The Relationship between Rumination and Milk Yield in Early Lactating Holsteins and Jerseys

A Senior Project

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by

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ABSTRACT

The objective of this study is to determine if there is a direct relationship between rumination and energy corrected milk produced, using a technologic rumination tracking system. This technology is better known as AI24™ and is produced by Micro Dairy Logic: Advanced Dairy Solutions and SCR™, but marketed through Semex. The collar system is able to track rumination, aid in diagnosing illness/injury, predict parturition, and detect estrus in cows. The sophisticated electronic tag monitors a cow's rumination time, chewing rhythm and time between feed boluses to determine how many minutes per day the cow is ruminating. Each collar is equipped with a microphone, which is used to monitor the rumination patterns. A protocol was implemented so that all fresh cows received a collar before entering the milking string to establish a baseline. This allows the baseline to be established by 21 days in milk. The collars are read through a system of infrared sensors located in the exit alley of the milking parlor. The data is transferred to the computer, equipped with the Data Flow software program, to collect rumination totals, in minutes, for the 48 hour period prior to test day. Rumination time was then compared to the amount of energy corrected milk, in pounds, to derive a level of significance between them. The data was sorted by test month. A total of three test days were examined, December 2011, January 2012, and February 2012, with a total of 180 cows used. In summary the data showed that there was no level of significance between energy corrected milk in pounds and rumination time in minutes.

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INTRODUCTION

Technological advances are occurring in every industry and the dairy industry is no exception. SCR HR-TAG™ rumination tracking devices are one of the more recent technological advances. The California Polytechnic State University – San Luis Obispo Dairy has implemented rumination tracking devices since the fall of 2010, after the product was released. The initial collars produced were specifically used to detect estrus, but the HR-TAGS implement a microphone to track rumination activity.

The new technologic advancements in the collar can be used to detect early signs of many problems the cow may be going through internally; problems that would have gone unnoticed before. The rumination collars can assist in diagnosing metabolic diseases, such as ketosis, displaced abomasums, hardware disease, fat cow syndrome, and rumen acidosis that otherwise couldn't be detected by a dairyman. Rumination can also greatly increase the chances to detect and treat mastitis at an early stage, by detecting irregular rumination levels indicating that an infection is occurring. Mastitis has a huge economic impact in the dairy industry and if detected at an early stage, the loss experienced by the dairyman can decrease.

The rumination collars may also predict events that may occur. Milk fever, udder edema, retained placenta, and laminitis are metabolic diseases that are easily visually detected by the dairyman, but still cause negative effects if not found at an early stage. With the rumination collars being able to aid in detection of such diseases, the dairyman will save money on treatments and overall cow health will increase. The rumination collars can give insight to when an animal will calve.

By detecting these events at an earlier stage, cows are able to return to the milking strings sooner and in much better health. This may increase the overall efficiency of the herd, which is a key goal when trying to achieve the maximum profit. However, there have been few studies done in rumination monitoring systems and there is still a potential to find other uses for the rumination collars.

LITERATURE REVIEW

The Rumen and Rumination

Rumination can be defined as the regurgitation of fibrous ingesta from the rumen to the mouth, remastication and reinsalivation, followed by swallowing and returning of the material to the rumen (Welch 1982). Rumination is centered on the rumen and the particle size of the feed be ingested by the ruminant. A healthy cow will have 500-600 minutes per day of chewing time and will spend 35 to 40 percent of each day ruminating or chewing her cud (Hutjens, 2008).

When cattle partake of feed, they do not chew very much but the processing of the feed is instead allocated to the rumination, where rumen content is formed as a bolus that is regurgitated and masticated a number of times (Sjaastad et al., 2003). Therefore, adequate particle length of forages is necessary for proper ruminal function as coarse particles stimulate chewing activity and hence increase saliva output (Beauchemin et al., 2003). Re-mastication will decrease the particle size of the feed, which allows it to pass on through to the reticulo-omasal orifice. Feed leaves the rumen due to particle size and density; rate of passage varies from 6 to 9 percent per hour (Hutjens, 2008). Furthermore particle shape, density and digestibility do also determine the retention time before passage on to the omasum (Sjaastad et al., 2003). Increased chewing activity also increases the amount of bicarbonate and phosphate buffers, which are very beneficial in rumination. The buffers aids in sustaining the ruminal pH at a level suitable for microbial activity which is approximately 5.5-6.5 (McDonald et al., 2002).

Table 1. Length of chewing activities for dairy cows fed TMR (Lindgren, 2009).

Chewing Activity	Min/Day	Min/lb DMI	Min/lb NDFI[2]	Min/lb peNDFI[3]
Eating	185.1-350.0	15.6-32.3	51.5-106	267.1-313.1
Rumination	344.0-496.3	33.7-53.7	104.9-175.8	449.9-519.4
TC[1]	558.0-846.3	51.5-85.1	163.7-281.2	717-832.3

[1]TC= Total chewing activity, minutes eating + minutes ruminating.

[2]NDFI= Non-Digestible Fiber Intake.

[3]peNDF= Physical effective Non-Digestible Fiber Intake

Development of the rumen begins when the animal is a young calf. Stimulation of the papilla growth begins when a young calf is introduced to propionic and butyric acid, which can be found in the calf's grain. Then rumen microbes are gained from the environment and the muscular development of the rumen is due to the forages in the diet of the calf. The rumen of a new born calf is fully developed by 4 to 6 weeks after dry feed introduction (Hutjens, 2008).

The rumen is known as the anaerobic fermentation vat and is located on the left side of the adult dairy cow. The rumen is also the biggest of the four stomachs of a dairy cow and constitutes 65 percent of the total stomach volume (Hutjens, 2008). It can hold over 132 liters of material containing 10 to 20 percent dry matter (Hutjens, 2008). The rumen also supports an active anaerobic microbial fermentation area where the bacteria attach to feed particles. These bacteria break down the feed particles and produce volatile fatty acids (VFA). Volatile fatty acids are used as energy sources for the cow and are the building blocks the cow needs to produce milk. Papillae are small, fingerlike projections that are placed on the inside of the rumen wall. The purpose of the papillae is to increase the surface area of the rumen wall, which thus increases the amount of the rumen's absorptive area. Volatile fatty acids, ammonia, and water move through the rumen wall directly into the bloodstream (Hutjens, 2008). Papillae growth will be stunted when a cow is fed a low energy diet, such as when a cow goes dry, and starch is needed to stimulate the growth of the papillae. By adding starch to the diet, rumen absorption of VFA's into the bloodstream will improve.

In the rumen, the uppermost layer consists of gas produced particularly during fermentation of carbohydrates (Sjaastad et al., 2003). The cow will belch 30 to 50 quarts per hour of methane and carbon dioxide. In the U.S., cattle emit about 5.5 million metric tons of methane per year into the atmosphere, accounting for 20 percent of U.S. methane emissions (Hutjens, 2008) Below the gas layer begins different layers of particle sizes. The smallest, densest particles are found at the bottom of the rumen, whereas the larger, less dense particles are found on the top. In the middle and bottom zones of the rumen are mainly particles, which are finely dispersed and ready for transport to the reticulum (Sjaastad et al., 2003). Contractions of the reticulum and rumen provide mixing of forestomach contents and a transfer of particles to the omasum (Lindgren, 2009). The rumen will contract every 20 to 40 seconds.

Rumination can tell you many things of what is occurring with the cow. It can warn you about metabolic issues, heats, calving, environmental stress, and almost any event in a cow's life shows up as a change in the rumination pattern. So by being able to track rumination with a device such as the ai24 SCR HR-Tag can vastly improve the overall herd health.

Particle Size

As previously mentioned particle size has a direct effect on rumination and in effect milk production. Penn State Particle Separator (PSPS) is an effective and inexpensive method used to determine if the total mixed ration (TMR) fed to the animal is adequately mixed. There are four different sized sieves with different sized holes with each sieve and the bottom sieve doesn't contain any holes. The four boxes are stacked, with the box with the largest holes on top. Then place TMR in the top box. Shake the separator five times, and then rotate the unit a quarter of a turn. Shake and rotate a total of eight times, then weigh the material remaining on each of the two screens and the bottom box. Percentages of different particle lengths can then be figured (Hutjens, 2008).

It is recommended that at least 10 percent of the TMR should remain on the top sieve; between 40 and 50 percent remain in the second sieve, less than 35 percent in the third sieve and less than 20 percent in the bottom. The compact, manually operated sieving device is constructed of three sieves with pores measuring 19.0, 8.0, and 1.18 mm and a solid bottom pan (Kononoff et al., 2003). The sieve size 1.18 mm has been widely used as the size in which feed particles retained on or above are considered physically effective for dairy cows (Maulfair et al., 2011). Physical effective fiber is an estimate of physically effective fiber and is calculated by multiplying the proportion of feed greater than 1.18 mm in length by total ration NDF (Mertens, 1997). The top sieve is where the hole size is 1.18 mm. This sieve is critical and can predict if the cow is ruminating as much as she should be. Physical effective fiber (peNDF) causes the cow to chew her cud, produce saliva, and maintain normal rumen movements. Because peNDF is related to fiber concentration, particle size, and particle size reduction, peNDF is related to the formation of the ruminal mat, which may be a critical factor for selectively retaining fiber in the rumen, determining the dynamics of ruminal fermentation and passage, and stimulating rumination. The peNDF is related to animal health and milk fat depression because ruminal pH and the pattern of fermentation may both be a function of the production of salivary buffers during eating and rumination (Mertens, 1997). Diets high in peNDF help to prevent ruminal dysfermentation and subacute ruminal acidosis (SARA). In contrast, offering diets in excess of fiber may decrease feed intake and lower the efficiency of feed use (Yang and Beauchemin, 2006a). Thus, it is essential to find an optimum of dietary fiber that may decrease the risk of SARA without impairing important production performances in dairy cows (Zebeli et al., 2008).

Using the Penn State Particle Separator Correctly

When using the PSPS to evaluate rations, there are some specific things that must be done to assure accurate results. Recently an extra sieve was added to the shaker box to better assess the amount NDF in the ration. There is a correct process when using the PSPS.

Stack the four plastic separator boxes on top of each other in the following order: sieve with the largest holes (upper sieve) on top, the medium-sized holes (middle sieve) next, then the smallest holes (lower sieve), and the solid pan on the bottom (Heinrichs and Kononoff,).

Approximately three pints of TMR should be placed in the top sieve. On a flat surface, shake the sieves in one direction 5 times then rotate the separator box one-quarter turn (Kononoff et al., 2003). This process should be done seven more times and should be done a total of eight times. If done correctly there should be a total of forty shakes done per sample. The force and frequency of shaking must be enough to slide particles over the sieve surface, allowing those smaller than the pore size to fall through (Kononoff et al., 2003). After completing the shaking process, weigh each sieve to calculate the percentage of feed particles in each sieve.

Energy Corrected Milk

Energy corrected milk (ECM) is determined by the amount of energy in the milk based upon milk, fat and protein and adjusted to 3.5% fat and 3.2% protein. The ECM formula is as follows, (0.327 X milk lbs.) + (12.95 X fat lbs.) + (7.65 X protein lbs.). ECM = (0.327 X milk lbs.) + (12.97 X fat lbs.) + (7.21X protein lbs.) is the old equation used for Total Protein. Total protein was the old expression for the amount of protein in milk. Since May of 2000, DHIA system has standardized True Protein. It has been established that True Protein is typically 0.19 lbs less per hundredweight of milk than Total Protein. Therefore, if Total Protein is 3.2, then True Protein is 3.0. The ratio of Total to True Protein at average test is 3.2 / 3.01 = 1.063. So, to convert to True Protein, the formula is 7.20 * 1.063 = 7.65. The formula for ECM becomes: (0.327 * milk lbs.) + (12.95 * fat lbs.) + (7.65 * protein lbs.).

The gross energy (or heat of combustion) value represents the most common characteristic to which all organic substances can be reduced (Tyrrell and Reid, 1965). It was found that the most accurate calculations for the amount of energy in milk come from lactose, fat, and protein milk components.

Rumination Monitoring Systems

Rumination collars have the potential to aid dairyman in their management system. The HR neck collar is a rumination monitoring system combined with a unique motion sensor. The basic principle of using sounds to measure rumination time has been developed by A.Bar-Shalom. This system, after technological upgrade, is integrated in commercial activity tags and is named HR-Tag. The rumination data is available as individual or group reports. These collars can potentially help in preventing calving disease, predicting calving times, detection of sick cows, monitoring the recovery of the sick cows and individual cow, group, and whole herd stress levels (Bar and Solomon).

Very few rumination monitoring system studies have been performed sue to the fact that it is a new technology system in the dairy industry. Most studies have been performed through SCR™ engineers in Israel. Some of the studies include identifying rumination dips at calving and to identify, diagnose, and treat calving diseases before they become acute. It has been found that rumination decreases the two weeks prior to calving with a sudden drop at calving and then a rapid increase in rumination in the days following calving (Bar and Solomon, 2010). After about a week postpartum, the cow usually reaches her maximal daily rumination time and stays relatively stable throughout her lactation period. Transition cows are the hardest animals to manage on a dairy operation and the rumination collar systems hint the dairyman to possible problems that may be occurring internally. In one study done by the SCR™ Engineers LTD, it was found that drops in rumination can help diagnose ketosis at an early stage and prevent a drop in milk production. Cows with Ketosis drop in production, remain lower in production, and achieve lower peaks than their peers (SCR™ Engineers LTD, 2011). By avoiding calving diseases and maintaining high levels of production, profitability, economic stability, and longevity for the herd can be ensured.

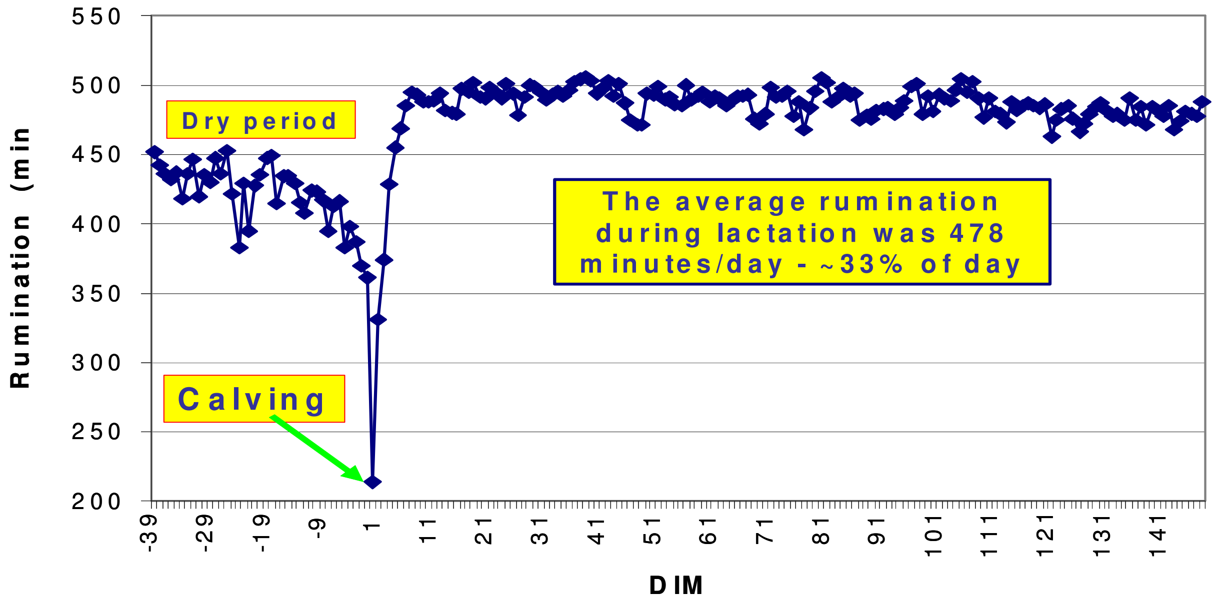

Figure 1. Shows the lowered rumination leading up to calving, the drop in rumination at calving and the climb back to normal rumination post calving (Bar 2010).

MATERIALS AND METHODS

The Cal Poly Dairy, located on the campus of California Polytechnic State University-San Luis Obispo, consists of 200 milking Holstein and Jersey cows. The cows are milked twice a day in a double 8 rapid-exit herringbone, equipped with automatic takeoffs and a backflush system. The DHIA milk tester comes to the dairy once a month, usually a Friday or Saturday pm shift, to pull milk samples on individual cows as well as the whole herd. I will be using the data from these test days as part of my research.

The cows are housed in a free stall barn with dry lot access, weather permitting, and are separated by breeds. All of the Jersey cows are grouped together no matter their stature, age or production statuses. Whereas the Holsteins are grouped into two different pens, pen 3 and pen 4. Pen 3 consists of all the confirmed pregnant Holsteins and pen 4 consists of all the recently fresh cows and breeding eligible Holsteins. The Holsteins in pen 3 should not be wearing collars because they have been confirmed pregnant.

The cows are fed a TMR two times per day and have feed pushed up at least six times per day. The TMR is comprised of alfalfa hay, corn silage, grain mix, brewer's grain, and water. The Cal Poly dairy currently has four students feeding throughout the week and a handful of other students that are on call to relieve the regular scheduled feeder. Due to the amount of feeders and different tendencies of each feeder, there may be differences from ration to ration. The Penn State Particle Separator (PSPS) will clarify if there is anything drastically wrong with the rations, but it should be noted that no ration is ever mixed the same.

The California Polytechnic State University – San Luis Obispo Dairy implemented the MICRO Dairy Logic Heatime® beginning in the fall of 2010. MICRO Dairy Logic and a former Cal Poly dairy science student, Trevor Nutcher, installed the technology and got the system up and running. The following year David Weststyn, another former Cal Poly student, picked up where Nutcher left off and kept the system updated for his own senior project. I will be taking over for Weststyn, along with the help of Christina Da Rocha, and will continue to keep the system updated. In order to keep the system updated, the following steps must be done:

- Attaching of the collars- This needs to be done before the cows enter the milking strings after freshening. The collars need to be attached in the hospital pen or when the cows are brought to the close-up pens from the dry cow pen.
- Entering of the data- This needs to be done multiple times a week to ensure all the of information is accurate and up to date.
- Data information- Correct SCR™ tag identification, breeding, positive pregnancy test, drying off date, freshening date, and culled animals are all information that needs to be input into the Heatime® computer system multiple times per week.

The Cal Poly Dairy has an off campus veterinarian come to the dairy bi weekly and confirm pregnancies of at least 30 days. Once a cow is confirmed pregnant, her collar is then removed and will be used on another cow on the dairy. Note that the information on the Heatime™ system needs to be updated when this occurs. When a collar is removed from a particular animal her SCR™ id number should be entered as a 0. If this does not occur then the system still believes that she is still carrying a collar when in fact she is not. By telling the system that collar no longer belongs to a cow, it makes inputting new collar information much easier because the system does not allow for the same collar id to be used by two different cows at the same time. The cows will remain with no collar until their next freshening unless the cow becomes open while still in the milking string, at this point another collar will be attached until the cow is confirmed pregnant again.

The SCR HR-Tag™ uses an accelerometer, when positioned correctly will recognize movements that the cow makes. The tag is located on the left side of the cow's neck, posterior to the jaw bone on the cow's neck (Figure 1). They must be positioned correctly because the tag will no record the information correctly on the Heatime™ system. For example if the tag was on the right side of the animal, rather than the left side, the data would be read backwards by the scanners. The tags are meant to be positioned in the exact same position every time and will transmit data based on the parameter that the tag is programmed to track. Thus by having the tag on the wrong side or flipped inside out would lead to inaccurate data in the Heatime™ system. The accelerometer filters out events that would skew the reports on the Heatime™ system, whereas a pedometer would record all the events. The tag is able to detect estrus because it can tell the difference between cows mounting other cows and when a cow is simply running in the dry lots being aggressive.

The SCR HR-Tag's™ track both estrus and rumination, whereas the SCR H-Tag™ is used just for estrus. The Cal Poly dairy is currently using the HR-Tags. Rumination is detected and tracked by sounds that occur during rumination. This is able to happen because the tags have a specially-tuned microphone placed against the back wall of the tag and should be snug against the neck of the cow. The microphone listens for teeth grinding as well as constant rhythmic chewing sounds for more than a few seconds, followed by a short rest, and then more rhythmic chewing. This indicates the tag that the cow is ruminating and will record, in minutes, how long the cow is ruminating until it stops. The tag also monitors the time between feed blouses to determine rumination. The tags come equipped with a battery and have an expected life of roughly 10 years.

The movements and rumination minutes are recorded and can be stored for 24 hours. The information is sent to the Heatime™ system due to infrared scanners strategically placed on the dairy. Two infrared scanners are mounted in the milking parlor, one over each return lane, and 4 more are located in the near close-up and hospital pens. The tags are read twice a day for cows in the milking string because the Cal Poly dairy milks two times per day, whereas the tags being worn in the close-ups and hospital pens are being read every time the animal goes to drink. In case of a power outage or skipped milking the information will remain on the tags for 24 hours.

In order for the collars to work correctly the tags require a seven day period in which the tags establish a baseline standard deviation for each cow. This baseline is used to determine what is considered normal for an individual cow and when a cow is in heat her activity will be higher than her baseline. This is available on a report and makes it very easy to identify what cows are in estrus.

When cows and heifers are moved from the far dry pen up to the near close-up they will be monitored closely. Once they have calved and been moved into the hospital pen a collar will be attached. All cows must have a collar before they leave the hospital pen. Once attaching the collar, the SCR tag id must be input into the Micro Dairy program, Data Flow, as well as the freshening date of the cow and proper pen number. In this study I will be excluding cows that are 21 DIM or fewer. So by putting the collars on before the cows leave the hospital this allows the seven day period to establish a baseline standard deviation for each cow. Once the cows have been confirmed pregnant at 31 days or greater, the collars are then removed and applied to a fresh cow.

On test days, if the cows are 21 DIM or greater I will be tracking their rumination on the Data Flow system on a special report that Zach Beutler, a Micro Dairy Logic technical support specialist, has constructed for my study. Also, cows that have been confirmed pregnant are no longer wearing the collars and will also be excluded from the study. I will be recording the rumination of each eligible Holstein and Jersey and be comparing their rumination to the amount of Energy Corrected Milk (ECM) that was produced. The 48 hour period before test day will be the interval focused on to record the rumination activity. I will be seeing if there is significance between the two and I will also be using a particle separator via the PSPS to see if the particle size is adequate at the Cal Poly dairy. The milk production records will be coming from DHIA official test day reports. This study will concentrate on early lactating Holsteins and Jerseys at the Cal Poly dairy.

RESULTS AND DISCUSSION

The rumination data were collected through the microphone technology system.

Table 2. December, January, and February test day results and averages.

Cow ID	Breed	ECM Total (lbs)	Rumination (0-48h total)	DIM
234	Jersey	113.3	760	269
243	Jersey	76.4	649	111
281	Jersey	87.0	748	25
282	Jersey	139.2	891	70
294	Jersey	93.4	725	123
309	Jersey	92.0	375	191
311	Jersey	75.5	879	90
322	Jersey	92.5	998	123
331	Jersey	117.5	935	80
334	Jersey	105.1	907	136
345	Jersey	75.8	800	83
368	Jersey	79.8	658	288
375	Jersey	73.2	830	84
393	Jersey	93.8	859	74
398	Jersey	75.1	841	50
405	Jersey	84.9	995	47
636	Jersey	84.8	770	357
814	Jersey	86.9	775	266
870	Jersey	109.6	548	136
903	Jersey	78.0	702	302
2136	Holstein	74.5	757	219
2266	Holstein	121.7	873	126
2309	Holstein	78.4	802	23
2316	Holstein	115.7	1,036	130
2340	Holstein	102.8	709	158
2343	Holstein	116.4	996	155
2362	Holstein	86.2	873	57
2364	Holstein	66.8	864	192
2411	Holstein	85.8	722	118
2414	Holstein	84.6	902	215
2430	Holstein	86.0	855	77
2431	Holstein	75.9	878	100
2435	Holstein	98.9	861	75
Average		91.7	811	138

January-12

Cow ID	Breed	ECM Total (lbs)	Rumination (0-48h total)	DIM
187	Jersey	96.5	777	44
203	Jersey	97.9	892	42
234	Jersey	83.6	815	304
281	Jersey	72.2	743	60
282	Jersey	96.3	998	105
294	Jersey	70.0	887	158
298	Jersey	66.5	670	66
304	Jersey	66.1	845	107
309	Jersey	70.3	516	226
311	Jersey	84.1	1,010	125
322	Jersey	97.4	930	158
331	Jersey	99.1	831	115
334	Jersey	80.3	939	171
338	Jersey	93.9	774	24
345	Jersey	62.9	722	118
349	Jersey	81.0	761	104
368	Jersey	68.9	762	323
375	Jersey	48.9	799	119
384	Jersey	83.2	836	30
398	Jersey	81.7	899	85
399	Jersey	79.2	933	56
405	Jersey	110.6	1,062	82
409	Jersey	87.5	895	101
410	Jersey	53.8	746	123
636	Jersey	59.6	817	392
814	Jersey	86.8	891	301
870	Jersey	92.4	658	171
903	Jersey	66.0	762	337
2136	Holstein	66.4	642	254
2266	Holstein	113.0	733	161
2300	Holstein	42.0	614	211
2303	Holstein	91.8	945	133
2307	Holstein	142.7	986	49
2309	Holstein	104.8	820	58
2316	Holstein	107.5	942	165
2326	Holstein	97.5	781	135
2338	Holstein	98.0	642	40
2340	Holstein	124.0	813	193
2343	Holstein	112.0	1,012	190
2348	Holstein	104.3	584	50

January-12	**Cont.**			
2354	Holstein	98.7	664	123
2362	Holstein	75.1	1,096	92
2364	Holstein	62.4	840	227
2382	Holstein	97.2	1,005	54
2394	Holstein	118.3	1,000	38
2410	Holstein	86.9	928	29
2411	Holstein	91.4	757	153
2414	Holstein	88.3	1,026	250
2420	Holstein	107.4	749	41
2422	Holstein	86.4	1,093	31
2429	Holstein	57.7	902	53
2430	Holstein	87.7	860	112
2431	Holstein	97.2	904	135
2435	Holstein	81.7	915	110
2436	Holstein	96.5	1,046	97
2443	Holstein	83.4	808	25
2444	Holstein	71.2	1,082	26
2445	Holstein	73.2	885	44
Average		86.2	849	126

February-12

Cow ID	Breed	ECM Total (lbs)	Rumination (0-48h total)	DIM
167	Jersey	72.9	763	257
203	Jersey	123.4	942	70
209	Jersey	61.8	785	261
234	Jersey	81.6	842	332
238	Jersey	85.0	861	63
243	Jersey	85.7	654	174
248	Jersey	104.0	566	25
271	Jersey	117.8	840	80
281	Jersey	24.3	651	88
282	Jersey	85.6	875	133
285	Jersey	71.0	796	25
294	Jersey	89.9	812	186
298	Jersey	113.3	689	94
304	Jersey	52.5	816	135
305	Jersey	96.4	736	26
309	Jersey	81.1	747	254
311	Jersey	77.3	783	153
322	Jersey	77.0	1,017	186
328	Jersey	78.9	513	72

February-12 Cont.				
331	Jersey	97.0	914	143
334	Jersey	79.7	759	199
338	Jersey	113.4	903	52
345	Jersey	32.0	804	146
349	Jersey	86.4	819	132
356	Jersey	94.0	718	23
357	Jersey	79.4	785	96
360	Jersey	107.7	1,011	47
368	Jersey	66.7	702	351
375	Jersey	43.6	804	147
381	Jersey	42.5	508	43
384	Jersey	80.4	753	58
398	Jersey	73.6	839	113
399	Jersey	88.2	906	84
405	Jersey	83.6	1,003	110
406	Jersey	64.4	736	29
407	Jersey	92.1	810	110
410	Jersey	60.1	547	151
412	Jersey	93.4	493	34
413	Jersey	71.1	777	44
420	Jersey	82.1	382	48
636	Jersey	39.5	596	420
814	Jersey	74.0	876	329
870	Jersey	80.6	682	199
903	Jersey	56.1	699	365
2129	Holstein	104.8	888	299
2136	Holstein	70.5	718	282
2266	Holstein	113.5	729	189
2300	Holstein	65.2	667	239
2303	Holstein	92.9	1,002	161
2308	Holstein	123.9	699	24
2309	Holstein	98.8	898	86
2316	Holstein	93.8	1,006	193
2326	Holstein	107.9	829	135
2338	Holstein	88.9	659	68
2340	Holstein	85.9	576	221
2343	Holstein	97.4	967	218
2348	Holstein	115.7	647	78
2354	Holstein	62.1	556	151
2358	Holstein	104.1	516	102

February-12	Cont.			
2359	Holstein	86.4	556	104
2362	Holstein	104.4	987	120
2364	Holstein	61.2	938	255
2369	Holstein	106.1	643	133
2377	Holstein	105.4	1,012	41
2382	Holstein	85.5	1,146	82
2387	Holstein	142.9	756	44
2394	Holstein	109.9	898	66
2397	Holstein	113.2	985	22
2410	Holstein	58.2	798	57
2411	Holstein	88.7	674	181
2413	Holstein	99.5	757	172
2414	Holstein	104.1	974	278
2420	Holstein	96.0	862	69
2422	Holstein	113.1	984	59
2427	Holstein	81.4	484	95
2429	Holstein	64.6	994	81
2430	Holstein	100.0	896	140
2431	Holstein	78.7	892	163
2432	Holstein	97.8	387	133
2435	Holstein	83.0	968	138
2436	Holstein	96.5	904	125
2438	Holstein	58.0	1,038	38
2441	Holstein	9.4	479	38
2443	Holstein	84.1	855	53
2444	Holstein	71.0	1,033	54
2445	Holstein	71.0	782	72
2446	Holstein	80.5	839	38
94731	Holstein	92.3	772	125
95321	Holstein	55.5	776	40
Average		84.1	786	130

Collections of the data were encountered with very few obstacles. Obstacles encountered included not having the desirable amount of data for the months of December 2011 and January2012. The collars were not being updated in the milking string as needed for these two months. This is evident when looking at the difference between data per month, 89 total head for February 2012, 58 for January 2012, and 38 for December 2011. This was probably due to the fact that the collar system was exchanging hands from the previous manager of the system to me. The study would have ideally included the maximum number of cows that are open and 21 DIM or greater, much more like the numbers for February 2012. With a greater increase in readily available data, this study would increase the reliability of the results.

Both Jersey and Holstein were used for this study and each of the breeds had the same procedure. The information recorded included the cow ID, DIM, ECM in pounds, breed, test month, and rumination time in minutes, as seen in Table 1. The 48 hour period prior to test day was the period examined when determining how many minutes of rumination each cow was ruminating. This period was determined after discussion with Dr. Henderson and Dr. Gustavo Luscano.

All of the data were run through SAS. The results in this study show that there was no significance for the effect on ECM total in pounds and amount of rumination in minutes. The P-Value of the effect of rumination time was 0.3127, which was much higher than the 0.05 or less that would confirm the significance between ECM total in pounds and amount of rumination in minutes. The P-Value for when comparing breed to ECM total in pounds was 0.0969 and

Table 3. SAS results, showing each effect and different statistical breakdowns

Effect	Num DF	Den DF	F Value	Pr > F
Breed	1	81	2.82	0.0969
Test Month	2	81	4.29	0.0169
DIM	1	81	0.49	0.4873
Rumination	1	81	1.03	0.3127

when comparing test month to ECM total in pounds the level of significance was the highest, with a P-Value of 0.0169. Breed and test month had an effect on the ECM total in pounds, but the significance when comparing rumination time to ECM was not where we expected before conducting the study.

Averages for ECM total in pounds, rumination minutes, and DIM for the test days were calculated and are located in table 1. The averages for ECM total in pounds were as follows, 91.7 for December 2011, 86.2 for January 2012, and 84.1 for February 2012. The averages for rumination time in minutes were 811 for December 2011, 849 for January 2012 and 786 for February 2012. The DIM averages were 138 for December 2011, 126 for January 2012 and 130 for February 2012. As more data plots were used in the study the average for ECM and rumination time began to decrease. Since February has the most data points, it should be recognized as the most accurate averages for the study.

Penn State Particle Separator

The particle size of rations directly affects the amount of rumination which occurs. To make sure that the particle size for the rations being fed at the Cal Poly Dairy were adequate; a PSPS was performed prior to the February test day. A shaker box test was done for both the Holstein and Jersey rations, as they are mixed in separate loads. These numbers were derived from the rations fed prior to the February 10th test day. The Jersey feed sample was a total of 850 g and the Holstein feed sample was a total of 820g. The percentages by sieve can be found in table 3. The distribution of the feed particles seems to be adequate. There is variability from load to load as anticipated, but the rations are meeting the ideal benchmarks or are very close to meeting them.

Table 4. Penn State Particle Separator results from the rations prior to the February 10th test day.

	Jersey Ration	Holstein Ration	Ideal TMR
Top	13.53%	7.93%	2-8%
Second	24.12%	27.44%	30-50%
Third	53.53%	53.05%	30-50%
Bottom	8.82%	11.59%	≤20%

There aren't PSPS results for the months of December and January. This is because the test days had already occurred prior to shaker box results being done. Considering that the ingredients in the ration at the Cal Poly Dairy is very consistent, the shaker box results throughout the year can be assumed to be relatively similar to the PSPS results found prior to the February test day. The only ingredient that has changed in the ration recently has been the transition from oat silage to corn silage. The change occurred after the December test day and prior to the January test day.

CONCLUSION

The system has been in place for 18 months now and has been rewarding the Cal Poly Dairy with useful information from numerous projects. The previous students did a great job of keeping the system relatively updated. However, there are still cows wearing collars that do not match the information on the Data Flow System. An ideal situation would have been to remove all of the collars from every cow and make sure that the SCR™ ID number matched up to the correct cow in the computer system. This is a time consuming event and I did my best to go through to make sure cows had the correct collars on. Also, January and February will be the only months with data that I personally collected. The previous month was data obtained through other students work and I'm not sure how reliable it actually is. If I could have more data to compare that would have been ideal. There were enough data points to come to a strong conclusion that there was no significance for the effect on ECM total in pounds and amount of rumination in minutes. However doing this study in a large dairy herd would have been more desirable to gather more data points to bring more assurance to this conclusion.

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