Quality Control Program in Cal Poly Creamery to Improve Records and Products

A Senior Project

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by

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Abstract

The purpose of this project was to improve the Quality Control Systems applied at the Cal Poly Creamery by means of implementing a new computer program that will allow more precise record keeping that will in turn produce enhanced results. Each quality control test that is performed at the Creamery and Dairy Products Technology Center was shadowed and thoroughly explained in order to fully understand and grasp all concepts of the tests. Some of the tests were then done solo to fully understand the idea, and data was collected. The data collected over the last two years was inputted into the new computer program along with all of the current UDSA and FDA regulation information. The inputted data was taken as a whole and compared to the regulations. Data from year to year was also compared to one another, by means of reports, to determine how product quality has changed across the board at the Creamery. Conclusions began to be made about the efficiency of the processes being done at the Creamery. Due to the fact that the quality control computer program is now in full effect, the overall goal of this project is to ensure that the computer program and its upkeep continues to be an integral part of the daily processes done at the Creamery by employees and students. Recommendations for ways to improve the quality control of the Creamery were put into place.

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Background of Quality Control

There are many characteristics of dairy products that determine the overall value or worth; however, the most important aspect is quality control. Over the years, the definition of this term has changed, as has technology. Many other parts of society have evolved that have an effect on dairy products and their quality. Around the year 1840, the first true form of quality control testing was used. There arose issues in the canning industry and individuals from the firm of Donkin, Hall and Gamble worked to invent a method for testing cans by exposing them in a test chamber for at least a month at a temperature above what they are ever likely to encounter. The results of this test would determine if putrefaction took place, which would cause the can to be convex instead of concave and allow unwanted contaminants in the can and product. Years later a man by the name of Stephen Fodner filed a patent for preserving canned foods by heating them in a water-bath containing nitrate of soda to raise the boiling point of water (Hawthorn, 1967.) For the time being, this method worked and sparked the idea for other scientists to change the way food products and their consumption were viewed, as well as how to preserve the quality of manufactured goods.

Important Aspects of Quality Control

According to Hawthorn, the definition of quality is “the attributes of the food, which make it agreeable to the person who eats it. In its broadest sense this involves the positive factors of colour, flavor, texture and nutritional value, as well as the negative characteristics of freedom from harmful micro-organsims and undesirable substances, whether added deliberately or present adventitiously” (Hawthorn, 1967.)

Data Collection and Quality Control Testing

Conversely, how quality control is defined and tested since Hawthorn has changed dramatically, along with all of the potential issues that can arise if the quality of a product is less than perfect. The authenticity of the ingredients that make up dairy foods as well as the quality of the final products is also at risk. Spectroscropic techniques including: near infrared, mid infrared, front face fluorescence spectroscopy, stable isotope and nuclear isotope and nuclear magnetic resonance coupled with chemometric tools have possible benefits as tools for the evaluation of the authenticity of specific ingredients and dairy products (Karoui, DeBaerdemaeker, 2007.) This level of analytical chemical testing is more common when the authenticity of ingredients or adulterations of the products are thought to be a problem; for instance, if a recall is done or a company runs into legal trouble. These tests are not normally done in quality control laboratories.

Other more common microbial analysis tests include: physical methods, metabolite testing and counting methods. Physical methods are circuitous yet prompt methods that are used to approximate the microbial content. An example of a physical method of testing is the measuring of pH. Metabolite testing is a quick, non-specific method that uses the presence of metabolites, which in turn corresponds to the presence of ATP or "dirt," more often than not on a surface (Belloque, et al., 2009.) At Cal Poly's facility, Charm® novaLUM® Pocket Swabs are used on a regular basis. These Pocket Swabs detect ATP bioluminescence and are used on all of the equipment and surrounding areas in the processing plant to ensure cleanliness.

Counting methods are the most utilized methods, as these tests have been the most successful over time. One of the most common counting methods used is the standard

plate count (SPC.) SPC is based on “the capability of microbes to grow and form colonies that can be counted visually or with the aid of automatic colony counters. It measures only viable cells” (Belloque, et al., 2009.) This test is very low cost and can be done by individuals without high levels of training.

Other tests that are common include the Laboratory Pasteurized Count (LPC) and the coliform count. LPC “determines the presence of bacteria in milk that can survive pasteurization. A high LPC indicated production conditions that promote the growth and survival of heat-resistant bacteria in the milk handling facilities. This test provides information about milk not available from other milk quality tests” (Jimenez, 2010.) The coliform count is not commonly used as a regulatory standard for raw milk in most of the United States; however, it is considered in regulatory standards for raw milk in California, due to the fact that California has higher standards in comparison to many other locations. The results of this test have a particular emphasis on the sanitation involved with preparing animals for milking and general environmental conditions (Jimenez, 2010.)

The difference in the coliform count and the LPC and SPC is that results of the coliform test are translated based on the number of colonies found, rather than the presence of absence of these specific bacteria. This is due to the fact that coliforms are likely to be found in raw milk; however, the bacteria found in the other tests should not be present or if present should be present in very low numbers (Jimenez, 2010.)

Other tests can be done that do not test bacteria in the product, but instead test for the overall structure of the product. These tests are done to determine the composition of the good to ensure the consumer will receive the best product possible. Some of these

tests include: fat, moisture and total solids composition tests. These tests are commonly carried out on ready-to-consume products. For instance, at the Cal Poly Creamery and Dairy Products Technology Center, composition testing is done on ice cream mix, eggnog and chocolate milk rather than simply the pasteurized or raw milk that the other tests are performed on. Records are kept to ensure continuity of the composition of the products.

Quality control is important and necessary at many different levels throughout the entire process. Quality control is done at the processing plant and at the farm as well as by the government. If the farmers have control of the raw milk and work to produce the best quality of raw milk possible, the processors will be able to use this milk as a raw ingredient and create a finished product of high quality, much easier than if the raw milk was of lower quality and needed to be further processed before it could be used. The government portion of quality control serves as the enforcer of rules. The government has regulations in regards to sanitation as well as the overall cleanliness of the milk that must be abided by in order for the product to be produced and consumed. Examples include United States Department of Agriculture (USDA,) California Department of Food and Agriculture (CDFA,) and the Food and Drug Administration (FDA,) among others. The government ensures that once the product is made, all parameters are followed concerning ingredients, bacteria levels, packaging of products, or anything related to the overall process (Belloque, et al., 2009.)

If the correct procedures, including sanitation and regulations, are not being abided by at the dairy, the poor results will be shown at the processing plant. For example, if the milkers do not correctly clean the teats before and after the milking of

each and every cow, it is possible that when the milk is tested the levels of LPC, SPC or coliform counts can be high. This will lower the quality of the milk which affects not only the product and the safety of the consumer, but may also cause others to look at the dairy in a lower light and lessen the respect the dairy or the farmer receives in the industry, as well as lowering monies received. Due to this fact, the gathering of data and statistical analysis requires more than one simple step. The individuals trusted with quality control undergo intense training to ensure they are knowledgeable and aware of every aspect involved with quality control.

Data collection not only requires knowledge in and around processing plants and equipment, but also equipment used at the dairy itself, such as milking machines, and the transportation equipment, which in most cases is a refrigerated truck of some kind and the hoses and valves used to transfer the product from the raw bulk tank to the area in which it will be further processed, as well as the cows themselves. Dairy products, milk specifically, are considered "the perfect food"; however, because of this there are many different contaminants and bacteria that can find their way into our "perfect food" at every step throughout the process, and cause many issues. The only other field observed more heavily for issues such as these is pharmaceuticals.

Data Analysis

The analysis of data in the dairy industry is much different than in most industries, simply because milk is especially perishable. "The analytical method used depends on the objective of the analysis, the need for a fast result, the instrumentation available, the specialized personnel available and the cost" (Belloque, et al., 2009.) The methods vary according to these reasons, in consort with the facility, such as the dairy

farm or the processing plant. No two dairies or processing facilities are the same or function in the same manner.

Methods of analysis at the farm must be quick and require as little advanced technology as possible, or at the very least, instruments that can be operated by any employee without needing to hire an employee specifically for operation of said instruments. However, there are tests that need to be run that cannot be completed within the farm environment. In some cases, farmers must send samples to professional laboratories and pay for results, as they do not have the instrumentation or correct setting to run the proper tests and get results that are completely accurate. Processing facilities run tests that require well-trained technicians or sanitary conditions and extra time (Belloque, et al., 2009.) In the dairy industry, everyone works together as best as they possibly can to ensure consumers are receiving the best possible product; whether this means quality lab technicians working over time to get results, sharing specific equipment when necessary, and so much more.

In conclusion, there are many different aspects and different realms of science that must come together and collaborate for quality control to be effective. If one part of the process is not followed or is not up to standards, the quality of the entire goods can be ruined. Farmers can milk eminent cows and get excellent milk out of them, but if the bulk tank where the milk is cooled and stored is not sanitary, the milk truck which transports the milk to the processing facility has a leak, or a worker who handles products has dirty hands, the integrity of the ingredients is uncertain, the packaging materials are inadequate or so many other reasons, the quality of the finished product will not be of the highest quality possible and meet the requirements.

The overall goal of any manufacturer is to produce a product they will be proud of that will meet the standards of every consumer, and the same is true in the dairy industry. Quality control is taken very seriously and will do nothing other than improve in the future. There are new and reemerging bacteria and diseases that continue to be a part of our world, especially in regards to milk, and the job of those involved with quality control is to ensure that every product consumed is the best it can possibly be.

Methods and Procedures

Many different quality control tests were done at Cal Poly's Dairy Products Technology Center and Creamery. These include tests for: raw milk, coliforms. *Escherichia. coli*, Aerobic Plate Count, yeast and mold, fat composition using Babcock and Mojonnier, moisture and total solids composition using the CEM machine, as well as the Charm Test which accounts for Relative Light Units (RLU.) Below are the steps that were taken for each test as I shadowed Valerie Arechiga one of the trained graduate students responsible for quality control at the Dairy Products Technology Center.

There are many steps involved in the process of testing raw milk for Aerobic Plate Count, Coliforms, as well as *Escherichia coli.* Before any work was done the lab bench was sprayed down with ethanol, wiped clean, sprayed with bleach, wiped clean, sprayed again with ethanol, and wiped down one last time in order to ensure a clean and sanitary work environment. Every time raw milk is collected for testing of any kind a Falcon tube is used for storage. There are multiple steps required in order to correctly collect raw milk for use. The agitator must be turned on; this will mix up the milk in order to get an accurate reading. Turn the agitator on by use of the computer system that controls all of the machines in the raw area of the Creamery. If unsure how to properly use the computer system ask for help before pushing buttons. Next, the valve in which the milk exits the bulk tank must be sprayed with ethanol. Let ethanol soak in, this ensures that area is completely sanitized. Next, let milk purge (stream out of valve) for about three seconds, this allows the milk sitting in valve or milk that contacted ethanol to be released. Collect a Falcon tube full of raw milk from the bulk tank. Clean everything by hosing down the area utilized. Make sure to turn the agitator back off, using the computer system, so that

all of the processes and machines run smoothly in the Creamery. Take sample of raw milk recently collected to lab and run necessary tests.

Microbiological Testing

There is also a specific procedure for plating raw milk. Before beginning, label each plate with what it is, (in this case, raw milk,) the date it was received, the dilution (such as 10^{-2}) and the date it was plated. Remember that tubes with sterile water for dilutions are kept in Room 103A in the Dairy Products Technology Center Laboratories. These can be used as control when performing dilutions and plating. To plate Coliform/*Escherichia coli* plates the process is as follows: create controls by pouring nine milliliters of sterile solution into clean tubes. Make duplicates of the control by repeating this process. Next, perform a 10^{-1} dilution by adding one milliliter of raw milk to nine millimeters of solution; make certain that duplicates of each dilution are done to ensure accuracy. For Aerobic Plate Count (APC) plates, perform 10^{-2} and 10^{-3} dilutions. Repeat the process described in the 10^{-1} dilution, however the one millimeter of solution will come from the 10^{-1} or 10^{-2} tube, rather than the sample of raw milk. Create duplicate tubes for accuracy and make controls for each.

Pour plates for Yeast and Mold Tests were made. The use of potato dextrose agar was needed for this process. Before beginning, I was instructed by Valerie Arechiga not to pour the extra agar down the drain, as the agar will gel and solidify once it cools and this would clog the sink drain in the laboratory. 23 plates were poured. The heated potato dextrose agar was poured into plates that were laid out on the counter. The agar was poured into the plate until the entire bottom of the plate was covered and the lid was placed on top to avoid contamination. The rim of the bottle that contained the heated agar

was flamed, using a Bunsen burner, after every three to four plates were poured in order to retain sterility. Gloves were used to hold the container of the potato dextrose agar, as the agar was very hot.

Yeast and Mold tests were also done. These tests are also fairly simple and are environmental tests, so the process is straightforward. The potato dextrose agar plates that were made earlier in the day were used for these tests. Each plate was labeled with the specific area they were placed in the Creamery and the date, when they were placed there. Two plates were placed in each room and left there with the tops off in order so that the air in the room was in direct contact with the agar. Each time this test is done, the plates are placed in the same place to ensure continuity. In the Ice Cream room the plates were placed on top of the ice cream maker. In the Cheese room the plates were placed on top of one of the cheese vats. In the Fluid room the plates were placed on top of the flat table near the pasteurizer. Five minutes went by and the plates were collected in the same order that they were left in their positions. This ensures each was only exposed to the environment for the five minutes, and no longer. The plates were taped together and placed on the side of the incubator for five days. The bacteria that grow on Yeast and Mold plates grows in room temperature, therefore the plates must be incubated at this temperature, nothing higher and nothing lower to ensure growth of the correct bacteria.

Pasteurized milk was also plated. The milk was plated for Aerobic Plate Count test at 10^{-1} and for *Escherichia coli* and Coliforms at 10^{0}.

The raw milk that was previously plated was analyzed and results are as follows: on the 10^{-1} dilution plate, 32 coliforms were counted after 24 hours in the incubator. The plate with the 10^{-1} dilution had 26 coliforms present after 24 hours in the incubator.

Coliforms are red in color and may or may not form a bubble of air. If the dot seen is blue in color and forms a bubble of air, this is *Escherichia coli* and is an issue. Coliforms do not always indicate dangerous bacteria are present, but *Escherichia coli* do and can cause major problems, especially if it is a specific strain of *Escherichia coli*.

Compositional Analysis-- Fat

The Babcock test is done to test the fat composition for cheese. In order to understand why steps are done in this test, one much realize that the sulfuric acid is used to free the fat and this is what determines the amount of fat or the composition of fat in the cheese. When this test was done, Lace cheese was used and tested. Nine grams of Lace cheese was weighed on the scale and finely shredded. The cheese grader was used for this process. The cheese was placed in the bottom half of a clean Babcock tube. The process of weighing and shredding nine grams of Lace cheese, as well as placing this cheese in a separate Babcock tube, was duplicated and used as a control. Ten milliliters of deionized water was added to both tubes. The Babcock tubes were placed in shaker for five minutes. It was made certain that all of the cheese in both tubes was completely under the water. 18 milliliters of sulfuric acid was added to the tubes. Ensured that only six milliliters of the sulfuric acid were added to the tubes at a time and the tubes were shaken in between each addition of the six milliliters of sulfuric acid. Made certain all of the 18 milliliters of sulfuric were added within 20 seconds of each other; if not done, compositional results at the end of this test can be misleading.

The Babcock tubes were placed in the shaker for five minutes. The solution in both tubes started to turn purple. This was good sign. If this occurs, one can know that the process is running correctly. The tubes were removed from the shaker and were placed in

the centrifuge for five minutes. Before turning the power on on the centrifuge, ensured it was balanced. If centrifuge is used without being balanced, the centrifuge can potentially break and the mixing in the tubes will not work as it should. Tubes were removed from the centrifuge and deionized water was added up until the base of the neck of the Babcock tubes. The tubes were place in the centrifuge for two additional minutes. Deionized water was added to the 45% line of the tubes, once the tubes were taken out from the centrifuge. The Babcock tubes were placed in the centrifuge for one minute. The tubes were removed from the centrifuge and were placed in the hot water bath to temper for five minutes. Must make sure the tubes are covered with water up to the solution line. This is done in order to get the most accurate results possible. The tubes were removed from the hot water bath. The amount of yellow material that accumulated in the tube (the composition of fat in the cheese) was measured with calipers. Results were recorded. 22% fat was collected for both samples of the Lace cheese.

One of the most common tests run to assess fat composition is Mojonnier. This is the test that is also run at the Dairy Products Technology Center at Cal Poly. The purpose of the Mojonnier test is to use ether to extract all of the fat from the given product. The ether works to allow all of the moisture to release from the product and due to this; the fat becomes the sole component of the product, which allows the fat level to accurately be measured. Out of all of the tests run on products in quality control at the Creamery, the Mojonnier involves the most steps and importance of precision throughout the process. In the test run in my presence, eggnog was the product used. All sufficient safety gear was worn and the entire procedure was done under a chemical hood in case

spills were to occur. If milk were to be tested, the correct way to go about the process would be to add ten grams to the container in the beginning but to not add any water.

However, since eggnog has a high content of sugar, 1. 5 grams per milliliter of eggnog was placed in each container of product being tested. One container held the eggnog and a second container was used as the control. Five milliliters of water was added to the blank or control container, as well as the container holding the eggnog. 1.5 milliliters of ammonium hydroxide was added to each container. The solution in each container was mixed 90 times or for total of 60 seconds. It was made certain that while mixing the containers, the end with the opening and cap was faced away from the individual doing the procedure. Later on in the process, gas will build up and allowing the opening with the cap to face body parts could be of harm. Next, 10 milliliters of ethyl alcohol was added to each container. The solution in each container was mixed for a total of 60 seconds; again it was made certain that the end of the container with the opening was facing away from the individual doing the work. 25 milliliters of ethyl ether was added to each container. The solution in each container was mixed for a total of 60 seconds. 25 milliliters of petroleum ether along with three to four drops of phenyl phaline indicator was added to each container. The solution in each container was mixed for a total of 20 seconds. The containers were carefully balanced and placed in the centrifuge and the centrifuge ran for a total of one minute. Metal tins were used in this process to collect the fat extracted during the procedure. The initial weights of these metal tins were weighed on a scale and these weights were recorded for later use while the containers were in the centrifuge. Once the containers were taken out of the centrifuge, there was a distinct and visual difference seen in the solution in the containers. The bottom of the

container was pink in color and contained the protein/sugar. This change occurred because the ammonium hydroxide lowered the pH level and this caused the pink to show. The top of the container contained the fat, which was clear in color, which was extracted by the ether. The fat, which included the entire top portion of the container, was poured into the tins that were previously weighed. The fat from the control was poured into the control tin and the fat from the eggnog was poured into the eggnog tin. The tins with the fat solution in them were placed on heat in order to evaporate the fat solution from them, as dried fat is easier to work with, in comparison to liquid.

This process requires two extractions. While the fat solution was evaporating on the heat, the process for the second extraction began. Five milliliters of ethyl alcohol were again added to each container. The solution in each container was mixed for a total of 30 seconds, again ensuring that the end with the opening and cap was faced away from the individual doing the procedure. The second extraction is when the most gas will build up in the containers. 25 milliliters of ethyl ether, as well as two to three drops of phenyl phaline indicator were added to each solution. The solution in each container was mixed for a total of 60 seconds, with the correct side of the container facing away from individual, in this case, Valerie Arechiga. 25 milliliters of petroleum ether was added to each solution. The solution in each container was mixed 40 times. Both containers were placed in the centrifuge for one minute. The clear liquid (fat that has been extracted) was poured into corresponding tins with the other fat that by this time had mostly evaporated. The fat in the tins sat on the heat until all of the liquid had completely evaporated. The tins were reweighed and these weights were recorded. This data was used in the formula to determine difference in weight of tins. This illustrated the weight of the fat and the

amount of fat extracted from the product or the fat composition of the product. The exact numbers were used and these numbers were calculated later on in the day.

Compositional Analysis—Total Solids/ Moisture

The total solids and total moisture composition test is done by the CEM Machine. The CEM Machine can best be described as a high-powered microwave that dehydrates any product that it tests. After dehydrating the product; this machine then calculates moisture and total solids of the given product. The machine's official name is the LabWave 9000, a Microwave Moisture/Solids Analyzer. When this test was done, Lace cheese was used. The process is fairly simple and not many steps are required, however the steps must be done very accurately in order to get precise results.

Approximately two grams of Lace cheese was placed in between the smooth sides of two CEM papers that are solely used for this machine. These papers are located in a box on top of the machine. The cheddar cheese button on the menu of the machine was pressed to start the process. The CEM machine was tared to make certain that the correct amount of product had been added before the process began and the papers were placed in the correct position inside the machine. The start button was pressed and I waited approximately five minutes for the process to take place. Machine made a 30 second warning noise, which alarmed the user when the procedure was almost complete. The results were shown across the screen. The test was run twice to ensure accuracy. The results were as follows: the first round, % Moisture: 45.18% and Total Solids: 54.82% and the second round, % Moisture: 42.82% and Total Solids: 57.18%.

The CEM Machine can be used for multiple products. Along with cheese, quality control also uses this machine to test the ice cream mix as well as the eggnog. The total

solid and total moisture composition test is the purpose of this test no matter what the product used is. During this test, Cal Poly Eggnog was the product looked at. Two milliliters of eggnog were placed between the CEM papers with the smooth sides facing down. A pipet was used to measure and transfer the eggnog from the original bottle of egnog to the CEM papers. The machine was tared and the papers were placed in the correct position. The ice cream setting was turned to on and the start button was pushed as the machine began to function. I waited for approximately five minutes for the machine to process the product. The results were shown as follows: Total Solids: 31.75 % and Moisture: 68.25%. The process was repeated to ensure accuracy on another two millimeters of eggnog. The results were as follows: Total Solids: 31.86% and Moisture: 68.14%.

Environmental Testing

Lastly, Charm environmental tests are run on a normal basis throughout the Creamery. Charm® novaLUM® Pocket Swabs are used to determine the sterility and cleanliness of given areas. The Pocket Swabs are wrapped individually. The individual doing the testing should label each swab with the date the swab was used as well as the location the swab was used at. Once locations in which the swabs will be used are determined, at each location, a one-inch by one-inch area can then be swabbed. The entire Q-tip should be covered in order to ensure a correct and thorough sample was taken. Once a sample has been taken from each location, the pocket swabs can be tested. Each swab should be snapped near the top, a cracking noise will be heard and the solution pertinent to this test will cover the top of the Q-tip, this should be done right before the test occurs. Insert the pocket swab into the correct place on the machine and

press the number one button. Within five seconds results will appear across the screen. Charm test results are configured in Relative Light Units (RLUs) the higher the RLU number the more bacteria present. The most common places to be tested using Charm are the bottom and sides of the cheese vats, the milk truck, as well as the drains in the raw and pasteurized rooms. Overall, the Charm tests done in the Creamery do not show need for improvement at the current time. The employees' work to ensure sterility is maintained.

Procedures

Once the basics of the tests were understood, all of the data from the Dairy Products Technology Center and Creamery from the past two years, collected by Valerie Arechiga, as well as other employees and students, was inputted into the computer program.

This data included daily or weekly tests run on: cheese, eggnog, chocolate milk, pasteurized milk, raw milk and environmental tests run for yeast/mold, *Listeria* and Charm tests. Due to the fact that the computer program, QA Studios, is extremely new and has not been used at the Cal Poly Creamery before, I was compelled to learn how to use it through trial and error. After some time, the data was entered in the correct places and the faculty and students who will hopefully continue the use of this system in the future were informed about how to properly input data and use the QA Studios program. Reports were computed from the program to show results over time to better determine what is working and what needs to be changed in the quality control of the Creamery.

Results and Discussion

Historical significant data was inputted into the computer program and from this graphs and different reports were compiled to show change over time in the quality of products manufactured at the Creamery facility.

The practical portion of this project taught me a great deal about quality control. Not only was I able to shadow an experienced graduate student and observe as she ran tests and collected important data, I was also able to experience this myself as she let me participate. The task of taking Valerie Arechiga's data and the information collected from other individuals from the Dairy Products Technology Center and Creamery and inputting it into the QA Studios computer program that will potentially be used in the future to further the improvement of Cal Poly's Dairy Science Program as a whole is extremely rewarding.

The knowledge I gained through the experience of this project is not only on paper, but also in the day-to-day activities that quality control technicians undergo. I feel as though I am more educated and confident in the challenges that the food and dairy industry face with the ever-evolving hazards and contaminants that continue to exist in the world today.

The figures shown below are examples of the results and graphs that can be created from this program. Figure 1 shows the main webpage on the program, called QA Studios, that I worked with. This site is very informative. It includes all relevant information needed to use the program as well as contact information in case of troubleshooting. Figure 2 shows the entrance screen for the program. At this stage, the user can choose which product to enter data concerning or which product reports are

needed for. The different sections include: Raw, Fluid, Ice Cream and Cultured. Most of the products made at the Cal Poly Creamery are entered under the Fluid section. Figure 3 shows the main screen for data input. Each time a new entry is added to the system this is the screen shown. Numbers and data can be entered and saved into the system from this page. Figure 4 shows Stand Plate Count values for Fluid Products. The different colors represent different products and the numbers corollate to the SPC for those products. This allows the employees and Quality Control Technician to see how numbers have varied for the different products over time. Figure 5 shows one of the raw product daily microbiological reports. This reports include any of the microbiological data that was entered into the program from August 5, 2012 until January 20, 2014.. These reports can be very specific or very general depending on what is needed. These reports include averages and can be generated daily, weekly or monthly.

These are just a few of the examples of reports and graphs that can be generated by this program. The more numbers and information entered into the program, the more specific the reports can become. The Cal Poly Creamery will potentially use these reports in the future, along with other reports created by Quality Control Technicians and employees to ensure that everything is in compliance with regulations and so forth. The program is fairly simple to use and the data saves into the program so fewer hard copies are needed. All in all, this program, QA Studios, is a great tool for the Creamery.

Figure 1: QA Studios Main Web Page

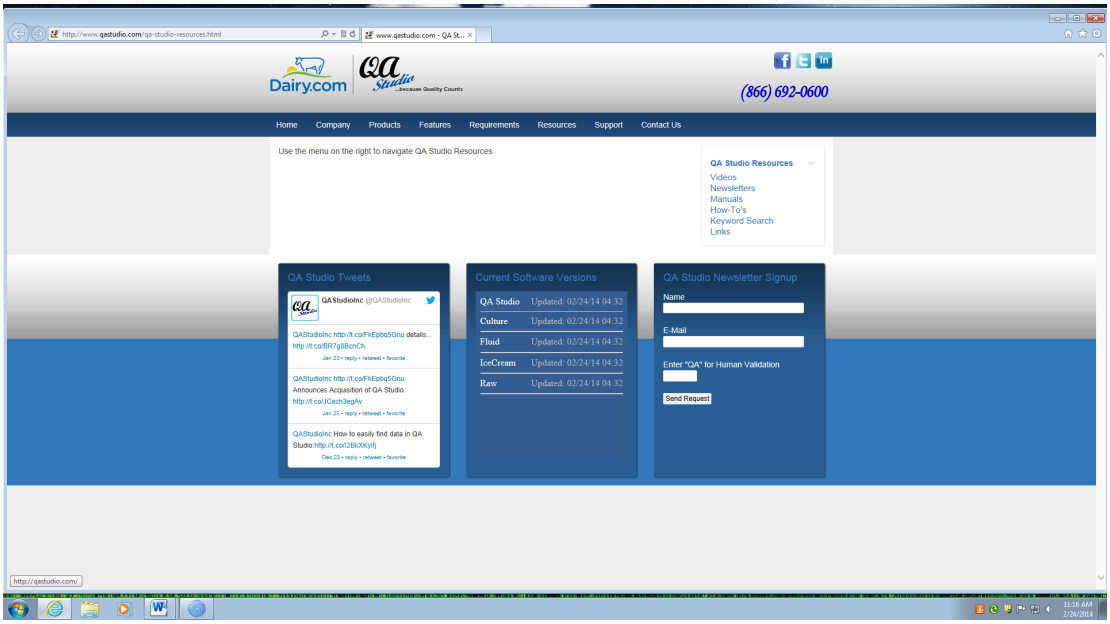


Figure 2: Entrance Screen on QA Studio to Choose Product

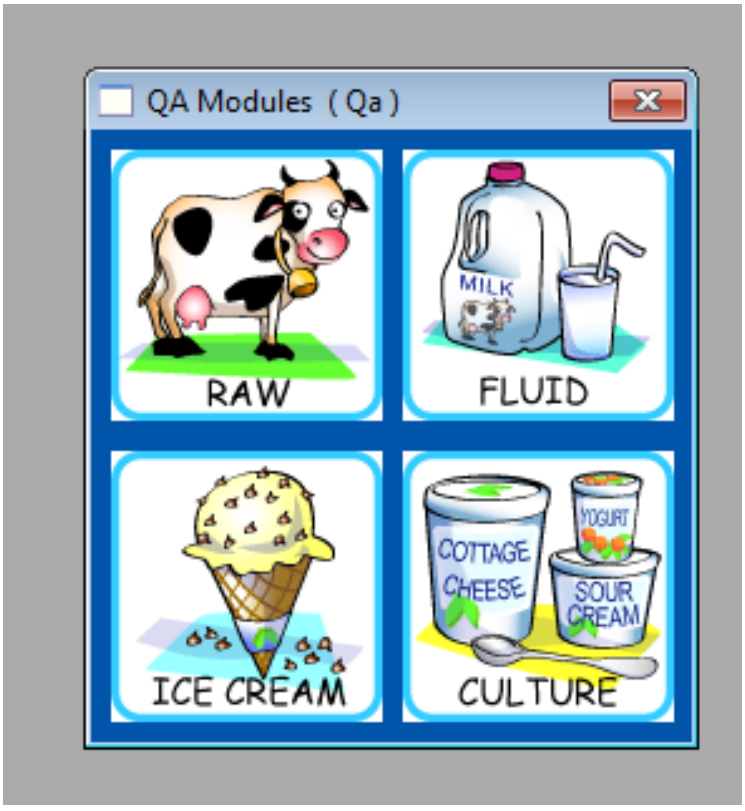


Figure 3: Main Screen for Data Input

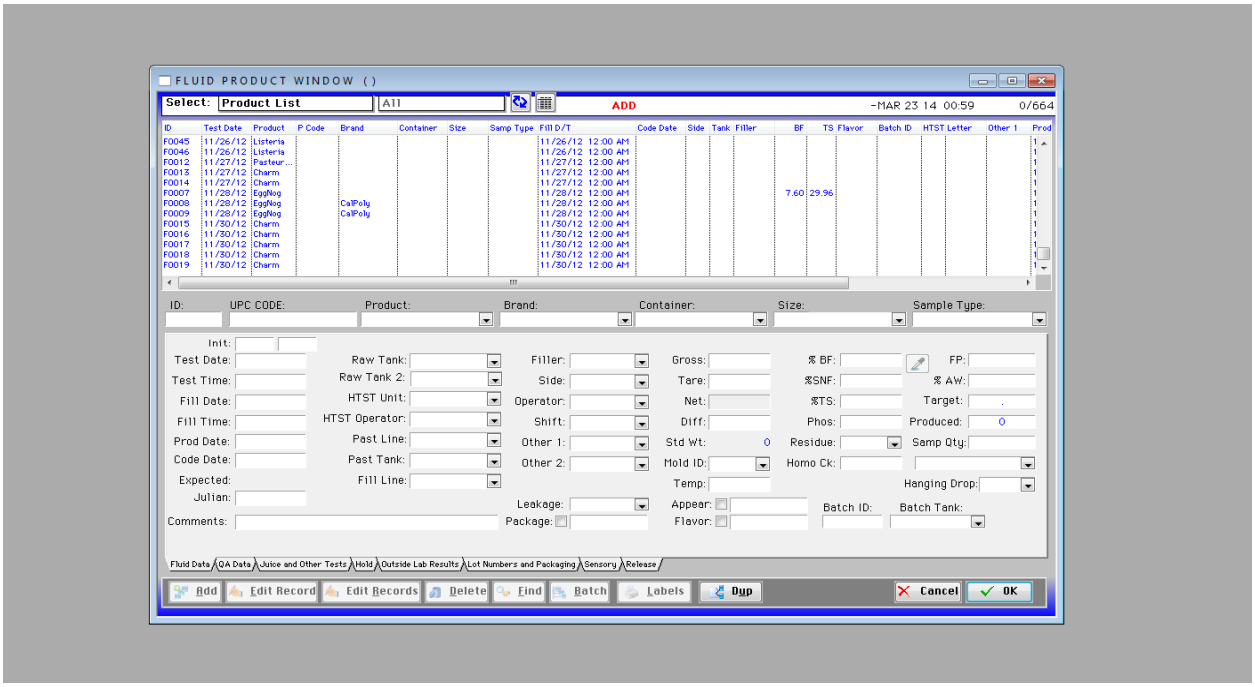


Figure 4: SPC Values for Fluid Products

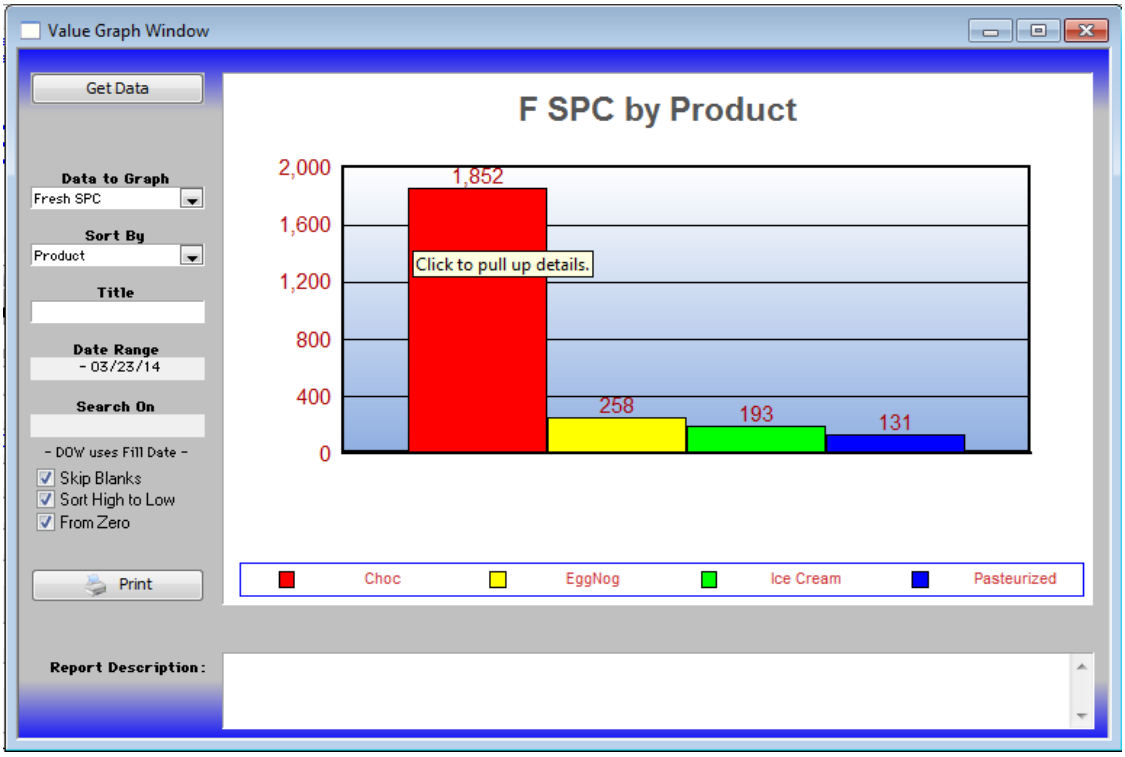
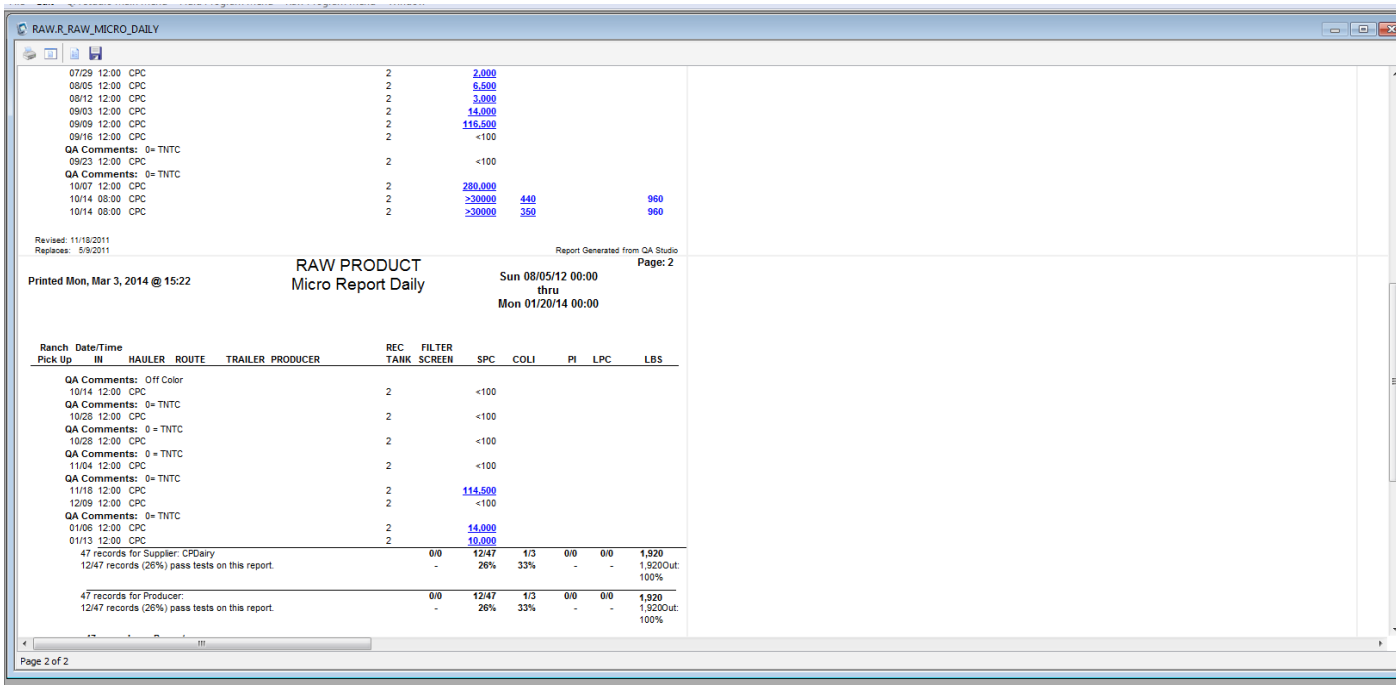


Figure 5: Raw Product Micro Daily Report



After inputting a large amount of data from over the past two years and creating graphs and reports with the numbers and information, there is one specific conclusion that can be arrived at. The Creamery has greatly improved the quality of products since 2012. Some of the results from 2012 show numbers that do not meet USDA or FDA requirements and part of this is due to the recall of eggnog that occurred. However, since this time, numbers are well within the regulations and quality is up to par for all products at the Creamery, as well as the environment that surrounds the Creamery itself. The student employees as well as all of the other individuals that are a part of the Creamery and Dairy Products Technology Center are doing their best to ensure quality is maintained.

Conclusion

The purpose of this project is based on understanding the quality control program put in place by means of the computer program, QA Studios. Before being able to understand and correctly use this program, I needed to completely appreciate all of the aspects that formulate the true idea and definition of quality control in the dairy industry. Each test is done for a very specific reason and the process for each of these tests is very precise. Results are collected not only for the manager of the creamery and the employees and students working there, but for State Inspectors and consumers as well. Individuals in and around the San Luis Obispo community consume products that are manufactured in this facility and quality is extremely important from a food safety standpoint as well as protecting the image of Cal Poly San Luis Obispo Dairy Science Department as a whole.

Once I learned quality control concepts and principles, the data was much easier to understand and organize in order to correctly record it in the program. Throughout the process, I worked with Valerie Arechiga who is one of the individuals responsible for quality control for the Creamery. She does all of the testing and records all of the results; if I didn't understand what something in the results pertained to or meant, she was able to give me an answer.

Because this project was completed, the students, as well as anyone else involved in the Dairy Science Department, will be able to use this computer program, after being trained. This will allow those individuals to keep up to date on the quality control of the products and of the facility in regards to microbiological, compositional and environmental testing. In the near future, this historical data can be analyzed and used for predicting trends or easy identification of abnormalities.

Lastly, after completing this project, I have some recommendations for ways to improve the quality control of the Creamery that, if agreed upon by all, may be put into place in the future.

First, based on what I have learned over the past several months from working and spending time at the Creamery and Dairy Products Technology Center, I believe that more than one individual should be trained in quality control. Valerie Arechiga is the only person who is highly knowledgeable about all of the specifics involved with quality control testing at the Creamery, whom I was exposed to. If some of these tasks were delegated to other student employees, the act of inputting and interpreting data would not consume so much of one person's time and these daily activities would become more habit than nuisance.

Secondly, I feel that the addition of organizational mechanisms involving quality control at this facility would be extremely useful. This computer program will help tremendously with this. If, at the end of each week, the pertinent data is entered into this program, a large amount of time can be saved and data will be more accessible in a timely manner. I agree that hard copies of paperwork are very important; however, with this system, both hard copies and electronic copies can be had and maintained. If the Creamery Manager would like to look back at numbers for a specific product two years in the past, finding this information with QA Studios would be extremely simple. The more employees that are trained, the better the outcome will be as a whole.

In conclusion, I believe that only positive things will come out of the addition of this computer program. This change may take some getting used to, but in the end, the

quality of products is the most important factor and this program will help to potentially improve this.

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