Development of a Training Program for the Cal Poly Creamery

A Senior Project

presented to

the Faculty of the Dairy Science Department

California Polytechnic State University, San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Dairy Science

by

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March, 2013

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ABSTRACT

The objective of this project was to create a program for training new employees of the Cal Poly Creamery in order to prevent accidents involving personnel and products. The goals of this program are to prevent product contamination, actively promote employee safety, and provide an environment in which employees can learn hands-on about the various aspects of dairy product processing. After analyzing the needs of this specific processing plant in regards to potential microbial threats, chemical and physical safety, and general good manufacturing processes, it was determined that the best method for properly training new employees was to provide them with an employee handbook. A second part of the training program will be to take them through the creamery with either a designated experienced employee or the plant manager to go over the function of each room and the uses and risks involved with all pieces of essential equipment. The handbook and set of training instructions were written based on a review of literature and evaluation of Cal Poly Creamery practices.

Key Words: employee handbook, training, risk prevention
INTRODUCTION

The Cal Poly Creamery provides students with the opportunity to learn various dairy processing procedures, similar to processes they would see in commercial facilities but on a smaller scale. Employees learn how to make and package cheese, make ice cream, bottle fluid products, use various types of equipment, learn good manufacturing procedures, and learn proper cleaning and safety protocols.

At the beginning of this project, there was no permanent program in place for training new employees. The Creamery has experienced a product recall, and accidents are almost inevitable in any processing facility. Because of this, a need arose for a set of detailed protocols and instructions that employees can refer to that would possibly prevent any incidents from occurring. Incidents would include biological contamination, physical harm to employees, and chemical harm to both employees and products.

It was determined that the most effective way of going about the creation of an employee handbook was to work closely with the current Cal Poly plant manager while also researching examples of other handbooks and technical literature. Once a handbook was put together, a set of instructions was also outlined for the person in charge of training the new employees. The objective of this project is an employee handbook with written and visual information to make the training process more effective, a set of instructions for the person in charge to ensure that they are trained properly and consistently, and a system in place that is permanent and effective yet easily altered to meet the growing and changing needs of the Cal Poly Creamery.
LITERATURE REVIEW

Microbial Risks

There are many microbial threats pertaining to a dairy processing plant, but there are several that stand out and cause a majority of the problems. After reviewing information on common pathogens and disease outbreaks, it became clear that three of the main pathogens that have caused the dairy industry a lot of time and money are *Listeria monocytogenes*, *Salmonella spp.*, and pathogenic *E. coli*.

*Listeria monocytogenes* is a pathogen commonly found in moist environments and foods such as raw milk, seafood, meats, and raw vegetables. It can grow in temperatures lower than 1 degree Celsius, which is uncommon in bacteria, is salt-tolerant, and is a Gram-positive rod (Chen, 2012).

Listeria monocytogenes causes two kinds of gastrointestinal illness: non-invasive and invasive (Chen, 2012). The non-invasive type tends to clear up on its own in generally healthy individuals, while the invasive type may cause septicemia and meningitis. Symptoms include fever, nausea, muscle aches, vomiting, and diarrhea. These can last for up to several weeks (Chen, 2012).

Several outbreaks of *Listeria* have been found in dairy products around the world. In 1999, an outbreak of *Listeria monocytogenes* was reported in Finland (Lyytikäinen et al., 2000). Twenty-five cases were reported, all hospital patients who had consumed contaminated butter; six of the infected patients died. The source of the strain was found at the local dairy producing the butter, and the outbreak was brought to an end. Another instance of *Listeria* occurred in 2012, in Albany, New York. The New York State
Department of Agriculture & Markets reported that *Listeria monocytogenes* had been found in several fresh cheese products made by the Mexicali Cheese Corp. The article described the bacteria as a pathogen which can cause serious, sometimes fatal infections in young children, the elderly, and others with weakened or compromised immune systems. Listeria may not be as commonly reported in dairy products as the others mentioned, but it does still potentially pose a threat to processors and consumers.

Salmonella is another organism that is often a threat when processing foods. It is a Gram-negative rod (Hammack, 2012) and causes an infection known as Salmonellosis (Centers for…, 2010). There are several sub-species that can manifest in humans (Hammack, 2012).

Salmonella can cause two types of illnesses. The first, and most common, is gastrointestinal illness, or non-typhoidal salmonellosis. The symptoms include nausea, diarrhea, cramps, and fever. These normally last four to seven days in otherwise healthy individuals and tend to clear up on their own. However, individuals with compromised immune systems may be more severely affected (Centers for…, 2010). The second type is typhoidal illness, or typhoid fever. This form is much less common, and also much more serious; up to 10% of untreated cases may result in death. Symptoms include high fever, lethargy, aches, gastrointestinal symptoms, headache, and loss of appetite. These usually appear one to three weeks after exposure and can last two to four weeks (Hammack, 2012).

The American Journal of Epidemiology reported in 1979 on an outbreak that had occurred three years earlier in Colorado, where officials noticed an outbreak of
Salmonella heidelberg and were able to trace contaminated cheddar cheese back to the source (Fontaine et al., 1980). By tracing it back quickly, they were able to prevent as many as 25,000 diarrheal illnesses. According to El-Gazzar and Marth (Salmonellae, salmonellosis, and dairy foods: a review), Salmonellae are not heat resistant and grow at 35 to 37°C, but they can grow at much lower temperatures, provided that they are given enough time to properly incubate. One suggestion offered in this article is to keep dairy foods at or below 2-5°C at all times to prevent contamination.

At the present time, the most concerning microorganism for the Cal Poly Creamery is E. coli, specifically the pathogenic strain O157:H7. The O157:H7 strain belongs to the group of Escherichia coli known as Enterohemorrhagic E. coli, or EHEC (Feng, 2012). This group contains only strains of E. coli that cause serious illness in humans, as most strains of the bacteria are not harmful.

E. coli produces Shigella toxins, which cause gastrointestinal illness. The symptoms of an E. coli infection can be mild, but in some cases become very severe. Symptoms include severe abdominal cramping, nausea, vomiting, and bloody diarrhea. These can last anywhere from 2 to 9 days, with the average being 8 days for uncomplicated cases. (Feng, 2012)

The journal “Emerging Infectious Diseases” published a study of pathogenic E. coli cases from 1982-2002 in the United States, and wrote that 49 states reported 350 outbreaks, with 8,598 cases, 1,493 hospitalizations, 354 hemolytic uremic syndrome cases, and 40 deaths (Rangel et al., 2005).
Plant Safety

There are several types of physical threats posed to workers in food processing plants. These include injuries to the eyes, skin, and any body parts. The Centers for Disease Control and Prevention (CDC) reports that over 2000 eye injuries occur in the workplace every year (Centers for…, 2009). Most of these are caused by small particles such as metal or wood shavings striking the eye. Recommendations for eye safety consist of wearing any kind of protective eyewear, such as goggles and full-face masks (Centers for…, 2009).

Machinery also poses a strong threat to workers. With moving parts, blades, and hot surfaces, there are many different ways for employees to get injured (Centers for…, 2012). The CDC recommends precautionary measures such as safeguards for machinery and control of all recognized hazards relating to equipment.

Chemicals are a huge part of any processing plant, no matter what type of products are being made, and are critical for washing and sanitizing equipment. Sanitizing, as defined by Jose Santos Garcia in chapter 19 of his book “Microbiologically Safe Foods,” means to treat food-contact surfaces by a process that is effective in destroying vegetative cells of microorganisms of public health significance, and in substantially reducing numbers of other undesirable microorganisms, without adversely affecting the product or its safety for the consumer (Garcia, 2009). Because these chemicals must kill microorganisms, they must be somewhat strong and hence potentially dangerous.
The most common chemical used in the Cal Poly Creamery is chlorine. It is diluted with cold water and used to sanitize almost every single piece of equipment used by the creamery staff. The Berkey Creamery GMP Manual provides an outline of some of the standard procedures for handling chemicals, such as chlorine and the other acids frequently used. These include wearing eye protection, closed-toed shoes, and gloves (Penn State…, 2010).

**Good Manufacturing Processes**

Good manufacturing practicing practices, or GMPs, can be used to enforce plant regulations, encourage employee pride and satisfaction, and set a standard of high quality for the processing plant (Penn State…, 2010). GMPs generally apply to all types of food processing plants, across the board of products.

There are a variety of universally accepted expectations for employees who work in dairy plants, as well as other types of food plants. These include personal hygiene, consumption of food, beverages, and tobacco, proper product handling, employee behavior, and safety procedures (Penn State…, 2010).

The most valuable resources I found in putting this project together were the resources available from the Penn State Berkey Creamery website. They have SOPs, SSOPs, a Good Manufacturing Practices guide, and a food allergen awareness plan, among other things. Their GMP handbook (Penn State…, 2010) provided an excellent layout to follow when writing up the employee handbook. It included various points that I found very useful and apply universally to processing plants. These points include not wearing jewelry, keeping hands clean, hygiene, smoking policies, not consuming food in the plant, and not working when sick.
One of the parts of the GMP handbook that was used in the Cal Poly Creamery packet were their definitions of parts of the plant that all new employees would need to know. The Berkey Creamery definitions cover all of the necessary terminology needed by employees and locations in the plant that they will need to know; for example, what a GMP is and how to properly use processing and storage areas. Using this example, definitions were written specifically for the Cal Poly plant. These are listed in the Training Instructions in Appendix C.

MATERIALS AND METHODS

Because the goal of this project was to create a program that promotes the safety and well-being of new employees and the proper training and use of equipment, the first step of the process was to identify the specific needs of the Cal Poly Creamery. All equipment used by Creamery employees was evaluated and classified as “essential” or “non-essential.” Essential equipment was defined as the machinery operated on a regular basis by employees; non-essential equipment is only used by researchers in the DPTC or only very rarely by creamery employees. Table 1.1 in Appendix A lists all equipment and how it was classified.

Through classifying the equipment with the plant manager, various risks and concerns were analyzed pertaining to each individual process. These risks included biological, physical, and chemical hazards, as well as potential educational opportunities for employees. Table 1.2 in Appendix A shows the results of this analysis.

The literature reviewed for this project provided scientific background for the information presented to the newly hired employees. Scientific journals and textbooks, as well as consumer alert articles and information packets from other university creamery
operations were highly useful in compiling resources that supported the creation of the handbook.

**DISCUSSION AND RESULTS**

At the conclusion of this project, the research gathered was condensed into a handbook for new creamery employees. This handbook is included in Appendix B, and the accompanying instructions are included in Appendix C. The training material created was split into three sections: the basics, equipment, and employee expectations.

The “basics” that are needed to be successful as a student employee at the creamery are broken down into sections for uniform, appearance, and various aspects of safety. The standard uniform for the Cal Poly Creamery includes whites (pants and shirt), rubber boots, a hair net, and rubber gloves. Things that should not be worn include watches, rings, necklaces, and any other types of jewelry. All uniform regulations are for the purpose of keeping Cal Poly dairy products clean and free of foreign objects. This allows the Creamery to provide a high level of quality and lowers the risk of recalls or wasted products.

Personal hygiene is also covered, as well as smoking. Hygiene habits play a role in keeping the plant and equipment sanitary. Keeping generally clean and washing hands frequently is required of all employees. Smoking is allowed only in designated areas and should be avoided if possible.

The products sold by the Cal Poly Creamery must always be free of pathogenic microorganisms. Several types of pathogenic bacteria were found to be threats, but
preventable with proper sanitation and prevention practices. These are Listeria, Salmonella, and E. coli.

Due to its ability to survive conditions that would kill off most other organisms, Listeria is still a threat to the Cal Poly Creamery in spite of how infrequently it may occur. Its ability to survive high salt levels and low temperatures make it a potential threat in the cheese ripening room, where salt in the cheese and lowered temperatures are intended to prevent bacteria from growing.

Because Salmonella is commonly reported on in the news and is found in cheeses, it poses a concern for the Cal Poly plant. However, it is relatively easy to prevent and thus not at the forefront of the Creamery’s bacterial concerns.

The creamery experienced a recall in 2011 for eggnog with a strain of E. coli. While the strain was not in fact pathogenic, E. coli is still a major possible threat to products produced at Cal Poly and steps must be taken to prevent it from occurring in the products produced.

In order to promote the safety and well-being of Cal Poly Creamery employees, an analysis was done of all plant equipment for safety hazards. The “Equipment” section of the packet features a break-down of potential hazards for each piece of essential equipment used. The risks include biological, chemical, and physical threats, as well as potential educational opportunities to promote a strong learning environment. The most common risks that can occur are contamination of products due to improper cleaning and sanitation, and physical harm to employees due to improper handling of chemicals. By indentifying these risks and training to prevent them from happening, the Cal Poly
Creamery will be able to greatly reduce accidents and product contamination, which are two of the main goals of this project.

At the Cal Poly Creamery, we expect our employees to not only follow a code of conduct, but to also further their education of dairy products and knowledge of how a successful dairy processing plant runs and is maintained. This final section outlines the points that students should take away from their work experience: knowledge of plant safety, knowledge of general processing methods, proper sanitation procedures, and problem solving in the plant. Because we want employees to have job opportunities that will create a path to a successful career, each student will be held to these high expectations.

**CONCLUSION**

The Cal Poly Dairy Science Department holds its students to high standards. By ensuring that the students working and learning in the Cal Poly Creamery are well-informed, accidents can be prevented and students can focus on increasing their knowledge of dairy processing. This is what makes Cal Poly students stand out from the crowd when applying for jobs, and takes them farther in their careers. It is my hope that the final product of this project helps to support Cal Poly’s “Learn by Doing” philosophy and continues to be used as a tool for the Cal Poly Creamery.
REFERENCES


APPENDIX A

Table 1.1 Essential vs. Non-Essential Equipment

<table>
<thead>
<tr>
<th>Essential</th>
<th>Non-Essential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasteurizer</td>
<td>Butter Churn</td>
</tr>
<tr>
<td>Bottle Filler</td>
<td>Research Equipment</td>
</tr>
<tr>
<td>Cheese Making Equipment (Vats, Press, etc.)</td>
<td></td>
</tr>
<tr>
<td>Ice Cream Equipment</td>
<td></td>
</tr>
<tr>
<td>Vacuum Sealer</td>
<td></td>
</tr>
<tr>
<td>Cheese Packaging Equipment</td>
<td></td>
</tr>
<tr>
<td>COP Tank</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.2 Hazards

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Biological</th>
<th>Physical</th>
<th>Chemical</th>
<th>Education Opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasteurizer</td>
<td>Improperly pasteurized milk can harbor dangerous bacteria</td>
<td>Hot metal</td>
<td>Acids used for CIP system</td>
<td>Opportunity to get pasteurizer license</td>
</tr>
<tr>
<td>Bottle Filler</td>
<td>Various potential entry points for bacteria</td>
<td>Moving parts</td>
<td>None at this time</td>
<td>Running equipment</td>
</tr>
<tr>
<td>Cheese Making Equipment</td>
<td>Improper sanitation of equipment and improper handling of products can introduce bacteria</td>
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<td>Handling of chemical and proper use of eye/hand protection, first aid</td>
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</table>
Welcome to the Cal Poly Creamery! As a new employee, there are certain things you will need to know and be aware of, as well as certain expectations. These expectations include knowing proper safety procedures, actively learning processing methods, understanding federal and state regulations for dairy products, being a responsible member of the dairy processing team, and truly embracing Cal Poly’s “Learn by Doing” motto. This packet contains the basic information you will need to work here safely, and will prepare you to learn the various processes used to make our CP dairy products.

The Basics

-Uniform

You will be provided with “whites” (shirt and pants), which will be kept in the locker room and washed by our laundry service. Also provided in the locker room are rubber boots in various sizes. If there are any problems with clothes or boots not fitting, please let the plant manager know. The final piece of the required uniform is a hair net. Long hair should be pulled back and tied up. Hair nets are available doors entering into the plant, and bead nets are also available for those who need them. Gloves will also be provided, and are worn for most processes.
-Jewelry

All jewelry is to be taken off before entering the plant, as it may accidentally fall off or come loose while working; it can be a contamination/choking hazard. Jewelry includes ALL necklaces, bracelets, rings, watches, and body piercings.

-Personal Hygiene

Keeping clean is very important in a processing plant. You will be expected to be generally clean in appearance, and for girls not wear excessive makeup. Hands should be washed every time you re-enter the plant or touch something that is not sanitized. This includes items that have touched the floor, body parts that do not get sanitized such as arms and face, and any items that have not been sanitized with chlorine solution.

If you have or appear to have any kind of illness, do not work with food products. Notify the plant manager to see if you are cleared to work.

-Smoking/Tobacco

Smoking is permitted in designated areas only, and no tobacco products may be used at any time inside the creamery.

-Food

Outside food may be brought in, but it must be eaten in the break room. No outside food may be brought inside any processing areas. There is a fridge in the break room for employees to keep their food.

Physical Safety

-Eye and Hand Protection

Disposable gloves must be worn at all times when handling chemicals as protection. Eyewear must also be worn, and there are multiple pairs of safety glasses in the chemical room. Eyewash stations, as well as the first aid kit, will be pointed out on your plant tour.
If you have cuts, open sores, or bandages on your hands you must wear gloves at all times.

-Chemical Protocols

When using any chemicals, always wear protective gear (as stated above) and follow directions from plant manager. Binders containing Material Safety Data Sheets (MSDS) are located in room (?) and contain information pertaining to the various chemicals used throughout the plant.

Biological Safety

-Cultures

The cultures used to make cheese are kept in a freezer near the cheese ripening room, and consist of live bacteria that give the cheese it’s characteristics. These are “good” bacteria.

-“Bad” Bacteria

There are certain bacteria that may be introduced into the processing environment that may be harmful to consumers. Examples of these would include but are not limited to Salmonella, pathogenic E. coli, Staph aureus, and Vibrio parahaemolyticus. We can prevent these from becoming a problem in our products by practicing good hygiene and proper cleaning and sanitation.

-Contamination Prevention

There are two kinds of contamination that the Cal Poly Creamery wants to avoid: pathogenic and cross-contamination. Pathogenic contamination involves the accidental introduction of pathogenic bacteria into products. This can cause consumers to become sick and can also cause costly product recalls.

The other less concerning form of contamination is cross-contamination of cheese cultures. Because each type of cheese is made using different amounts and types of
cultures, equipment used in the making of one type of cheese should not be used immediately after in the making of another cheese without being properly sanitized first.

-Sanitation and Cleaning

Basic cleaning procedure consists of first washing equipment (all tools and vats) with HCL10 soap and hot water, and then rinsing them with chlorine solution. You will be shown how to prepare these solutions on your first day. Proper cleaning and sanitation are extremely important parts of preventing contamination incidents.

Equipment

Various biological, physical, and chemical hazards are associated with all of the equipment used by creamery employees. Here you will find a list of all essential equipment you should be familiar with, and the potential hazards associated with them.

Pasteurizer

Biological- If milk is not pasteurized properly, harmful bacteria can survive. These bacteria can cause spoilage and, most importantly, dangerous illnesses.

Physical- Pipes can become extremely hot and can sometimes burn hands if touched.

Chemical- Acids used for Clean in Place (CIP) system can be corrosive to skin and clothing.

Bottle Filler

Biological- At various points in the bottling process, there are potential points of entry for harmful bacteria (filling, capping, placing empty bottles of the line).

Physical- The bottler has many moving parts, which hands and clothing should be kept away from.

Chemical- no risks at this time.
Cheese Making Equipment (Vat, agitators, knives, measuring devices)

Biological- Improper sanitation of equipment and improper handling of products can introduce bacteria into the cheese.

Physical- Knives for cutting curds may be sharp; steam to heat the vat causes pipes to become very hot.

Chemical- Chlorine solution and caustic soap are used for clean-up; these solutions should be kept away from eyes and mouth; rinse with water and get first aid immediately.

Ice Cream Equipment

Biological- Improper sanitation of equipment and improper handling of products can introduce bacteria into the ice cream.

Physical- Ice cream filler has many moving parts, which hands and clothing should be kept away from.

Chemical- Chlorine solution and caustic soap are used for clean-up; these solutions should be kept away from eyes and mouth; rinse with water and get first aid immediately.

Cheese Packaging Equipment

Biological- Improper handling can lead to contamination inside sealed packages; cross-contamination of cheese cultures can occur on knives if they are not sufficiently cleaned off between cheese types.

Physical- Hands should be kept away from lid of vacuum sealer; wire knives may have sharp ends, gloves should be worn; heat proof gloves should be worn when shrink-wrapping.

Chemical- Acid is used to clean the shrink-wrapping kettle, should wear gloves and proper eye protection.
**COP Tank**

Biological- Improper use can result in bacteria surviving and remaining on equipment.

Physical- Water used is very hot, could potentially burn skin.

Chemical- Acid and caustic soap will burn skin and could damage eyes; must wear gloves and safety glasses.
APPENDIX C

Training Program- Instructions

Step 1: Trainee receives Employee Handbook; go over all points of interest and answer any questions. Plant manager will give you a printed copy for each trainee.

Step 2: Tour of the plant. Take trainee through each room of the Creamery and describe the essential pieces of equipment, as well as biological, chemical, and physical hazards identified for each. Table and list of tour stops:

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</table>
Equipment Photos

Pasteurizer

Pasteurizer                                              Bottler

Cheese Making Equipment

Top Left: Cheese Vat
Top Right: Tools
Bottom Left: Curd Miller
Ice Cream Equipment

Cheese Packaging Equipment

Kettle

Vacuum Sealer

Tour Points:

1. The Pilot Plant- used by the various researchers and graduate students that work in the DPTC. It houses a variety of equipment that is for specific research use. There are, however, certain pieces of equipment that creamery employees occasionally share with them.

2. Cheese Room- where all cheeses are made; contains three cheese vats and all of the equipment used for CP cheese making.

3. Butter/Ice Cream Room (?)- contains the only continuous butter churn in (?), as well as the equipment for mixing and packaging pints of ice cream.
4. Grade A Room- room where the milk/products are pasteurized; also where liquid products are mixed and bottled.

5. Raw Room- where the raw milk is brought in from the dairy, stored before being pasteurized.

6. Dry Ingredient Room- storage for all “dry ingredients” (cocoa powder, sugar, salt, inclusions), packaging supplies, and refills of hairnets, gloves, and earplugs.

7. COP Room- Clean Out-of-Place; where equipment is brought to be washed in the COP wash tank. Also, the chemical room is directly off the right side of the room. Always follow proper chemical protocols when in the chemical room.
8. Milk Cooler- liquid products are kept in this temperature controlled room; kept at (?) °F.

9. Freezer/Deep Freezer- used to store ice cream and frozen products, kept at (?); deep freezer is used to blast-harden ice cream right after it is packaged and is kept around (?).

10. Cheese Ripening Room- contains cheese blocks and wheels that are aging before they are ready to be cut.

11. Warehouse- located across from the back dock; used to store extra equipment and supplies.