Process development and standards for kefir cheese

2006 Final Report

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Summary

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Goals:
The goal of this project was to scale up a home recipe for raw milk kefir cheese made with authentic living kefir grains, to a commercial process. In cooperation with Cornell University Food Processing & Development Laboratory, under the advisement of David Brown, Senior Extension Associate/Dairy Technology, a method for making the cheese, would be established and standardized.
The project would establish an efficient, economical procedure, and set a benchmark for kefir cheese.

Farm profile:
Finger Lakes Dexter Cattle has been in operation for seven years. My husband and I have a twelve-acre farm located on the east side of Cayuga Lake, in Ledyard, N.Y. We breed and sell purebred registered Irish Dexter cattle. This year we registered a DBA as Finger Lakes Dexter Creamery. We are now a micro-dairy, currently consisting of 3 milking cows, two heifers, one bull and one steer. In the spring of 2007 we anticipate the birth of four new calves. We will add one more milking cow this spring, and one more in 2008. Our goal is to milk six Dexter cows. To our knowledge, we are the first Dexter dairy in the United States.
This year we completed the cheese room and dairy facility. I am now a certified Processing Plant Superintendent pursuant to Ag & Mkt. Law 1NYCRR Part 2. Our dairy is permitted to receive+/or Process Milk and Milk Products, Plant #36-0025. We are now making the Kefir cheese we set out to establish.

Participants:
My advisor, David Brown has been paramount in this project. Without his exceptional knowledge of cheese, the goals of this project would not have been accomplished. Mr. Brown's willingness to take on this project, and ability to think through the difficult issues we faced (there were many) has been absolutely stellar. He has worked with me on every challenge, and has helped me through each procedure, finally achieving a recipe for Kefir cheese. I cannot thank him enough.
Sean Schell, Research Support Specialist for the Food Processing & Development Lab has given this project excellent support. His technical assistance with each step in the lab has been exceptional. He facilitated a step-wise process, and went beyond what was expected of him, caring for the project as if it was his own.
Dairy Products Specialist, Kris Danielsen has been key in getting me up to speed in my facility. She has run more tests than we had anticipated, to ensure that the kefir starter and my facility meet NYS Ag&Mkts standards. She has instructed me in dairy/food, safety/cleanliness, and has problem solved with me on finding the right equipment for my unique dairy, which has been a challenge. The learning curve for running a dairy/cheese operation for a first time dairy farmer is steep, and I appreciate all their time and effort they have invested in my education.

Project activities:
The activities of this project cover a very broad spectrum. Ranging from a beginners guide to managing a dairy operation, to hooping and aging cheese, to discussions on cheese mites and prevention of product recall. Everything in-between included:
1. sterilization process
2. sanitizing
3. learning to use a pH meter
4. learning to use my own equipment in my dairy facility (jacketed kettles, sterilization equipment)
5. calculations and conversions for accurate measurement
6. complete in-depth procedures for non-enzymatic recipe for Kefir cheese
7. complete in-depth procedures for enzymatic recipe for Kefir cheese
8. science of basic cheese making
9. science of intermediate cheese making
10. science of advanced cheese making is ongoing

11. aging cheese
12. dating (coding) cheese
13. packaging labels
14. record keeping
15. market readiness

We had planned to run a control batch with another culture for comparison, but as we got into the project, it became evident that bringing the kefir culture into compliance with NYS Ag & Mkts rules and regulations required much more of our time and attention than originally thought. Also, the kefir starter proved unique enough to deem the initial idea of comparing it to another culture unnecessary for what we were trying to accomplish. The cheese was analyzed after 60 days of aging with two methods of packaging: shrink wrap, and with no wrap. The shrink-wrapped method proved to be too air tight and the cheese never formed a rind. The cheese remained almost the same as when it was wrapped. This was not acceptable as this new cheese is a rind cheese. The cheese with no wrap formed a very nice rind and was tested for moisture and fat content. The moisture was 22% (desired moisture content is 45%). Because we did not achieve the desired moisture content, we decided it that if we wrap the cheeses in a parchment or wax paper before the cheeses are placed in the aging facility in a non-air tight wrap, and hold the cheese in this wrap for 60 days or more, it would help to add moisture to the cheese. The fat content was 27% (desired content is anywhere from 25%-30%). The color of the cheese is a whitish yellow, and the texture contains mechanical holes and small air spaces from the pressing process. The taste is anywhere from sour to sweet, depending on whether the palate is recognizing before or after tastes, also tangy, and creamy. Considerations of pH in the final product were as follows: anywhere from 4.6-5 would be considered a strong acidy flavored cheese, and from 5.1-5.4 would yield a milder acid flavor. It was suggested that the cheese maker decide on what pH to use in the final product and that these two categories could feasibly be considered two different kefir cheeses based on the two distinct flavors. Salt content used for the brine is anywhere from 9%-17% and the amount of time the cheese remains in the brine depends on the quantity of salt used.

Results:
We achieved what we set out to achieve, and more! We developed a process for non-enzymatic Kefir cheese, and an enzymatic Kefir cheese, with the addition of rennet. The two methods are listed below:

Kefir cheese: non-enzymatic process:

Step 1. Make starter:
Culture kefir from 4 tablespoons of kefir “grains” in 2.8 quarts of milk that has been steamed at a temperature of 180 degrees F. or more for 30 minutes. The kefir starter will culture at room temperature until a pH of approximately 4.8 is reached. 1.2 quarts of milk will also be sterilized, in the same manner as stated above, for holding the kefir grains during the week when they will be refrigerated until the next week.

2.8 quarts is calculated to be enough to inoculate 4.5 gallons of raw milk twice per day at an average of 1% (0.5%-1.5%) inoculation rate and scheduled to last for one week.

The calculated quantity of milk for the inoculation batch is based on an average yield of a two per-day milking from 3-5 Dexter cows for a one-week period of time. The actual amount of starter culture processed may be more or less depending on the amount of milk collected at any given time in the lactation cycle. If the amount of starter needed on a weekly basis is different from what is stated above, the calculations will be adjusted, using the formula above, to meet the quantity of milk collected.

Step 2. Strain out “grains”:
When the kefir culture starter is set, the kefir “grains” will be strained out of the sterilized starter. The “grains” will be strained through a plastic or stainless steel strainer, retrieved, and placed into a sanitized container to be used for the next 2 quarts of starter. The “grains” must be held in a milk environment to remain viable, so will be immersed into the 2 pints of the sterilized milk referred to in Step 1. The grains will then be refrigerated until the next batch of kefir starter culture is to be made in one week hence. The 2 quarts of kefir starter culture will also be refrigerated until needed throughout the week to inoculate the raw milk in the cheese making process.

Step 3. Inoculate raw milk batch with starter:
The milk collected in accordance with NYS Ag & Mkt. rules and regulations, from one milking session, will either be placed directly into the kettle for cheese processing, or it will be held over in a chilled environment (milk container to set in freezer for two hours or less, until it reaches a temperature of 45 degrees, and then moved to the refrigerator compartment). A timer will be used to insure that the appropriate temperature of the milk will be reached within the required two hour period. Cream will not be skimmed if the milk goes directly into the kettle. Cream may be skimmed, depending on the cheese that is being made, if the milk is held over in the refrigerator for no more than 24 hours. The cream that would be skimmed will be brought into the house for home use only, and not sold. Once the milk is in the kettle, it will be inoculated with an average of 1% starter (0.5%-1.5%), (6.5 ounces per 4.5 gallons) and placed in a covered jacketed kettle surrounded by 72-76 degree F. water, or adjusted temperature, but not more than 80 degrees to reach the desired pH level of 4.6-4.8. If the milk does not culture, it will be discarded after 14 hours.

Step 4. Drain the whey from the curds:
The cultured milk will be poured out of the kettle into a plastic or stainless steel container, and then placed in either muslin cloth draining bags or a stainless steel drainer on a draining table, to remove the whey from the curd. This process typically takes 24 hours for complete draining, although it could take up to 48 hours, depending on the amount of cultured milk placed in the bag. The draining process may be continued, if not adequately drained to continue on to the next step, by placing curds into another cheesecloth drain bag until the intended amount of drying is achieved. The muslin and cheesecloth will be sanitized to remove curd, and then sterilized in water at 180 degrees F. or more for 30 minutes. The muslin will then either be hung to dry on a clothes rack in the cheese make room, or put back into use. The cloth will again be rinsed in a chlorine soak just prior to use. The whey will be used on the farm as plant fertilizer or in home culinary preparations, or disposed of according to NYS Ag & Mkt. rules and regulations, but not sold.

Step 5. Add salt:
Once the desired consistency of curd is achieved, 1-1.5% sea salt is added. The curd will be weighed to calculate the amount of salt needed.

Step 6. Shape and press the curd:
For semi-soft, and hard cheeses the curd will be placed into a mold to create shape and size of the product. They may also be pressed with weights (acceptable by NYS Ag & Mkts.) placed on followers on top of the cheese curd in individual molds. While in the mold, whether pressed or not, more whey will be expelled from the

curd to the desired extent. The cheese will then be removed from the mold and set out to air dry, covered, until a thin dry coat appears on the surface of the cheese. The cheese will then be coded with food grade ink and a date stamp that will both identify the cheese and code each piece to be sold with the first date of the aging process. The cheese will then be refrigerated for aging. The temperature of the refrigerator used for aging will be recorded daily on a calendar kept in the cheese make room.

Step 7: Cheese preparation and aging:
As mentioned in step 6, each piece of cheese to be sold will be coded with a start date, and placed into the refrigerator for 60 days or more. If the cheese will be cut into sections, each section of the cheese will be stamped with the start date. After the cheese is aged for 60 days or more, each cheese unit may be coated with ingredients, or may if inoculated with mould. If inoculated with mould, it will be during the aging process.

Step 8. Name, wrap and label:
The cheese is now ready to be wrapped, labeled and shipped.

Kefir cheese: enzymatic process:

Step 1. Make starter:
Culture kefir from kefir grains in milk that has been steamed for 30 minutes at a temperature of 180 degrees F. The kefir starter will culture at room temperature until a pH of approximately 4.8 or less has been reached. Milk will also be sterilized, in the same manner as stated above, for holding the kefir grains during the week when they will be refrigerated until the next week.
Equipment to be used to steam the milk will be either a canning pot and glass ball jars for larger amounts of milk, or a double boiler for smaller amounts of milk required. The jars in the canner will be sanitized and filled ¾ full with milk, and lightly capped during steaming.

Suggested amount of milk to steam:
2.8 quarts is calculated to be enough to inoculate 4.5 gallons of raw milk twice per day at an average of 1% (0.5%-1.5%) inoculation rate and scheduled to last for one week.

The calculated quantity of milk for the inoculation batch is based on an average yield of a two per-day milking from 3-5 Dexter cows for a one-week period of time. The actual amount of starter culture processed may be more or less depending on the amount of milk collected at any given time in the lactation cycle. If the amount of starter needed on a weekly basis is different from what is stated above, the calculations will be adjusted, using the formula above, to meet the quantity of milk collected.

Step 2. Strain out “grains”:
When the kefir culture starter has reached a pH of 4.8 or less, the kefir “grains” will be strained out of the starter culture. The “grains” will be strained through a sanitized plastic or stainless steel strainer, retrieved, and placed into a sanitized container to be used for the next batch of starter. The “grains” must be held in a milk environment to remain viable, so will be immersed into the sterilized milk referred to in Step 1. The kefir starter culture will be refrigerated, and labeled with the make date and pH. This starter will be utilized throughout the week to inoculate the raw milk in the cheese making process.

Step 3. Inoculate raw milk batch with starter:
The milk collected in accordance with NYS Ag & Mkt. rules and regulations, from one milking session, will either be placed directly into the kettle for cheese processing, or it will be held over in a chilled environment (milk container to set in freezer for two hours or less, until it reaches a temperature of 45 degrees, and then moved to the refrigerator compartment). A timer will be used to insure that the appropriate temperature of the milk will be reached within the required two-hour period. Cream will not be skimmed if the milk goes directly into the kettle. Cream may be skimmed, depending on the cheese that is being made, if the milk is held over in the refrigerator for no more than 24 hours. The cream that would be skimmed will be brought into the house for home use only, and not sold. Once the milk is in the kettle, it will be inoculated with an average of 1% starter (0.5%-1.5%), (6.5 ounces per 4.5 gallons) and placed in a covered jacketed kettle surrounded by 90-110 degree F. water, or adjusted temperature, to maintain a milk temp. of between 85-90 degrees F.

Step 4. Add rennet:
Rennet will be added to the milk in the kettle when there has been a .05 pH drop. When the curd sets, within 1 hour, cut into curd to release whey. Let the curds release whey by leaving them in the kettle for 1-2 hours before putting in hoops. The curds may also be flipped over in the kettle to allow for more whey release. The curds are then to be hooped, set on a cheese rack on a drain table, and covered to reach a pH of 5.2 within 12 hours of the start time. The hoops will be turned over after at least one hour and then turned again in another hour or more to release whey. Once drained and a tight curd is formed, the cheese will be removed from the hoops, covered until the desired 4.9-5.0 pH is reached. All whey will be used on the farm as plant fertilizer, in home culinary preparations, or disposed of according to NYS Ag & Mkt. rules and regulations.

Step 5. Brine:
Once the desired pH of the cheese is reached, the cheese will be brined with 9%-17% salt for 1-4 hours, depending on the size of the cheese, and the quantity of salt used.

Step 6. Pre-aging dry time:
The brined cheese will be set on a cheese rack over a drain table, and covered, to continue to dry at room temperature until the cheese is dry enough to code. The cheese will need to be turned several times within this time period. The cheese will then be coded with food grade ink and a date stamp that will both identify the cheese and code each piece to be sold with the first date of the aging process. The cheese will then be refrigerated for aging. The temperature of the refrigerator used for aging will be recorded daily on a calendar kept in the cheese make room.

Step 7: Cheese preparation and aging:
As mentioned in step 6, each piece of cheese to be sold will be coded with a start date, and placed into the aging refrigerator for 60 days or more. To retain moisture, the cheeses will be wrapped in a wax paper.

Step 8. Name, wrap and label:
The cheese is now ready to be wrapped for market, labeled and shipped or brought to market.

Marketing:
Cheese will be sold through my website, www.kefircheese.com, to local caterers, restaurants, wineries, and small specialty cheese shops.

Conditions:
One of the most disheartening aspects of the process was when the kefir grains that were used at Cornell in the test batch (that also had tested coloform free by NYS Ag&Mts.) were found to be non-viable when I brought them back to my facility. It took several weeks to problem solve this setback.
The starter culture we had made from these kefir grains was not curding the milk batch at the expected inoculation rate. David Brown finally looked at the contents of the grains at Cornell to discover that the kefir grains had failed to maintain a level of starter bacteria required for getting the pH to 4.8 within 12 hours. We had left these kefir grains too long in the Cornell refrigerator without changing the milk. They were found to have a yeast overgrowth. A subsequent group of kefir grains were grown, and we finally reached the desired pH in the correct time frame with the new grains.
Getting the cheese to work in my own dairy was another challenge. The kettles in my own facility, which have been converted to hot water, are not the same as the Cornell kettles, which are steam. In order to achieve the results we were looking for, I had to increase the temperature of the water circulating through my kettles to 105 degrees F. for the curd to set the same way that it did at the Cornell lab. Things began to take shape once these issues were under control.

Economics:
At this time, economics have not yet been evaluated, as cheese is just now beginning to be sold. After the first full year of milking four cows (beginning spring of 2007 and ending winter of 2008), economics will be reviewed.

Assessment:
The enzymatic Kefir cheese process, despite my initial hesitation to use rennet, has become the process of choice. It facilitates a smoother, more economical operation, as well as a more acceptable product.
The results of the project have generated several ideas. One important question is whether the Kefir cheese made with authentic kefir grain starter, aged for 60 days or more, has viable probiotics at the time of consumption. Plans are to seek funding to research whether beneficial lactic bacteria are present in the aged cheese.
It would be great to be able to promote Kefir cheese as a probiotic food. It would add market value as well as a new healthy choice for the consumer.

Adoption:
One of the experiments we ran was to achieve a non-enzymatic raw milk, aged, Kefir spreadable cheese. After the curds had been drained in drain bags (enough to rid the whey, but not enough to dry out the curds), the curds were placed in a sealed plastic container and aged for 60 days at 46 degrees F. The cheese successfully made it through the aging process, qualifying it as truly a raw milk spreadable Kefir cheese.
Although this is a success, it will not be used right away at the Finger Lakes Dexter Creamery. The current plan is to focus on perfecting the enzymatic cheese process first, and after successful marketing, perhaps I will then turn my attention to the spreadable non-enzymatic process.

Outreach:
Regarding presentations; on April 4th, 2007 I will give a presentation on the new cheese and the SARE process to the NY State Farmstead Cheese Guild annual meeting in Oneonta, N.Y. On June 26th, 2007, I will host a Local Foods/Local Markets Discussion Group on site, at my dairy, presented by Cornell University/Cooperative Extension of Cayuga County Educational Center.
I have three articles currently being published in journals; the “Record”, a publication by the Purebred Dexter Cattle Association, “Weston A Price Foundation”, and “Small Dairy”. I intend to submit more articles, but would prefer to wait until this year’s cheese making season is underway, in order to have more product to sell. A new book coming out in July of 2007 by Jeffery Roberts called “Atlas of American Cheese’s”, published by Chelsea Green, will include my dairy with photos and information.
Several people have visited my diary from as far as Idaho. The focus has been mainly in milking Dexters. It appears that there are no other Dexter dairies in the U.S. at the present time. There is increased interest, as I have received several calls from potential start-ups.

Report Summary:
The purpose of this project was to up-scale a home recipe for raw milk, aged, Kefir cheese from authentic living kefir grains. Not one, but two commercial processes have been established. Standards have been successfully achieved for the culturing of safe kefir culture from kefir grains, and the standard for this cheese has been recorded and documented. With the methods established at the Cornell Food Processing and Development Lab, under the advisory of David Brown, Sen. Ext. Assoc./Dairy Tech., the commercial production of the Kefir cheese is now possible.

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