

DEVELOPMENT OF APPLIED STANDARD OPERATING PROCEDURES AND
MONITORING PRACTICES

A Senior Project

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ABSTRACT

Development of a standard operating procedure program for Southfield Dairy was chosen in order to improve the work environment and animal health with an underlying goal to improve profitability. Critical control points for the milk barns, maternity barn and calf barn on the dairy, were identified as being critical to the production of quality milk, both for sale and calf feed. Data recording implementation through identification of recordable data, equipment purchases, and log sheet production, was done so to increase relevant information available for veterinary services and specialty consultants.

Implementation of procedural documents and training programs are discussed to see that dairy management fully embody the proposed recommendations.

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INTRODUCTION

The current focus on food safety in the dairy production industry has led to an increased need for documented procedures and other monitored activities to become routine in dairy operations. The need for increased data collection leads to increased involvement in management decisions from veterinarians and other specialty consultants (Noordhuizen, 2005). This project was designed to incorporate the monitoring and control of standard operating procedures (SOPs) and critical control points (CCPs), with the consciousness of economic value controlling the breadth of the project. The proposed recommendation and implementation of standard operating procedures is intended to create a better work environment, for the purposes of improved milk quality, animal health, and employee welfare.

Standard operating procedures have been used in food processing and production for the purposes of improved quality and the minimization of variables (EPA, 2009), and to control “procedural drift”, or the change in procedure over time (Grusenmeyer, 2003). Food production factors for efficiency and quality include environmental and equipment sanitation, equipment and material quality (PMO, 2011), and employee performance (Stup et. al, 2006). Proper data collection and storage, for purposes of future reference to quality and health issues, are also recommended (BAMN, 2008)

LITERATURE REVIEW

Developing Standard Operating Procedures

When developing standard operating procedures, Grusenmeyer (2003) suggest beginning by organizing an effort using these five steps. First, identify key areas where standard operating procedures should be implemented. Second, identify the top priorities for each area identified from step one. Third, identify all procedures and steps with priorities from step two. Fourth, continue identification of more detailed procedures, or merge similar procedures. Lastly, identify the most qualified person to lead the generation of new SOPs.

The key areas identified for the purpose of SOP generation on Southfield Dairy, were the milking procedures, and liquid feed management, including waste milk and colostrum. These areas were selected for purposes of economic value that comes from consistency of operations (Grusenmeyer, 2003). The critical control points (CCPs) of the stated areas of development include, pre-dip exposure time, mastitis identification, milk equipment attachment and operation, post-dip procedure (Schroeder, 2012), milk/colostrum storage, milk/colostrum solids/quality (Moore et. al, 2009), pasteurization time and temperature (PMO, 2011), and equipment and material sanitation (EPA, 2007).

Milking Procedures

The importance of milking procedures comes primarily from the need to control mastitis events within the operation (Schroeder, 2012). Mastitis is the inflammation of the mammary system (Berning, 2013) and is usually caused by bacterial infection (Schroeder, 2012). Mastitis, as measured by the somatic cell count (SCC) per one mL of milk, is estimated to decrease overall production by 400 lb. per unit increase in linear

SCC score during the lactation. (Schroeder, 2012) The main goal with ensuring proper milking procedures are to reduce the current level of infection, and prevent new cases (Noordhuizen, 2005) Increased farm hygiene (Noordhuizen, 2005) and consistency in procedure (Grusenmeyer, 2003), will improve animal health and performance through decreases mastitis incidence resulting in a positive economic impact.

Pre-dip Procedure

Pre-dip efficacy is a common area of malpractice on many dairy operations. To prevent mastitis and protect milk quality it is recommended to “always milk clean, dry teats” (Berning, 2013). A clean, sanitary, and dry teat will reduce exposure to mastitis causing organisms (Berning, 2013), and prevent pollutants from entering the milk (PMO, 2011). An adequate pre-dip, as selected by management, will be used with complete coverage for the recommended 30 seconds of exposure time (Schroeder, 2012) before being wiped. Single service paper towels for wiping are recommended (Berning, 2013); procedures for udder hygiene will determine if dry cloth towels may be used when conditions may prevent proper cleaning with the use of paper towels (Schroeder, 2012).

Mastitis Detection and Milking Stimulation

Sophisticated measures like biomarkers, conductivity readings, and using culturing methods to identify mastitis are available, but for purposes of mastitis detection in a commercial herd, fore-stripping is an acceptable practice (Schroeder, 2012). Fore-stripping helps identify clinical infections, and stimulates milk let down, accelerating the milking process (Berning, 2013). Fore-stripping will be done in conjunction with the pre-dip step of procedures, as milking time increases when having pre-dip in your milking

procedures (Schroeder, 2012). Employee training in mastitis identification will be continuous to ensure improvement and reduce biological risks (Grusenmeyer, 2003).

Milk Equipment Attachment and Operation

Milking unit attachment is important in that it is the source of contamination for most mastitis cases (Berning, 2013). Air entering the unit at any time may cause potential mastitis causing organisms to be propelled into the teat end (Schroeder, 2012), for this reason any “squawking”, or other air leaks, should be attended to immediately (Berning, 2013). The use of automatic take offs are implemented in both of Southfield Dairies milking parlors, diminishing the effects of “over-milking” by employees (Berning, 2013). Manufacture recommendations will be followed when addressing pulsation rates and ratios, and when determining frequency of liner changes (Berning, 2013).

Post-dip Procedure

As suggested by Berning (2013) the most important factor in mastitis prevention is post-dip coverage. Most available post-dips are proven effective in eliminating and reducing exposure to mastitic pathogens. “The action of creating a sanitized condition at the streak canal has been proven to be extremely beneficial in reducing some forms of mastitis” (Berning, 2013). *Staphylococcus aureus* and *Streptococcus agalactiae*, the most common mastitis causing pathogens, are effectively managed with teat dips.

Environmental pathogens such as *E. coli* are dependent on environmental sanitation (Schroeder, 2012). Current post dip procedures at Southfield Dairy incorporate a dip-cup application method, which has been shown to be advantageous in ensuring proper teat coverage.

Milk Storage

Currently, milk being produced at Southfield Dairy is stored in four, 10,000 gal bulk tanks (Southfield PI, 2014). Milk produced is immediately cooled to <45°F (PMO, 2011). This CCP for bulk tank temperature will be continuously monitored (EPA, 2009) via an analog circle chart recorder (Table 1) for legal protection (Grusenmeyer, 2003), and verified by an analogous thermometer, placed “as close as possible” to the digital recording device (PMO, 2011). Identification of issues with the milk cooling systems will be more readily addressed (EPA, 2009), as data available will show any change in cooling capacity.

Colostrum Harvesting and Quality

All colostrum on Southfield Dairy is collected from all cows within the maternity barn on a separate portable milking system. Colostrum is pasteurized in a batch LTLT (Low Temp Long Time) pasteurizer (145°F for 30 min.), colostrum >1.5 hours post-harvest will be frozen and stored for later use. All unused colostrum is sold to a secondary party (Southfield, PI, 2014). The recent implementation of a portable milking system allows for discrepancies in colostrum quality to be managed. It is suggested a refractometer be purchased (Table 1) to provide data for total milk solids (TMS) which is a representation of colostrum quality. Lower quality colostrum should be segregated for sale, or for bull calf feed, as bull calves are not retained in the dairy’s operation.

Pasteurization of Waste Milk

When waste milk is pasteurized the microbial load is reduced or eliminated by application of heat for a specific amount of time, (BAMN, 2008). Waste milk from mastitic cows can be utilized as a viable, economical source of calf feed. (Jamaluddin et.

Al, 1996). Southfield Dairy started utilizing HTST (High Temperature Short Time) pasteurization for their calf feeding operation in 1997 because of the economic benefits (Southfield, PI 2014), however the utilization of the equipment has not reached full potential. The lack of SOPs and data monitoring, leaves CCPs for pasteurization unobservable, disallowing for any future reference regarding animal health.

Producers should facilitate the infrastructure for harvest, storage, and transport of pre and post-pasteurized waste milk (BAMN, 2008), and “adhere to protocols for pasteurization, sanitizing equipment, routine equipment maintenance and monitoring of the system” (BAMN, 2008). CCPs for waste milk pasteurization are 161°F for fifteen (15) seconds (PMO, 2011), these CCPs will be recorded via circle chart, with which all pasteurization temperatures will be recorded and stored. Current procedures according to Southfield, for storage and transfer of waste milk, start at the isolated hospital milking parlor. All waste milk from this parlor is stored in an outdoor 500 gallon bulk tank. From this tank, waste milk is transferred to pasteurization via a transfer truck. Pumped directly from the transfer truck, milk then enters the HTST pasteurizer where it is pasteurized at >162°F for about 15 seconds. This pasteurized product is then stored in a 400 gallon tank until milk cools to 110°F before milk is transferred into bottles for calf feeding. Current procedures will be modified to address recommended equipment changes (Table 1) and proposed Standard Sanitation Operating Procedures (SSOPs) (Figure 2, 5, 7) to create a comprehensive waste milk management system.

Milk Replacer

Due to the variability in Total Milk Solids (TMS) and quantity of waste milk (BAMN, 2009) additional solids may be needed to meet the nutritional demands of dairy

calves (Godden, 2005), and to insure consistency of product (BAMN, 2009). To measure TMS of waste milk a brix refractometer will be used (Table 1). A digital brix refractometer will be used, eliminating employee variation when measuring TMS (EPA, 2009). Determining the amount of milk replacer to be used, if necessary, will be done by personnel using the table generate (Table 2) using Moore's equation,

$y = 0.9984x + 2.077$, where y is equal to the refractometer reading, and x is the TMS.

Solids will be standardized to 13% TMS (Moore et al., 2009) before pasteurization because milk replacer is not sterile and can support microbial growth (BAMN, 2009)

Equipment and Material Sanitation and Replacement

The provision of quality milk to calves is dependent on the sanitation and quality of equipment in which it is handled and stored. Routine maintenance of equipment is important for the production of quality liquid feed (Jamaluddin, 1996). Figure 3 shows proposed SSOPs and SOPs for maintenance, including gasket change program and replacing bottle nipples. All cleaning in place (CIP) and cleaning out of place (COP) procedures, including sanitation of storage equipment, HTST pasteurizer, transfer lines, bottles and nipples are identified in the procedural documents (FIGURE 3).

Cleaning In Place

CIP is a common practice in the dairy environment for purposes of microbiological reduction and product quality (Walton, 2008). Factors affecting CIP efficacy include time, temperature, flow rate (mechanical action), and chemical concentrations (Watkinson, 2008). On Southfield Dairy, the CIP program consists of chlorinated alkaline detergent, acid, and a chlorine sanitizer. Detergents allow for the removal of organic soiling, such as milk fat and proteins, and increase the ability of water

to hold these solids in solution without re-adhering to equipment surfaces. Acid is used to remove inorganic soils such as calcium carbonate, CaCO_3 , responsible for milk stone, which can provide harborage for microorganisms (Watkinson, 2008). Chlorine sanitizers are used to eliminate microorganisms, and provide an alternative to other available sanitizers which use more costly ingredients such as peracetic acids and hydrogen peroxide, H_2O_2 (Walton, 2008). Time, temperature, and chemical concentrations, require the least amount of equipment for monitoring, and will provide the observable data for most CIP monitoring. Mechanical action will mostly be affected by employee action during the cleaning process, as flow rate is not significant for the identified wash steps, excluding the parlor bulk tanks.

Safety

Language barriers and improper training have created a more dangerous work environment for dairy employees (Opatik et al, 2010). Most employee injuries come from animal handling and milking (Garry et al., 2006). According to Grusenmeyer, well defined SOPs can help keep employees safe, and provide legal protection if injury takes place during work (2003). Improving safety training, including addition of signage, training, and monitoring, are important in reducing safety risk. All identified risks will be addressed in SOP documentation, including the required Personal Protective Equipment (PPE) for each procedure (OSHA).

MATERIALS AND METHODS

Standard Operating Procedure Generation

For a successful SOP program, SOPs should be written in a “concise, step-by-step, easy to read format” (EPA, 2009). No information in SOPs should ever be implied, and it is important to convey exactly what is required from the procedure (EPA, 2009). All SOPs should be prepared with enough detail to allow for someone with little experience to be able to complete the procedure unsupervised (EPA, 2009). Implementation of well-defined SOPs in regard to any dangerous work, or procedures with environmental risks, may provide legal protection from any adverse situations (Grusenmeyer, 2003).

When generating SOPs it is crucial to allow the employee for which the SOP is targeted to have input (Grusenmeyer, 2003), as employees will tend to be more supportive of the procedures. Communication quality between management and personnel, in regards to “empathy, emotion, perception, attitude, voice, and tone of speaking” (Noordhuizen, 2005), are critical for success of the proposed standard operating procedures (Noordhuizen, 2005).

Depending on the personnel to be using the SOPs, different methods of presentation, such as visual or auditory training, and the use of flow charts and other aids will be needed (Grusenmeyer, 2003). The amount of background information provided in the SOPs should be adjusted to the importance of the process and the level of training required (Grusenmeyer, 2003). All CCPs will be supported with basic scientific background, in order to provide education about the SOP to the employee, and exemplify the importance of the procedure.

Monitoring Critical Control Points

Maintaining both electronic and physical copies of all temperature data is recommended for the monitoring of CCPs. (EPA, 2009). Physical log sheets will be used to document completed actions, and ensure procedure was done properly (EPA, 2009). Not every SOP will have an attached log sheet, however any identified SOP relevant to animal health records will be monitored through documentation. The increase in recorded data will provide Southfield Dairy with more information regarding management decisions. Log sheets should be presented in the same clear, unambiguous form provided in the generation of SOPs (EPA, 2009).

Communication with Dairy Management

Contact with the Southfield Dairy management team was critical in understanding the dairies operations. Information on current practices, along with direction when formatting the suggested SOPs was received. The input from Southfield Dairy management was necessary for proper implementation of procedure because of the increased time commitment needed by management for monitoring SOPs and CCPs.

Equipment Selection

Equipment selection was based mostly on initial cost and ease of cleaning. Due to similarities in performance among most options (PMO,2011), ease of cleaning was the second factor for equipment selection. Equipment selected is to replace or repair existing infrastructure, as well as to facilitate new data recording and SSOPs. Pricing of new equipment incorporates initial costs, material pricing, and an hourly wage of \$15.00/hour, for an in house installation labor, and \$75.00/hour, for any labor done by a secondary party for installation (Southfield, 2014).

RESULTS

Table 1: Equipment Purchase Pricing

Item	Count	Product	Pricing			Total
			Materials	Labor		
Dual pen chart recorder	2	\$ 1,741.00	\$ 10.00	\$ 150.00		\$ 3,642.00
Single pen chart recorder	2	\$ 1,290.00	\$ 125.00	\$ 150.00		\$ 2,855.00
Refractometer	2	\$ 159.00	\$ -	\$ -		\$ 318.00
Scale	1	\$ 99.99	\$ -	\$ -		\$ 99.99
Cleaning Equipment						
Tank Brushes	4	\$ 24.50	\$ -	\$ -		\$ 98.00
Bottle Brushes	4	\$ 12.99	\$ -	\$ -		\$ 51.96
Wall Brushes (yellow)	3	\$ 24.50	\$ -	\$ -		\$ 73.50
Floor Brushes (black)	3	\$ 24.50	\$ -	\$ -		\$ 73.50
Fitting Brushes (white)	3	\$ 7.95	\$ -	\$ -		\$ 23.85
Lid for raw milk tank (calf ranch)	1	\$ 200.00	\$ -	\$ 45.00		\$ 245.00
Personal Protective Equipmet						
Face Sheild	6	\$ 39.99	\$ -	\$ -		\$ 239.94
Apron	6	\$ 19.99	\$ -	\$ -		\$ 119.94
Goggles	6	\$ 19.99	\$ -	\$ -		\$ 119.94
Gloves	12	\$ 4.99	\$ -	\$ -		\$ 59.88
Storage and Posting						
Poster	4	\$ 35.00	\$ -	\$ 15.00		\$ 155.00
File Storage	4	\$ 19.99	\$ -	\$ 15.00		\$ 94.96
PPE Hanger	4	\$ -	\$ 30.00	\$ 15.00		\$ 45.00
Brush Mount	4	\$ 29.99		\$ 15.00		\$ 134.96
Total						\$ 8,450.42

Table 2: Quick reference chart for amount (lb) of milk replacer needed to meet recommended total milk solids¹ based on volume and refractometer reading²

Gallons	350	360	370	380	390	400	410	420	430	440	450
Refractometer	(lb)										
9	61.3	63.1	64.8	66.6	68.3	70.1	71.8	73.6	75.3	77.1	78.8
9.1	58.3	60.0	61.7	63.3	65.0	66.7	68.3	70.0	71.7	73.3	75.0
9.2	55.3	56.9	58.5	60.1	61.6	63.2	64.8	66.4	68.0	69.5	71.1
9.3	52.3	53.8	55.3	56.8	58.3	59.8	61.3	62.8	64.3	65.8	67.3
9.4	49.3	50.7	52.1	53.5	54.9	56.3	57.8	59.2	60.6	62.0	63.4
9.5	46.3	47.6	48.9	50.3	51.6	52.9	54.2	55.6	56.9	58.2	59.5
9.6	43.3	44.5	45.8	47.0	48.2	49.5	50.7	52.0	53.2	54.4	55.7
9.7	40.3	41.4	42.6	43.7	44.9	46.0	47.2	48.3	49.5	50.6	51.8
9.8	37.3	38.3	39.4	40.5	41.5	42.6	43.7	44.7	45.8	46.9	47.9
9.9	34.3	35.3	36.2	37.2	38.2	39.2	40.2	41.1	42.1	43.1	44.1
10	31.3	32.2	33.1	34.0	34.8	35.7	36.6	37.5	38.4	39.3	40.2
10.1	28.3	29.1	29.9	30.7	31.5	32.3	33.1	33.9	34.7	35.5	36.3
10.2	25.3	26.0	26.7	27.4	28.2	28.9	29.6	30.3	31.0	31.8	32.5
10.3	22.3	22.9	23.5	24.2	24.8	25.4	26.1	26.7	27.3	28.0	28.6
10.4	19.3	19.8	20.4	20.9	21.5	22.0	22.6	23.1	23.7	24.2	24.8
10.5	16.2	16.7	17.2	17.6	18.1	18.6	19.0	19.5	20.0	20.4	20.9
10.6	13.2	13.6	14.0	14.4	14.8	15.1	15.5	15.9	16.3	16.6	17.0
10.7	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.3	12.6	12.9	13.2
10.8	7.2	7.4	7.6	7.9	8.1	8.3	8.5	8.7	8.9	9.1	9.3
10.9	4.2	4.3	4.5	4.6	4.7	4.8	5.0	5.1	5.2	5.3	5.4
11	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.5	1.5	1.5	1.6

¹ Current TMS = 13.10

² representation of TMS where y = refractometer reading and x = TMS, $y = 0.9984x + 2.077$

Standard Operating Procedures

Southfield Dairy Calf Ranch

Standardizing Milk Solids

1. Measure volume of raw milk
 - a. Is there enough to meet feeding requirements?
 - b. If not, add warm water until volume needs are met.
2. Using refractometer measure TMS of raw milk
 - a. Is it at least 13.0%
 - b. If not, add milk replacer powder according to table 2
3. If yes to both, move to pasteurization
4. Record data to log sheet

Waste Milk Pasteurizer Operation

Check equipment cleanliness

- a. Is the bulk pasteurized milk tank clean? Check with flashlight for signs of any dirty surfaces.
 - b. Are all lines and pumps clean and in good repair?
2. Start Pasteurizer by turning the start switch right to ON
 - a. Does the temperature recorder indicate if the pasteurizer is warming up?
3. Connect all milk transfer lines
 - a. Are all connections made properly?
 - b. Make sure the pasteurizer output is returning to the raw milk tank
4. Begin recirculation step of pasteurization
5. Once temperature of milk leaving pasteurizer reaches >162°F, divert milk into pasteurized bulk tank.
6. Once raw milk tank is empty, turn off pasteurizer hot water supply
7. Remove pasteurized tank supply line, redirect to drain
8. Rinse Raw Tank with Cool Water, run rinse water through pasteurizer until water runs clear
9. Set up Pasteurizer for recirculation

Milk Bottle Feeding

1. Check equipment and bottle cleanliness and condition
 - a. Are bottles dry?
 - b. Do bottle nipples appear to be in good repair? Replace if cracked or opening is enlarged
 - c. Are milk lines and bottle filler clean?
2. Connect bottle filler line and pump to pasteurized milk bulk tank.
3. Allow pasteurized milk to cool to 110°F before bottling
4. Fill all bottles from back to front of trailer
5. Attach nipples to all bottles
6. Distribute all bottles to calves in the order they were filled in order to maintain temperature
 - a. Make sure milk is 101-103°F when fed
7. Collect all milk bottles

Figure 1: SOPs for dairy calf ranch

SSOP Pasteurizer

PPE Required: **Rubber Gloves**
 Goggles
 Face Shield
 Apron

1. Turn pasteurizer start switch to CIP, turn on pasteurizer hot water supply
2. Dose pasteurizer balance tank with Chlorinated Alkaline Solution 0.8% concentration
 - a. Run for ten (10) min at 165°F, label on chart recorder (*Initials, wash step*)
3. Rinse with fresh water to drain
4. Dose pasteurizer balance tank with Acid, 0.4% concentration
 - a. Run for five (5) min at 145°F, label on chart recorder (*Initials, wash step*)
5. Rinse with fresh water to drain
 - a. Turn off pasteurizer hot water supply
6. Dose balance tank with Chlorine, 100 ppm concentration
 - a. Run for two (2) min, cold water
 - b. Do not drain until before next time pasteurizer will be used
7. Turn pasteurizer start switch to OFF

SSOP Bottles (1)

PPE Required: **Rubber Gloves**
 Goggles
 Face Shield
 Apron

1. Rinse nipples and outside of bottles with warm, not hot water, make sure to remove all visible filth
2. Remove nipples and place in bin
3. Rinse nipples with warm water, drain bin.
4. Fill bin with hot water (140°F) and dose with chlorinated alkaline detergent, 0.8%, 100ppm Cl
5. Soak nipples for twenty (20) minutes, maintain water temperature and chemical concentrations
6. Using white nipple brushes, scrub nipples thoroughly, focus on cleaning nipple openings.
7. Place nipples in chlorinated sanitizer water bath (100 ppm)
8. Cover bin to protect from contamination before next use

SSOP Pasteurized Milk Tank and Bottles (2)

PPE Required: **Rubber Gloves**
 Goggles
 Face Shield
 Apron

1. Rinse Pasteurized milk tank, and milk bottle filler and lines with warm water to drain
2. Fill milk tank ¼ full with hot water (>145°F), using chlorinated alkaline detergent dose to 0.8%, 100ppm Cl
3. Using white tank brushes, scrub every part of the interior and exterior of the tank, use solution from tank.
4. Fill bottles with water from Step 2, let stand for ten (10) minutes
5. Rigorously scrub bottles while soaking with bottle brushes, drain bottles
6. Rinse tank and bottles with hot water
7. Fill milk tank ¼ full with warm water, dose with acid sanitizer, 0.5%, repeat Step 2
8. Fill bottles with water from Step 7
 - a. Let stand for one (1) minute, drain bottles
9. Store bottles upside down to dry and prevent contamination

SSOP Raw Waste Milk Tanks (Truck and Hospital Barn)

PPE Required: **Rubber Gloves**
 Goggles
 Face Shield
 Apron

1. Rinse with warm water to drain
2. Fill tank ¼ full with hot water (>145°F), using chlorinated alkaline detergent dose to 0.8%, 100ppm
3. Using white tank brushes, scrub every part of the interior and exterior of the tank, use solution from tank.
4. Rinse tank with hot water

Figure 2: SSOPs for Dairy Calf Ranch

Material and Equipment To-do

Daily

- Check bottle nipples for signs of wear, replace any nipples with visible cracks or too large of an opening
- Replace charts on temperature recorders

Weekly

- Review temperature charts to insure wash pasteurization temperature is consistently reached, as well as CIP wash temperatures.

Monthly

- Replace all gaskets on HTST pasteurizer
- Review milk transfer line quality, replace if cracked or leaking at connection points
- Calibrate refractometer
- Check bottle quality, replace any cracked or over-worn bottles.

Bi-Annually

- Check plate exchanger on HTST pasteurizer for signs of fouling, manually clean with white brush if necessary
- Calibrate temperature recorders
- Replace ink pens in chart recorders

Figure 3: Material and Equipment Monitoring and Replacement

Milking Barns

Milking Procedures

1. Apply pre-dip with sprayer wand.
 - a. Ensure complete teat coverage and thirty (30) second exposure time
2. Fore-striip each quarter, 2x, check for signs of mastitis in milk
 - a. Does milk appear discolored, flaky, bloody?
 - b. If so, segregate cow for hospital string
3. Using a dry, clean towel, wipe each teat. Use as many towels as necessary to get the teat ends clean.
4. Attach milking unit
 - a. Ensure milk claw is balanced, and each teat cup is attached properly
 - b. Any “squawking” or air leaks must be fixed immediately
5. Post-dip each teat with dip cup, ensure coverage around entire teat, and $\frac{3}{4}$ of the way up the teat.

Figure 4: SOPs for Milking Barns

Bulk Tank SSOP

1. Set milk lines for CIP, open bulk tank door.
2. Fill COP tank with hot water ($>145^{\circ}\text{F}$)
3. Dose COP tank with chlorinated alkaline detergent, 0.8%, 100ppm Cl
 - a. Run for ten (10) minutes at $>145^{\circ}\text{F}$, label on chart recorder (*Initials, wash step*)
4. Drain COP tank, and rinse bulk tank with fresh water to drain
5. Fill COP tank with hot water ($>135^{\circ}\text{F}$)
6. Dose COP tank with acid, 0.5%
 - a. Run for five (5) minutes at $>135^{\circ}\text{F}$, label on chart recorder (*Initials, wash step*)
7. Drain COP tank, and rinse bulk tank with fresh water to drain
8. Fill COP tank with cold water
9. Dose COP tank with chlorine sanitizer (100ppm Cl)
 - a. Run for five (5) minutes
10. Using white tank brush and chlorine sanitizer from COP tank, thoroughly scrub all exterior stainless steel.
11. Set milk lines for production.

Figure 5: SSOPs for Milking Barns

Maternity Barn

Colostrum Harvesing

PPE Required: Latex or nitrile gloves

1. Move cow into milking area
2. Prepare milking system
 - a. Is all equipment sanitary, and in proper working condition?
 - b. Ensure proper connection of milk and vacuum lines
3. Pre-dip all teats with pre-dip cup, completely cover all teats
4. Fore-strip all teats, 5-6x
5. Using a clean towel, wipe all teats
6. Turn milking system on
7. Attach milk cups to teats, make sure it is balanced and free of any air leaks or “squawking”
8. Once milk flow has decreased to about 20% of initial, remove milking machine
 - a. It is not necessary to milk out fresh cows, especially if colostrum quality is low
9. Remove milking unit
10. Post-dip all teats with post dip cup, ensure complete coverage
11. Release cow
12. Measure volume, and using spectrometer, measure total milk solids
13. Record data to log sheet

Colostrum Storage

1. Colostrum, unless used within 1.5 hours of harvest, needs to be frozen.
2. Pour colostrum into clean, dry, 5-gal bucket and cover.
3. Apply log sheet to lid of bucket using provided tape.
4. Place in freezer located in maternity barn.

Colostrum Pasteurization

1. If frozen, thaw colostrum in warm water bath. DO NOT USE hot water.
2. Pour milk into balance tank of pasteurizer
3. Turn pasteurizer to on position
 - a. Pasteurize at 135°F for one (1) hour
4. Fill bottles with pasteurized colostrum
5. Turn pasteurizer to off position

Figure 6: SOPs for Maternity Barn

Colostrum Pasteurizer SSOP

PPE Required: **Rubber Gloves**
 Apron
 Goggles

1. Rinse all parts of pasteurizer with fresh water
2. Using chlorinated alkaline detergent, dose hot water in balance tank(0.8%, 100ppm Cl)
3. Turn on pasteurizer
 - a. Run for ten (10) minutes at >135°F
4. Rinse balance tank with fresh water to drain
5. Using chlorine sanitizer (100ppm Cl) scrub balance tank and all exterior parts with white brush

Figure 7: SSOPs for Maternity Barn

Log Sheets

Table 3:

Calf feed Composition LogSheet						Southfield Dairy	
Name of Operator	Date	AM/PM	Volume	Solids (%)	If needed, how much was added?		Final Solids (%)
		(Circle one)			Water (gal)	Milk Replacer (lbs)	
	Day/Month/Year	AM/PM					
		AM/PM					
		AM/PM					
		AM/PM					
		AM/PM					

Table 4:

Colostrum Log Sheet				Southfield Dairy	
Name of Employee	Date	Time	Volume (gal)	Refractometer Reading	Bucket Number
		AM/PM			
		AM/PM			
		AM/PM			
		AM/PM			
		AM/PM			
		AM/PM			

DISCUSSION

Implementation of Results

The proposed SOPs will need to be posted near the area the identified procedure will be taking place. All documents are to be presented in an easy to understand method, in English and Spanish. The identified resources (Table 1) will be used to store log sheets and circle charts, which will be monitored by management weekly to evaluate employee performance and product quality. In order to control procedural drift, SOPs must be monitored regularly by management. Any changes or revisions to procedures, requires new training to the employee (EPA, 2009). It is recommended a display board with storage for log sheets, safety information, and SOPs, be installed in the maternity area, both milking barns, and near the pasteurizer.

CONCLUSION

With the implementation of this project on Southfield Dairy, the beginnings of a SOP program are in place. Immediate results are expected to be reduction in disease outbreak incidence on the calf ranch, improved employee performance and well-being, and decreased variation in procedure between shifts. This project will bring new training opportunities for management and allow for improved management-employee relations. New SSOPs are for improved environmental and equipment sanitation, and will provide a better environment for milk and calf feed production.

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