Sources
        Source(s) of cheese composition targets for reference. Targets can be from previous experience or other sources, such as the Code of Federal Regulations.
    - Moisture Target (%)
    - Salt Target (%)
    - Salt in Moisture Target (%)
    - Fat Target (%)
    - Protein Target (%)
    - pH Target
    - Fat in Dry Matter Target
- Data Table
    - Make Date
    - Cheese Lot #
    - Cheese Age (Days)
    - Moisture (%)
    - Salt (%)
    - Salt in Moisture (%) (Calculated)
        This is a calculated field based on the data entered in the salt and moisture fields.
    - Fat (%)
    - Protein (%)
    - pH
    - Fat in Dry Matter (Calculated)
        This is a calculated field.

Graphs

- Cheese Moisture by Age
    Displays target and actual moisture (%) on the y-axis by cheese age (in days) on the x-axis.
- Cheese Salt by Age
    Displays target and actual salt (%) and salt in moisture (%) on the y-axis by cheese age (in days) along the x-axis.
- Cheese Fat and Protein by Age
    Displays target and actual fat (%) and protein (%) composition on the y-axis by cheese age (in days) on the x-axis.
- Cheese pH by Age
    Displays target and actual pH on the y-axis by cheese age (in days) on the x-axis.
- Fat in Dry Matter by Age
    Displays target and actual fat in dry matter (%) on the y-axis by cheese age (in days) on the x-axis.

Instructions for Use

Customizing the Workbook for a Specific Cheese

1. Save and rename 4-2-CheeseCompositionWorkbookPSU.xlsx as a new file, giving an appropriate name for the working document.
2. Customize the Cheese Chemical Composition worksheet with compositional targets. See Appendix B for further discussion of target selection.
   - Include the source(s) of target information in the column labeled "Target Sources."
3. Save the customized template.

Adding and Evaluating Data

1. For the first use and as data collection dictates, copy and rename the Cheese Chemical Composition worksheet by month or year, as appropriate. It is good practice to leave the worksheet template clean.
2. For the first time, add data directly below the thick black line of the header border of the data table.
3. Add additional data below the thick black line on the bottom of the table border. The table borders will automatically adjust to incorporate the new data.
4. Graphs will populate automatically.
5. Graph scales are set to be appropriate for a wide range of cheeses. Adjust scales if needed.

5. Sensory Evaluation

The Sensory Evaluation component tracks the cheesemaker's choice of sensory attributes for their cheese over time. A consistent program that documents sensory properties in measurable terms is helpful for monitoring cheese quality, developing new cheeses, and assisting in troubleshooting problems that may be traced back to raw material or processing issues.

This system relies on having a sensory evaluation program in place with standardized procedures for evaluating cheese, and ballots with appropriate attributes and scoring scales. The Cheese Sensory Evaluation Guide provides information on developing a sensory evaluation program.

Associated Files

- 5-1-CheeseSensoryEvaluationGuidePSU.pdf
- 5-2-SensoryBallotPSU.docx
- 5-3-SensoryAttributeScalePSU.docx
- 5-4-SensoryEvaluationWorkbookPSU.xlsx

Sensory Evaluation Documents

These documents can you help you develop or refine a sensory evaluation program for your cheese. This is based on a simple quality and defect-based program that is used in traditional dairy foods evaluation and judging. This is not intended to be a detailed, statistically based descriptive program.

Information on how to set up a sensory evaluation program is found in the Penn State Extension Cheese Tracking System Cheese Sensory Evaluation Guide (5-1-CheeseSensoryEvaluationGuide PSU.pdf). This document discusses good sensory practices; explains how to describe your cheese, develop a ballot, and choose appropriate scales; and contains a list of attributes with descriptive references.

When setting up a sensory evaluation program it is important to keep in mind that you may not be able evaluate all the attributes you would like to on a regular basis. It is better to choose a smaller number of attributes (for example, four to ten) that you can evaluate regularly over time to observe trends, as opposed to many attributes that you can only evaluate sporadically. It make take some time and several iterations of the sensory ballot to determine which attributes are the most important for evaluating quality and troubleshooting. Be flexible and adjust the sensory program as needed to get the most out of it!

The sensory ballot template and scale example documents are for reference and can be customized to meet the cheesemaker's needs. The 5-2-SensoryBallotPSU.docx file has space for evaluation of attributes describing appearance, flavor and aroma, body and texture, and overall quality. The 5-3-SensoryAttributeScalePSU.docx file has examples of different scales that can be copied and pasted to the sensory ballot:

- Just About Right
- Five-Point
- Attribute Half-Scale
- Intensity
- Overall Quality
- Absent/Present Check Box
- Category Scale
- Difference from Control
- Overall Difference Rating
- Defect

Sensory Evaluation Workbook

The Sensory Evaluation Workbook (5-4-SensoryEvaluationWorkbookPSU.xlsx) has two worksheets:

- Multiple Variable
- Individual Variable

Multiple Attribute Worksheet

The Multiple Attribute worksheet contains one table that allows for comparisons of multiple attributes of cheeses from different lots and different ages. The data table is customizable to match the attributes on the sensory ballots. There are no limits on how many attributes (columns) can be added to the data table.

Data Fields

- Header Data
  - Date Updated
    Date of the most recent change to the workbook.
  - Name
    Person who performed the most recent update.
- Targets Table
  - Target Day
  - Cheese Age (Days)
    Age of the cheese at the corresponding Attribute Target.
  - Target Sources
    Source of cheese sensory targets for reference.
  - Overall Quality Target
  - [Attribute 1] Target
  - [Attribute 2] Target
  - [Attribute 3] Target
    Label and add [Attribute] Target columns as needed.
- Data Table
  - Cheese Lot #
  - Make Date
  - Cheese Age (Days)
    Age of the cheese at the time of sensory evaluation, in days.
  - Evaluator
  - Notes
  - Overall Quality
  - [Attribute 1]
  - [Attribute 2]
  - [Attribute 3]
    Label and add [Attribute] columns as needed.

Individual Attribute Worksheet

The Individual Attribute worksheet allows for a single sensory variable to be tracked by cheese age or compared with a variable such as pH or moisture content. The data table is customizable to match the attributes on the sensory ballots. This worksheet automatically generates a graph of the data as the table is populated. This worksheet was designed for a single variable over time because it can be difficult to interpret several attributes on one graph.

- Header Data
    - o Date Updated
        - Date of the most recent change to the workbook.
    - o Name
        - Person who performed the most recent update.
- Targets Table
    - o Target Day
    - o Target Sources
        - Sources of cheese sensory targets for reference.
    - o Cheese Age (Days)
        - Age of the cheese at the corresponding Sensory Attribute Target.
    - o [Sensory Attribute] Target
        - Choose one sensory attribute to track.
    - o [Tracking Parameter] Target
        - Choose one tracking parameter to track, such as Cheese Age.
- Data Table
    - o Cheese Lot #
    - o Make Date
    - o Cheese Age (Days)
        - Age of the cheese at the time of sensory evaluation, in days.
    - o Evaluator
    - o [Sensory Attribute]
        - Choose one sensory attribute to track.
    - o [Tracking Parameter]
        - Choose one tracking parameter to track, such as Cheese Age.

- Individual Sensory Attribute
    - Displays the target and actual score of the cheesemaker's choice of sensory attribute on the y-axis by tracking parameter on the x-axis. The units of the tracking parameter will depend on the parameter chosen.

Instructions for Use

1. Save and rename 5-4-SensoryEvaluationWorkbookPSU.xlsx as a new file, giving an appropriate name for the working document.
2. Customize the Multiple Attribute worksheet to include sensory attributes and targets:
    - Add multiple sensory attribute headers and columns by typing in the cell directly to the right of the headers, delineated by a thick black border. The table will expand to the right to include the new column.

- In the Targets table, add in sensory targets and target sources by cheese age. Some attributes may have target measurements that change over time; for example, the target "bitterness" may go up as the cheese ages.
- When adding more than five target days, insert rows into the worksheet before continuing to add to the Targets table. This only applies to the Targets table on this worksheet.

3. Save the customized template.

Adding and Evaluating Data

1. Add new data to the customized Multiple Attribute worksheet:

- For the first use and as data collection dictates, copy and rename the customized template. It is good practice to leave the worksheet template clean.
- For the first time, add data to the Multiple Attribute worksheet directly below the thick black line of the header border of the data table.
- Add additional data below the thick black line on the bottom of the table border. The table borders will automatically adjust to incorporate the new data.

2. Use the Individual Attribute spreadsheet to visualize one specific sensory attribute by an additional tracking parameter.

- Copy and rename the worksheet by sensory attribute.
- Copy and paste the values from the Cheese Lot #, Make Date, Cheese Age (Days), Evaluator, and [Sensory Attribute] columns from the Multiple Variable worksheet.
- Manually label the [Sensory Attribute] header.
- Select a tracking parameter from this or another workbook. Copy and paste the data values or add them manually. When using cheese age as a tracking parameter, it is necessary to copy this column again into the [Tracking Parameter] column in order for the graph to populate automatically.
- Manually label the [Tracking Parameter] header.
- Add the sensory attribute and tracking parameter target data to the Targets table. When adding more than five target days, insert rows into the worksheet before continuing to add to the Targets table. This only applies to the Targets table on this worksheet.
- Adjust the graph scales as needed.

6. Cheese Tracking Data Summary

The Cheese Tracking Data Summary component is a checklist for the convenience of the cheesemaker to provide a quick overview of the data that has been recorded for each cheese. The Cheese Tracking Summary document and workbook contain the same information. This allows the cheesemaker to choose a paper worksheet or electronic spreadsheet format to track the data.

Associated Files

- 6-1-CheeseTrackingDataSummaryPSU.docx
- 6-2-CheeseTrackingDataSummaryWorkbookPSU.xlsx

Cheese Tracking Summary Document

The 6-1-CheeseTrackingDataSummaryPSU.docx file contains:

Data Columns
- Cheese Lot #
- Make Date
- Milk Composition
- Cheese Make
- Post-Make Day Processing
- Cheese Composition
- Sensory Evaluation
- Notes

Cheese Tracking Data Summary Workbook

The 6-2-CheeseTrackingDataSummaryWorkbookPSU.xlsx file has one worksheet with a data table.

Data Fields

- Header Data
  - Date Updated
    - Date of the most recent change to the workbook.
  - Name
    - Person who performed the most recent update.

- Data Table
  - Cheese Lot #
  - Make Date
  - Milk Composition
  - Cheese Make
  - Post-Make Day Processing
  - Cheese Composition
  - Sensory Evaluation
  - Notes

Instructions for Use

1. Save and rename 6-2-CheeseTrackingDataSummaryWorkbook.xlsx as a new file, giving an appropriate name for the working document.
2. For the first time, add data directly below the thick black line of the header border of the data table.
3. Add additional data below the thick black line on the bottom of the table border. The table borders will automatically adjust to incorporate the new data.
4. Record Make Date, Milk Composition, Cheese Make, Make Sheet, Post-Make Day Processing, Cheese Composition, and Sensory Evaluation data collected with an X or other mark.

Appendix A: Tips for Using Excel in the Cheese Tracking System

This primer includes basic information on using Microsoft Excel relative to the Penn State Extension Cheese Tracking System.

Excel Organization in the Cheese Tracking System

Each ".xlsx" file is considered a *workbook*, which is composed of one or more *worksheets*. Switch between worksheets by clicking the worksheet tabs found at the bottom of the Excel window. Worksheets can be renamed by double-clicking the tab.

Each worksheet contains one or more *tables*. Tables are outlined with a thick black line. Tables are composed of columns and rows. The top row of the table is the *header* row, which describes what data to enter beneath it. These tables have special properties beyond those of an ordinary data *cell*. For example, tables can be linked to graphs so that graphs populate automatically with only the information in that table. Tables will automatically adjust to include new data entered directly into the row below the bottom of the table or into the column to the right of the table. The table can also be manually adjusted to include or exclude adjacent rows or columns by clicking and dragging the bottom right-hand corner of the table to include only the desired cells.
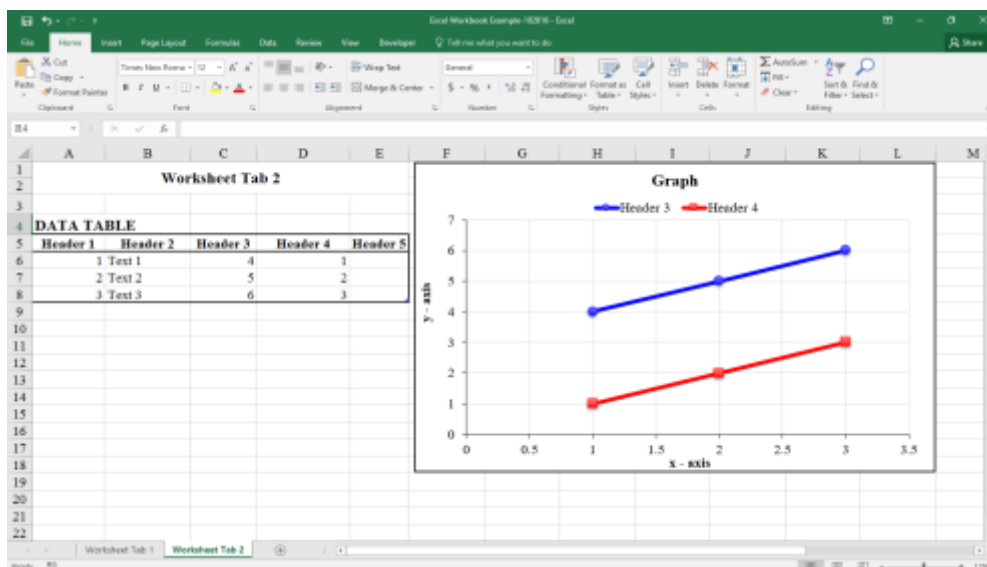
Some columns are for direct data entry, while other columns calculate data based on other columns in the table. Columns that are self-calculated will always include "(Calculated)" in the header. If there is not enough information for the calculation, "#N/A" will be displayed in the data cell. Cells with "#N/A" will not affect graphs.

To remove table columns or rows, delete the column or row:
1. Select a cell in the specific row or column.
2. Right click.
3. Select "Delete" and then "Table Columns" or "Table Rows" as appropriate.

It is important to delete table columns or rows in this way to prevent graphs from linking to the wrong cells and to keep them linked only to the cells within the table.

To insert table rows in a table that is above another table on a worksheet where there are multiple tables, it is sometimes necessary to add rows to the entire worksheet. You must insert rows into the worksheet before continuing to add to rows to the data table.

1. Right click on the row number directly below the bottom of the data table (found at the very left-hand edge of the Excel window).
2. Select "Insert" to insert a row along the entire worksheet. Repeat as needed.
3. Add additional table rows normally, by entering data directly below the thick black bottom border.

Copying Worksheets

Copy worksheets within a workbook to track new cheese lots,

1. Right click on worksheet tab at the bottom of the window.
2. Select "Move or Copy…"
3. In the pop-up window, highlight "(move to end)."
4. Select the "Create a copy" check box, then click "OK."
5. Rename the new worksheet by double-clicking the tab name or right clicking and selecting "Rename."

Best practice is to always copy worksheet templates before entering data and save a clean template for future use.

Copying and Pasting Data

To view data in different ways, data columns will be copied from one table and pasted into another. It is a good practice to copy and paste *values* rather than the contents of a cell. This is especially important when data is calculated rather than directly input, as with process times calculated in individual cheese make sheets. Errors can arise when calculated data is copied and pasted without pasting values specifically.

To copy and paste values:

1. Select all of the data in the column to copy.
2. Copy the data.
   - Right click and select "Copy"

     OR

   - In the "Home" toolbar, select "Copy"

     OR

   - Simultaneously press the "Ctrl" and "C" keys when using Windows or "Cmnd" and "C" keys when using a Mac.
3. Select the first cell of the column into which the data will be pasted.

4. Paste the data values
   - Right click and select "Paste Special…" In the pop-up window, select "Values" and click "OK."

     OR
   - Using Windows, under the "Home" toolbar, expand the "Paste" menu by clicking on the arrow below "Paste." In the drop-down menu, select the middle icon under "Paste Values"

     OR
   - Using a Mac, under the "Edit" toolbar, click "Paste Special…" In the pop-up window, select "Values" and click "OK."

Graphs

Graphs have been set up for a wide range of data interpretation. Graphs will automatically populate from data within a table. Any data not within the confines of the table (designated by a thick black border) will not be a part of the graph. Errors may occur if table rows or columns are not deleted properly (see above).

Graph axes will automatically adjust based on entered data measurements. Sometimes graph axes will cover a larger or smaller scale range than necessary. To modify axis scales to fit a specific range:

1. Double-click the numbers of the axis.
2. In the pop-up window:
   - When using Windows, select the Axis Options tab.
   - When using a Mac, select the "Scale" tab.
3. Adjust the minimum and maximum as needed.
   - When graphing by time, Excel uses a different number format. In this format, 0.5 represents 12 hours, and 0.04167 represents 1 hour.

Appendix B: Tips for Developing Make Procedures and Targets

Controlling the cheese make-day process is key to making high-quality cheese consistently. Small changes in raw materials and processing can alter curd composition, leading to differences in pH, moisture, fat, protein structure, calcium, lactose, and salt in the cheese. Targets should be defined at key steps to achieve the desired curd composition and cheese quality. Variable parameters should be controlled to ensure that the pH drops at a consistent rate from batch to batch. For example, the times at different steps may vary based on milk composition and influences such as the temperature of the make room. It important to understand what the targets are during the cheesemaking process and monitor the process to make sure those targets are being met.

Writing Procedures

Procedures are a set of detailed instructions that a trained employee should be able to follow to achieve a consistent result every time. Procedures should include ingredient type and quantity, the processing steps (sequence and timing), and target measurements for monitoring temperature, pH, and other factors important to the particular cheese making process. If there are known variations in the procedures, they should be noted as well. For example, calcium chloride may be added when using late lactation milk, but not when using early lactation milk. Procedures should be written, signed, dated, and revised as needed.

Choosing Targets

For common cheeses, targets have been established and can be found in papers and books on cheesemaking. Many cheeses have procedural and compositional requirements that are specified in the Code of Federal Regulations (21 CFR 133 Cheese).

Make-day processing targets can include the flocculation time, time between steps, the temperature, the pH, or other empirical measurements such as curd firmness. Post-make day processing targets can include chemical composition or sensory analysis. Processing targets are linked to an optimal pH development schedule and result in the desired cheese composition and sensory quality.

For many unique and artisan cheeses, however, there may not be well-established pH profiles. In this case, you will have to develop your own targets. Targets may come from:
- Research reputable sources of information for cheeses similar to the one you are making to see what is already known about the cheese type.
- Your own research and development.
  - Gain an understanding of the pH development during the cheesemaking process by measuring the pH at several points for a large number of batches.
  - Evaluate the quality of the cheese produced using sensory or compositional analysis.
  - Link the cheeses of optimal quality with the pH development during the cheesemaking process.
  - Select targets based on the optimal pH curves tied to high-quality cheeses.

In order to successfully link desirable sensory outcomes with processing targets, it is important to understand or minimize other sources of variation as much as possible. For example, if you are working with a small herd on seasonal grazing, there will be a more noticeable effect from seasonal and lactation changes in the milk than for larger, pooled milk sources.

Make Sheets

Once procedures are determined and appropriate targets are selected, develop a make sheet that lists each step with time, temperature, and pH targets and space to record the observed measurements. Use the make sheet to track measurements at key steps and establish that targets are being met. If targets are consistently not being met, revise the targets or adjust the process.

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