The Promotion and Scale of Specialty Dairy Products in the United States

A Senior Project

Presented to

The Faculty of the Dairy Science Department

California Polytechnic State University, San Luis Obispo

In Partial Fulfillment

Of the Requirements for the Degree

Bachelor of Science

by

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March, 2013

ACKNOWLEDGEMENT

I would like to acknowledge the California Polytechnic Dairy Science Department faculty and staff for their knowledge and expertise in dairy husbandry and processing. With the faculty's enthusiasm and willingness to teach made learning about dairy husbandry and processing the most enjoyable for me. Secondly, I would like to thank my project supervisor, Dr. Bruce Golden for his help and advice throughout this whole learning experience. Lastly, I would like to thank my parents for their continued support through out my collegiate career. Their continued belief and support has been the driving factor to my accomplishments.

ABSTRACT

The objective of this paper is to determine the growth and future scale of artisan dairy products. The purpose of this paper is to analyze why there has been such a great demand for artisan dairy products, how they are produced, and the promotion and scale of the specialty dairy industry product production.

The review begins with a brief discussion on the different terms used for specialty dairy products. Followed by the introduction is history of the dairy industry and its growth and change over many, many years. Dairy products have been around longer than they have actually been recorded. As the population increased so did the production of dairy products. In 1850, the production of dairy products in American was larger than any other country. The first major increase in the distribution and consumption of milk happened from approximately 1870-1950. With the development of the centrifugal cream separator by Alfred de Laval, and soon after the factory system of production was established. With the big industrial push came the escalated production of commodity products produced in a large scale by machinery.

In the past few decades the United States consumers have been pushing away from the commodity dairy processing industry and are interested in the smaller scale specialty dairy products. Many more dairy producers and processors have been converting over to either shipping their milk to processors to make specialty products or use their own milk to produce artisan and farmstead dairy products. Some of the specialty dairy products produced are a variety of different cheeses, yogurt, butter, and bottled milk. Specialty cheese is by far produced on the largest scale compared to any other dairy

product. Specialty dairy products, especially specialty and artisan cheese, have increased production substantially in the last few decades.

The production of specialty dairy products has grown due to various factors. According to the California Milk Advisory Board, specialty cheese consumption has increased five times faster than the total cheese consumption in the past ten years. In 2003, the CMAB recorded that the United States specialty cheese production totaled 815 million pounds with an estimated value of $6.4 billion. Recently, the specialty cheese category in the dairy industry is a major factor driving the sales of United States cheese production. The specialty dairy industry is growing due to many different areas. Some reasons of the growth of the specialty cheese market are: that Americans are wanting more variety and flavor in their food, Americans are traveling abroad and wanting the unique flavor of specialty dairy products that they have had in other countries, the growth of ethnic groups and their ethnic food, and the greater availability to a variety of different and unique cheeses. Other areas of growth include specialty dairy products used in food services, restaurants, farmer's markets, supermarkets, and ingredients in prepared foods.

Although the specialty dairy industry has been increasingly growing over the years a big question is whether it is profitable to an on-farm processor and specialty processor to produce value- added specialty dairy products. On-farm processing is very difficult to manage because of both the farm and the processing plan, and the expenses that go along with it. Many considerations and evaluations need to be analyzed before making the commitment of producing specialty dairy products. There is value in the production of specialty dairy products, but many factors and variables need to be considered because, many risk arise in the production of specialty dairy products also.

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INTRODUCTION

The dairy industry is a volatile industry that comes across different problems in different region throughout the nation and the world. In some areas there is too much milk being produced while in others there is not enough. The increase in the production of artisan dairy products seems to be due to the volatile dairy industry. Dairy products that are produced on a small scale with uniqueness and pride of accomplishment with every different product produced and are usually referred to not only as artisan products but also as specialty or farmstead products. Whichever way the dairy product is being referred to it still has the same meaning, a product produced from a farm or a small processing plant that is produced in small quantities usually hand made by the artesian.

In Wisconsin, milk production is currently about 10-15% below what the processors need in order to stay in production (Wisconsin Department of Agriculture, Trade and Consumer Protection, 2012). Wisconsin has both large and small-scale dairy farms attempting to adapt and change the way they manage their dairies in order to meet the demands of the processors (Wisconsin Department of Agriculture, Trade and Consumer Protection, 2012). Since the high demand for milk and the low production some processors are moving to different states in order to keep up with their production (Wisconsin Department of Agriculture, Trade and Consumer Protection, 2012). This has made some farms shift to developing and producing their own specialty dairy products in order to stay in business (Wisconsin Department of Agriculture, Trade and Consumer Protection, 2012). California on the other hand is a state known for its quantity and quality of milk supply (Ellerby, 2010). From the economic crisis of 2008 to present day, milk prices have been very volatile and have made it hard on some producers to survive

(Ellerby, 2010). Because of this, some producers are willing to supplying smaller processors or going into their own farmstead production of dairy products themselves (Ellerby, 2010). The objective of this paper is to determine the promotion and scaled of the special dairy products industry. The purpose of this paper is to analyze why there as been such a great demand for specialty, artisan and farmstead dairy products, how they are produced, the growth of specialty dairy product production, and some of the economic factors associated with production of specialty dairy products.

HISTORY

The consumption of milk and milk products has been around for a very long time. As the population in concentrated areas grew, so did the consumption and distribution of milk (Roadhouse and Henderson, 1975). The first major increase in the distribution and consumption of milk happened from approximately 1870-1950 (Roadhouse and Henderson, 1975). Between the times of 1850-1900 the population on the east coast multiplied by seven (Roadhouse and Henderson, 1975). With the growth of the population came the increased consumption and distribution of milk (Roadhouse and Henderson, 1975). In 1850, the production of dairy products in America was larger than any other country (Roadhouse and Henderson, 1975).

It was common not long ago, that dairy farms processed their own dairy products from the milk that they produced on farm (Nicholson and Mark Stephenson, 2006). Dairy farmers use to be able to produce the milk, process the products, and market and distribute all in one operation (Slee, 1991). In the late 1800s the transformation of centralized processing facilities and specialized producers began (Slee, 1991).

The development of factory systems of dairy products came in large part due to the cream separator and the development of the Babcock test (Roadhouse and Henderson, 1975). Due to the invention of the centrifugal cream separator by Alfred de Laval, an opportunity for new dairying techniques had been established and the first creamery in the San Joaquin Valley was opened soon after by D.C. Hayward (Danish Creamery Association, 1975).

With the development of the factory system came a large push for the sanitation of dairy products. But even before the factory systems came, many people were actually concerned about the health and sanitation long before any manufacturing plants were in place. Health problems and concerns with milk were recognized and recorded as long ago as 1599, when according to reports by Brew, the Senate of Venice forbade sale or use of dairy products such as butter, milk, and cheese during the epidemic. The sale of dairy products was punishable by death (Roadhouse and Henderson, 1975). Then in 1682 the Senate of Venice, demanded a law put in place that milk should be buried because of anthrax among cows (Roadhouse and Henderson, 1597). Then, in the 18th century Johann Petrias Frank was one of the first to put hygiene with milk production. He mentioned that milk should not be stored or handled in zinc, lead, copper, or brass vessels and that cows should be fed fresh feed (Roadhouse and Henderson, 1975). Frank later stated that colostrum and or watered down milk should not be sold (Roadhouse and Henderson, 1975). Then in 1742 Paris passed a law that regulated the feed fed to cows goats, and donkeys (Roadhouse and Henderson, 1975). Spoiled or moldy feed was prohibited (Roadhouse and Henderson, 1975). Along with the worry of the health of the cows and the quality and sanitation of the milk came scientific discoveries that paved the way for the progress in the dairy industry.

The first important discovery was the improvement of the microscope by Anton Van Leeuwenhoek of Holland (Roadhouse and Henderson, 1975). Leeuwenhoek was the first to observe bacteria under a microscope that he called "animalcules" (Talero, 13). Then in the 19th century, Louis Pasteur invented pasteurization from working with the microbial role with beer and wine, which in turn ended up being a huge benefactor for the dairy industry (Roadhouse and Henderson, 1975). Pasteur was able to prove that human diseases could arise form infection (Roadhouse and Henderson, 1975). Pasteur's experiments were able to disprove the theory of spontaneous generation and became known as the germ theory of disease (Talero, 2012). The germ theory of disease is, "a theory first originating in the 1800s that proposed that microorganisms can be the cause of disease. The concept is actually so well established in the present time that it is considered a fact" (Talero, 2012). Then, in 1872, Robert Koch proved bacteria caused disease (Roadhouse and Henderson, 1975). He was able to study the organism responsible for Tuberculosis and typhoid (Roadhouse and Henderson, 1975). With his knowledge and experience, Koch later studied bovine tuberculosis and then developed tuberculin, which was used as a diagnostic agent (Roadhouse and Henderson, 1975). With the advancements in science and knowledge, the study in bacteriology stressed the importance of sanitation and sterilization of dairy utensils was able to increase the growth of the market milk industry and help broaden its horizon (Roadhouse and Henderson, 1975).

As more and more dairies and creameries were being established the sanitation and sterilization was a big issue with considering, but also, people were concerned with the quality of the milk as well (Roadhouse and Henderson, 1975). Milk sold before the 1900 were distributed as raw natural milk (Roadhouse and Henderson,

1975). This practice was done all the way until 1910 (Roadhouse and Henderson, 1975). Then towards the end of the 19th century, Dr. Soxhlet of Germany was boiling milk for infants (Roadhouse Henderson, 1975). By doing this he had great success. Those practices were later adopted and applied in America, but instead of boiling, the milk was pasteurized (Roadhouse and Henderson, 1975). Later, in 1902 medical professionals encouraged experiments in pasteurization of milk by the holding method (Roadhouse and Henderson, 1975). According to Charles E. North, the first pasteurizer of the holding type was installed in 1907 (Roadhouse and Henderson, 1975). By 1912, 33% of Boston milk, 50% Chicago, and 75% of Milwaukee milk was being pasteurized and then sold (Roadhouse and Henderson, 1975). Later, by 1920, 90% of milk in New York was being pasteurized (Roadhouse and Henderson, 1975).

With the increase of pasteurization of milk, came the decrease of foodborne illnesses caused from milk and milk products, larger consumption of dairy products, and a growing dairy industry. Many dairy products were now on their way to being produced on a larger industrial scale. The most common dairy products being produced in a factory setting are a variety of cheeses, yogurts, ice cream, butter, and bottled fluid milk. With the push of industrialization came the loss of the romanticized way of having your cows on pastures grazing, producing milk where the farm owner would but all their knowledge and love into making homemade dairy products. With the push of specialty, artisan, and farmstead dairy products later in the 19th century came the on-farm or small specialty dairy plant processing.

GENERAL MANUFACTURING OF VARIOUS DAIRY PRODUCTS

General Cheese Manufacturing

Due to the variety and different classifications of cheese produced, as demonstrated by Figure 1, there are many different ways to manufacture cheese, but there are some main stages that are common for a large variety of cheeses. Six basic steps will help identify the main general manufacturing of cheese.

Step One: Milk Is Delivered and Prepared

The milk is first picked up from a near by producer and then delivered to the cheese factory. When the milk truck first arrives to the factory it is weighed and then tested for quality. Once the milk passes the quality tests it will then most likely be pasteurized. When the raw milk comes into the cheese plant it is usually then pasteurized at 72-73°C for 15-20 seconds which is the HTST pasteurization method most commonly used (Tetra Pak, 2003). Following pasteurization is the standardization and separation of the milk (Tetra Pak, 2003). Cheeses have different classifications and are usually numerated by the fat on dry solids basis (Tetra Pak, 2003). To reach the certain fat levels wanting to be accomplished more fat can be added in by in-line remixing after the separation step, which separates the cream from the skim milk, or by mixing whole milk and skim milk after pasteurization (Tetra Pak, 2003). When adjusting the protein level for cheese, membrane filtration is one method used or adding skim milk powder can adjust the protein content (Tetra Pak, 2003). As with specialty cheese we see the increase of using unpasteurized milk. Still to this day the majority of cheese produced in the U.S is still pasteurized.

Next, the milk is then poured into a cheese vat of some kind. Steam jacketed vats are a common type of vat used (Pearl et.al., 1978). To put it simply, the vat can be compared to two pails, a large pail, and within the large pail sits a smaller pail (Pearl et.al., 1978). Between the two pails or vessels, there are coils wound around the inner vessel (Pearl et.al., 1978). These coils emit steam, which increases the temperature for the inner vessel (Pearl et.al., 1978). The operator of the steam vat is able to control the temperature precisely and is able to heat the milk in the vessel evenly (Pearl et.al., 1978). The operator is able to heat the milk at different various temperatures depending on the type of cheese they are making (Pearl et.al., 1978).

Step Two: Coloring, Starter, and Rennet Addition

Now that the milk is in the vat and is at a specific degree, coloring is then added to the milk if the actual end product is to be colored (Pearl et.al., 1978). The coloring is usually a tasteless yellow-orange vegetable dye. One example of this type of dye is the vegetable source such as annatto, a dye from the Latin American bush, which is called annatto also. After the addition of the dye if necessary, the starter culture is then added to firm up the curd (Pearl et.al., 1978).

The addition of the essential additives, starter culture and rennet are what makes the next step in cheese processing possible, curd production. Adding the starter culture to the milk is a very important step in cheese processing. The primary importance of adding starter culture to the milk for cheese making is to produce lactic acid, break down the protein and, to produce CO2 when needed (Pearl et.al., 1978). Starter cultures are added to the milk before rennet so that the bacteria added could be distributed evenly throughout the vat and, to give the bacteria time to pre-ripen, which is usually 30-60 minutes (Tetra Pak, 2003). A starter culture in cheese making has much of the same

purpose that it does when producing yogurt, it is the initial "start" of the process (Pearl et.al., 1978).

The curds are then produced by the addition of rennet. The primary purpose of the addition of rennet (an enzyme) is the coagulation of casein (Pearl et.al., 1978). Rennet helps speed up the process in the separation of curds and whey (Pearl et.al., 1978).. Sometimes the rennet is usually stirred into the milk by paddles so that it is evenly distributed throughout the vat of milk (Cuttle and Deskins, 1978). The rennet is added to the milk usually around the optimum temperature for rennet, around 40°C, and then stirred carefully for no more than five minutes (Tetra Pak, 2003). Leave the milk to sit stagnate so that the coagulation process can occur without disruption (Pearl et.al., 1978). The coagulation time usually takes around 30 minutes (Tetra Pak, 2003).

Step Three: Curd Cutting and Cooking

Once the coagulum reaches its custard like firmness, the coagulum is then cut into curds. The cheese makers cut the coagulum into curds by using wire knives (Pearl et.al., 1978). Pre-stirring occurs after the coagulum is cut into curd grains so that the curd grains are not able to sediment to the bottom of the vat causing lump formation. The stirring is done gently. The stirring helps continue the production of lactic acid and expel whey from the grains (Tetra Pak, 2003). Next, the cheese makers heat the whey and the suspended curds to the proper cooking temperature (Pearl et.al., 1978). This heating process aids in firming up the curd and separating the curds from the whey (Pearl et.al., 1978). Most of the cheeses are heated and cooked to some degree, but there is a distinction between cooked and uncooked cheese (Pearl et.al., 1978). Cooked cheeses are those cheeses whose curds are heated at a fairly high temperature of approximately 128°F to help solidify it (Pearl et.al., 1978). Swiss type cheeses fall into the cooked category

(Pearl et.al., 1978). Cheddar, although heated to 100°F during the cheese making process is considered an uncooked cheese (Pearl et.al., 1978).

Step Four: Separating the Curds From the Whey by Draining

Next, the first drainage of whey acquires to separate the curds from the whey depending on the different types of vats used (Pearl et.al., 1978). If a rectangular vat is used, at the end of the draining process the curd is sometimes then gathered to each side to create a ditch and help the draining process (Pearl et.al., 1978). Then the curd is left to the side to knit or mat together and left undisturbed to form a solid mass (Pearl et.al., 1978).

Step Five: Salting the Curd

Due to the different types of cheese produced the salting step can be done in various ways. Most cheeses are salted after draining but some cheeses do not get salted at all (Pearl et.al., 1978). Measured out amounts of salt are now introduced to the curd (Pearl et.al., 1978). With a few expectations, the salt content of is usually 0.5-2.0% (Tetra Pak, 2003). The addition of salt to the cheese not only adds flavor but also aids in drawing out excess whey and hindering starter activity and bacterial processes in cheese processing (Tetra Pak, 2003).

Salting can occur by either dry salting or brining (Tetra Pak, 2003). Dry salting is when the salt is spread as evenly as possible over the curd after the whey has all been drained (Tetra Pak, 2003; Pearl et.al., 1978). To completely and uniformly distribute the salt, the curd is stirred for about 5-10 minutes (Tetra Pak, 2003).

Another way cheese can be salted is through brining. After the cheese is molded and pressed (Step Six) it is placed into container with a brine solution (salt and water) (Tetra Pak, 2003).

Step Six: Pressing and Curing Cheese

After the curd has been salted, it is then pressed into cheese hoops, metal containers, cheesecloths or other devices and then is ready to be pressed (Pearl et.al., 1978). Pressure is applied to give the cheese its shape of the mold. At this time more whey is then expelled out due to the pressure applied (Tetra Pak, 2003). The curd is left in the molds depending on the type of cheese being made. It can be left in the molds for either a long or short time. After pressing, the cheese is then taken out of the molds and placed into the curing room, which has a specific temperature and humidity for different cheeses (Pearl et.al., 1978). Not all cheeses will undergo the curing process, such as fresh cheese (Tetra Pak, 2003). During the curing or ripening period, additional modifications are done to different types of cheeses to give the cheese their final, finished characteristic (Pearl et.al., 1978).

Cheeses such as Brick, Camembert, and Limburger, are aged during the curing process by fungi, mold, and yeast on the surface (Foster, 2011). Other cheeses such as Swiss cheese produce carbon dioxide gas as a byproduct and the gas has no where to escape (Pearl et.al., 1978). Consequently, holes, also called eyes are formed in the cheese (Pearl et.al., 1978). Also, during curing rinds are formed on some cheeses. Aged Cheddar types form a natural rind over time, cheeses sprayed with mold such as Brie form velvet like mold-curved crust which is called a bloomy rind, and cheeses that are washed periodically during curing are called washed rinds(Pearl et.al., 1978). Other cheeses that are packaged or coated in paraffin, wrapped in foil, or are left untouched (Pearl et.al.,

1978). Last but not least, cheeses that are aged but the processor does not want a rind on it they will package in in plastic for the desired rindless cheese (Pearl et.al., 1978). The purpose of all these procedures is to create the proper environment to develop the desired interior and body of the cheese (Pearl et.al., 1978). If done correctly and desired product will reach its exquisite potential, and if done incorrectly the product will become apparent with defects (Pearl et.al., 1978).

Figure 1: Image of a variety of different specialty cheeses

General Manufacturing for Yogurt

Yogurt is a cultured milk product that is consumed in large numbers around countries in the Mediterranean (Tetra Pak, 2003). Yogurt is produced in in a variety of flavors and different textures such as, low viscosity or high viscosity, frozen as a dessert, or can be drinkable. According to toe Tetra Pak Handbook (2003) yogurt can be classified as listed in Table 1.

Table 1. Terms and definitions for yogurt types

Term	Definition
Set Type	incubated and cooled in the package
Stirred Type	incubated in tanks and cooled before packing

Drinking Type	similar to stirred type, but the coagulum is broken down to liquid before being packed
Frozen Type	incubated in tanks and frozen like ice cream

Information from the Tetra Pak Handbook (2003).

For this paper I will be going through the manufacturing process for the two most common types, set type and stirred type. The first five steps of yogurt processing for set type and stirred type yogurts are the same.

Step One: Standardization of Milk

To reach the desired fat content milk used in yogurt manufacturing is often mixed with skim milk and cream (Lee and Lucey, 2010). According to Lee and Lucey (2010), the milk solids for yogurt ranges from around 9% for skim milk yogurt and greater than 20% for certain types of concentrated yogurt. Many commercial yogurts contain 14-15% milk solids (Tamime and Robinson, 1999). Yogurt under the Code of Federal Regulations state, that yogurt must not contain less than 3.25% milk fat and not less than 8.25% milk solids not fat (Department of Agriculture, Food and Drug Administration Department of Health and Human Services). An increase in the dry matter particularly casein and whey protein; will result in a firmer yogurt (Tetra Pak, 2003). Stabilizers such as pectin, gelatin are used as additives in yogurt to maintain the appropriate properties of yogurt and prevent the separation of whey (Tamime and Robinson, 1999). Attention needs to be paid to the amount of stabilizers added to the milk. Over stabilization will make a jello-like springy body of yogurt while under-stabilization will make a runny body and whey separation may occur (Vedamuthu, 1991). When making yogurts added with fruit stabilizers are often added to the fruit preparation to help improve the texture (Tamime and Robinson, 1999).

Step Two: Homogenization

Milk is homogenized mainly to prevent creaming during the incubation period and to insure the uniform distribution of milk fat (Tetra Pak, 2003). Homogenization is the process of disrupting the fat molecules into smaller fat globules (Tamime and Robinson, 1999). The homogenization for all yogurt types is approximately 60 degree C (Tetra Pak, 2003). When the milk is homogenized milk fat globules act like protein particles due to the presence of protein on the fat surface (Lucey and Lee, 2010).

Step Three: Heat Treatment

In yogurt processing pasteurization is a very important step due to the fact that it greatly influences yogurt properties (Lee and Lucey, 2010). Heat treatment is done before the addition of the starter cultures so that the high heat does not inactivate the starter cultures. According to Tamime and Robinson (1999) the temperature and time combinations that are commonly used for batch processing in the yogurt industry are 85 degrees C for 30 min or 90-95 degrees C for five minutes. During this process approximately 70-80% of the whey proteins are denatured (Tetra Pak, 2003). The principal whey protein b-lactoglobulin interacts with the k-casein giving the yogurt a more stable body (Tetra Pak, 2003).

Step Four: Cooling to Incubation Temperatures

The milk is then cooled to optimal incubation temperatures used for growth of starter cultures (Lee and Lucey, 2010). The starter cultures used for yogurt production are *Streptococcus*, *thermophiles* and *Lactobacillus delbruekii.* The optimal temperature for all of the thermophilic lactic acid bacteria is around 40- 45 degrees C (Lee and Lucey, 2010).

Step Five: Addition of Starter Cultures

Once the milk has reached it optimal temperature for the starter cultures they are then added. This is the step where bacterial fermentation converts lactose into lactic acid, which will in turn reduce the pH of milk because of all the acid the bacteria's are producing (Lee and Lucey, 2010). The pH decreases form 6.7 to less than or equal to a pH or 4.6 (Lee and Lucey, 2010).

Set Type Yogurts

After the first five steps of yogurt manufacturing set type yogurts go through three more processing steps. First, the yogurt is packaged. When packaging and processors want to add fruit or other additives they need to be added into the packages or cups first before they are filled (Tetra Pak, 2003). After yogurt is packaged, the filled packages will then be incubated (Tetra Pak, 2003). After incubation comes the cooling and storage of the product. When the optimum pH of the product is reached in incubation, typically 4.5, it is then time to start cooling (Tetra Pak, 2003). Once the cooling starts it is important to stop any further growth, which means that a temperature of 35 degrees or less should be reached within 30 minutes, and 18-20 degrees C after another 30-40 minutes (Tetra Pak, 2003). Final cooling is usually down to 5 degrees C (Tetra Pak, 2003).

Stirred Type Yogurts

Stirred type yogurts are incubated first before packaging. The pre treated milk is pumped to incubation tanks simultaneously with the culture (Tetra Pak, 2003). Stirring is then done for a short time to make sure there is uniformity in the distribution of the starter culture (Tetra Pak, 2003). The incubation in stirred type yogurt is usually 3 to 3.5 hours at a temperature of 42-43 degrees C (Tetra Pak, 2003). When the required pH is

meet (pH 4.2- 4.5) the yogurt is then cooled to 15-22 degrees C (Tetra Pak, 2003). The coagulum is broken up by be pushed through a strainer when the product is being pumped to a plate heat exchanger to be cooled (Tetra Pak, 2003). Flavoring and fruits are then ready to be added after cooling. The flavoring and fruits are then added when the product is being transferred to the filling machines (Tetra Pak, 2003). This processes is done simultaneously. This is where the fruit and yogurt are stirred together. The fruit additives are usually sweet, about 50-55% of its ordinary sugar content. Pectin can then be added at this step but not usually more than 0.5% (Tetra Pak, 2003). The product is then packaged and sent to cold storage.

The difference between stirred type yogurt and set type yogurt is that the final product of the stirred type of yogurt has the fruit or other additives already stirred in while the set type does not. The set type either hast the fruit set at the bottom or top and you as the consumer will stir it in once opened.

General Ice Cream Manufacturing

There are many different types of ice cream and related product categories such as dessert ice cream, “ice cream”, milk ice, sherbet, water ice, and sorbet (Tetra Pak 2003). Within those categories are different standardization such as ice cream can be standardized into economic, regular, premium, and super premium by the quality and the amount fat and overrun percentages in the product. Each category had different fat, MSNF, sugar, emulsifiers/stabilizers, water and overrun percentages (Tetra Pak, 2003). Also, ice cream can come in many shape and form. In this section I will only be defining the general production of regular ice cream.

Step One: Preparing mix for Ice Cream

Raw materials used in the ice cream mix can either be wet or dry. Ingredients used in ice cream production are fat, MSNF, sugar and non-sugar sweetener, emulsifiers and stabilizers, flavors, colors, and other various ingredients (Tetra Pak, 2003). Fat makes up about 10-15% of an ice cream mix and either can be from milk or vegetable fat (Tetra Pak, 2003). Milk fat comes from either whole milk, cream, butter of anhydrous fat (AMF) where as vegetable fat comes from coconut oil of palm oil (Tetra Pak, 2003). The fat in the ice cream mix gives creaminess and stabilizes the air cell structure in the ice cream (Tetra Pak, 2003).

Next, the MSNF consists of proteins, lactose and mineral salts. MSNF has high nutritional value and acts and helps stabilize the structure of ice cream (Tetra Pak, 2003). MSNFs also help with the air distribution in the freezing process of ice cream making more of a consistency to improve the body and creaminess of the ice cream (Tetra Pak, 2003). MSNF is typically around 11.5% in the ice cream mix (Tetra Pak, 2003). Sugars are added to ice cream to increase the sweetness levels, but it also can adjust the consistency of ice cream making it easier to scoop. Sugar free ice creams are possible with the addition of sweeteners such as aspartame and glycerol (Tetra Pak, 2003).

Lastly, in the ice cream mix emulsifiers/stabilizers, flavors, coloring, and any other additives are included in the ice cream mix (Tetra Pak, 2003). According to the Tetra Pak Handbook (2003), emulsifiers are used to assist emulsification by reducing the surface tension, stabilizers are used to prevent to water molecules from moving freely by forming a matrix, flavors are added at the mixing stage or after pasteurization, colors are added to the mix to give an attractive appearance, and lastly, other additives are added for molds, coatings, ripples or ribbons that are added for taste and appearance, and other such

dry additives such as chocolate chips, nuts, dried fruit, candies, cookies, etc. (Tetra Pak, 2003).

After the formulation of your ice cream mix has been reached the materials are then blended together, homogenized and pasteurized.

Step Two: Homogenization and Pasteurization

The mix that is suspended in the milk is then pre-heated in a plate heat exchanger to 73- 75 degrees C (Tetra Pak, 2003). After, the mixture I then sent to the homogenizer to disrupt the fat particles (Tetra Pak, 2003). It is then sent back to the plate heat exchanger where it is pasteurized at 83-85 degrees C for about 15 seconds (Tetra, Pak, 2003). The pasteurized mix is then cooled to about 5 degrees C and goes to the next step called ageing (Tetra Pak, 2003).

Step Three: Ageing

The mixed is then aged for at least 4 hours at a temperature of 2-5 degrees C with very gentle stirring. The Tetra Pak Handbook (2003) states that, “ageing allows the milk proteins and water to interact and the liquid fat to crystallize. This results in better air incorporation and improved melting resistance.”

Step Four: Continuous Freezing

After ageing the ice cream mix is then transferred to the continuous freezer. As the mix is being added in a constant airflow is then added simultaneously as well. This airflow is whipped into the mix by dashers (Tetra Pak, 2003). The continuous freezers purpose is to freeze the water content in the mix into small ice crystals and to whip a controlled amount of air in called overrun (Tetra Pak, 2003).

During this time the cylinder is surrounded by refrigerant that generates the freezing process. As the dasher knives turn the scrap of the layer of frozen mix formed on the sides. The ice cream is being continuously pushed through the machined to either an ingredient feeder, filling machine or is being hand filled. The ingredient feeder in large plants are usually automated while in small production the ingredients are usually just fed in by hand as the ice cream is coming out. When the ice cream is being dispersed from the continuous freezer the temperature is approximately -3 to -6 degrees C (Tetra Pak, 2003).

Step Five: Filling, Extrusion, Molding

The ice cream is then filled into containers, put into molds to freeze in specific shapes, or extruded onto a tray tunnel processor. Extrusions are usually premium stick products (Tetra Pak, 2003). After the extrusion process and the ice cream extrusions are hardened, the bars can then be dipped into chocolate to form an outer shell. Chocolates can be covered with a different variety of ingredients (Tetra Pak, 2003).

Step Six: Hardening and Cold Storage

First, ice cream is hardened at -20 degrees Celsius. Products that are apart of the extrusion line go through hardening during the process while the others go through the process later (Tetra Pak, 2003). After hardening the products are then taken to cold storage where they are stored at a temperature of -25 degrees C (Tetra Pak, 2003). The storage life of the product depends on the type of product and on average can be stored for 0-9 months (Tetra Pak, 2003).

DEFINITIONS AND TERMS

In this literature review specific terms such as “specialty”, “artisan”, “farmstead”, and “commodity” dairy products will be referred to. Each of these terms has a different meaning although specialty, artisan, and farmstead are very closely related but have different meanings. It is usually hard to differentiate these terms because of the close similarities but also because these terms are usually mixed up and used improperly by people causing even more confusion. Although there are no formal definitions for specialty, artisan, and farmstead dairy products, they all refer to the specific way the product is processed and the volume it is made in.

Commodity dairy products are those dairy products that are produced on a large industrial scale and are usually produced on a volume basis of more than 40 million pounds in a year (Greenberg, 2005). A commodity dairy product such as cheese that is produced on a large scale would be Cheddar, Mozzarella, Muenster, and Colby as seen in Figure 2. (Greenberg, 2005). The processes of commodity dairy product productions are usually automated (Greenberg, 2005).

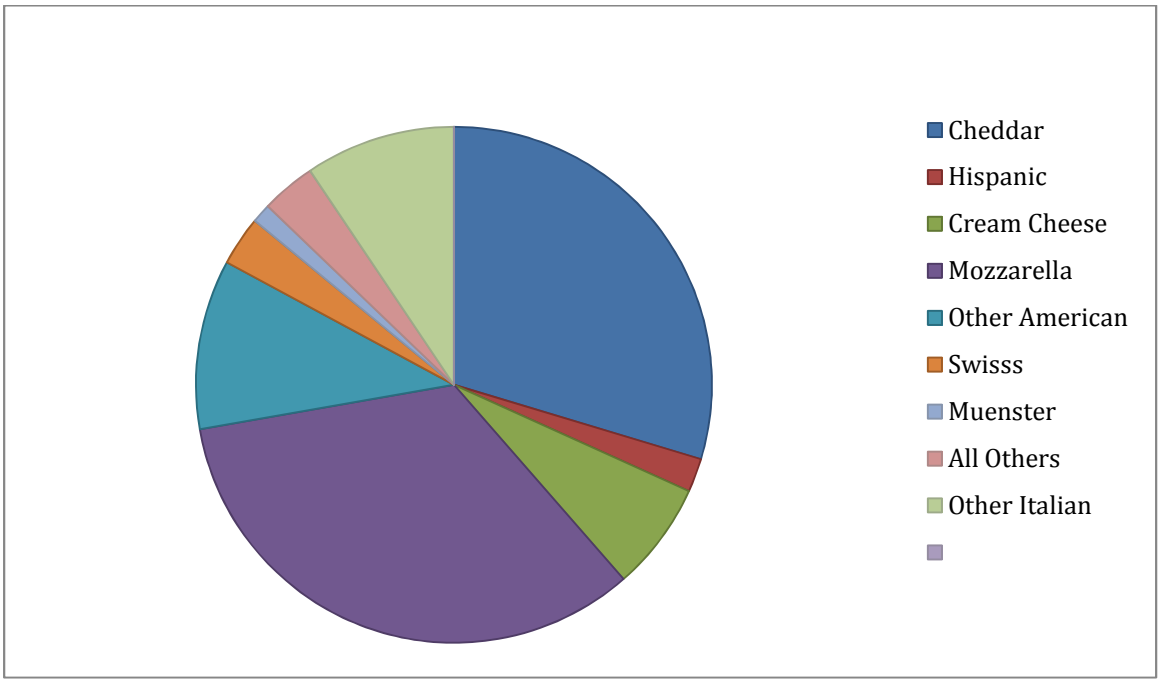

Figure 2: US cheese production by variety, 2011

Chart was redrawn from Wisconsin Milk Market Board

Specialty dairy products are value-added products that are produced and packaged in certain distinct ways on a smaller scale that differentiate them from commodity dairy products. With the decreased volume comes the consumer perception of a higher quality product, which drives the premium price of specialty dairy products (Gloy and Stephenson, 2006). Attention is paid to the natural flavor and texture of specialty cheeses, which can be made from all types of milk (American Cheese Society, 2011).

Artisan dairy products are produced in small batches that maximize handcrafted production of the products and they can be manufactured from milk of any species of mammal. When producing the products, the artisan's try to keep their process as close to traditional as possible under the limitations of health and sanitation laws (American Cheese Society, 2011).

Farmstead dairy products are produced on the farm with the milk from the animals on that specific farm. The milk used must be only from that specific farm and may not be from any outside sources (American Cheese Society, 2011).

Specialty dairy products industry refers to the business that produce, market, and distribute specialty products (Greenberg, 2005). The specialty dairy products are slightly different from artisan and farmstead dairy products because they are produced on a slightly larger scale and are usually produced in smaller scale factories that use

mechanical equipment to process the product. The Specialty Dairy Industry though, engulfs the more specific categories of artisan and farmstead classes (Greenberg, 2005).

WHAT DAIRY PRODUCTS ARE PRESENT IN THE SPECIALTY DAIRY PRODUCT INDUSTRY

Dairy products such as cheese, yogurt, butter, ice cream and even bottled milk are present in the specialty dairy industry. Cheese is by far the largest segment of the specialty industry, but the other dairy products do have room for growth in this niche market. Consumers seem to be paying more attention the where their food is coming from. The locally produced specialty, artisan, and farmstead push is being greatly pursued by customers today. Table 2 in the appendices shows some examples of specialty, artisan, and farmstead dairy product processors. Unfortunately, most of the information of this report will be on the production and growth of specialty cheeses due to the larger database of peer-reviewed papers and articles.

Also, not only are these products being produced by cows milk, but also goat and sheep milk. This creates another competitive market in the specialty dairy industry due to the different composition, taste, and flavor of milks.

PRODUCTION AND MARKETING OPPORTUNITIES FOR SPECIALTY CHEESE

Specialty cheese is the main dairy product produced in the specialty niche market. In California alone, cheese is the most important dairy product produced accounting for 40% of California's milk supply (Ellerby, 2010). In California the production of

commodity is largest part of the cheese-processing sector (Ellerby, 2010). Commodity cheese is the largest, but is no longer the only (Ellerby, 2010). The specialty cheese product category has grown over the past few decades. From 1996 to 2000 the production of specialty cheese grew by 4% annually (Ellerby, 2010). Not only in California has the specialty cheese business grown. In Wisconsin, they expect to increase their specialty cheese volume by 25% in the next five years (Wisconsin Department of Agricultural Trade and Consumer Protection, 2012).

Trending through out the nation in the dairy industry is the production of "specialty" or "artisan" dairy products. In this section I will discuss thoughts on why this is happening, what are the advantages, what are the disadvantages, marketing opportunities for specialty products, and the future of specialty dairy products. Most of the information found will be on the specialty cheese category because of the particular growth and availability of information due to the much larger popularity and production of cheese in the Untied States.

The Trend of Specialty Dairy Products

The production of specialty dairy products has grown due to various factors. According to the California Milk Advisory Board (CMAB), specialty cheese consumption has increased five times faster than the total cheese consumption in the past ten years (Greenberg, 2005). In 2003, the CMAB recorded that the United States specialty cheese production totaled 815 million pounds with an estimated value of $6.4 billion (Greenberg, 2005). Recently, the specialty cheese category in the dairy industry is a major factor driving the sales of United States cheese production. The specialty dairy industry is growing due to many different areas. Some reasons of the growth of the specialty cheese market are: that Americans are wanting more variety and flavor in their

food, Americans are traveling abroad and wanting the unique flavor of specialty dairy products that they have had in other countries, the growth of ethnic groups and their ethnic food, and the greater availability to a variety of different and unique cheeses (Food Processing Center, 2001). Other areas of growth include specialty dairy products used in food services, restaurants, farmer's markets, supermarkets, and ingredients in prepared foods (Ellerby, 2010). Also, the trend in the escalated growth of specialty cheese products is driven by various economic and demographic factors. Some of these factors are the interest of the Baby Boomers for more novelty and sharply flavored products, the consumer preference of a "slow food" of organic or sustainable production practices and of a local origin, and because of the increased exposure in retail stores (Ellerby, 2005).

Some specialty cheese makers and specialty dairy product processors have joined the artisanship for a sustainable retirement project, others with no dairying background have entered into to trade just because they enjoy the flavor of artisan cheese, some to earn a living, and others have converted to specialty cheese because of the value added product and to escape from going out of business in the harsh times in the dairy industry. (Werlin, 2000). Not only are some producers converting to become specialty cheese makers, but some processors are switching from producing commodity cheese to producing specialty cheese and specialty dairy products to obtain higher margins (Wisconsin Department of Agriculture Trade and Consumer Protection, 2012).

Opportunities

The production of specialty dairy products is a potential for the dairy business through out the United States because of the high-value in the products. In California, the production of specialty cheese grew 4% annually from 1995 to 2000 (Ellerby, 2010). In 2005, specialty cheese production rose to 11% or 240 million lbs. out of all the cheese

produced in California (Dryer, 2006). Growth of specialty cheese production has also become an opportunity for producers to earn a higher margin for their milk when it is made into a specialty product rather than a commodity product (Greenberg, 2005). With all their different outlets of distribution it is hard to track the statistical analysis of the production and growth of specialty dairy products. Also, governmental information provides precise information on the total cheese production as a whole but does not separate it out to organic and conventional, or commodity and specialty.

Marketing Overview

Specialty dairy products are known as and qualified by containing one or more unique qualities such as exotic origin, design, particular processing method, supply, unusual application or use and extraordinary packaging or channel of sale (Wisconsin Specialty Cheese Institute, no date). I will be grouping artisan and farmstead products into the "specialty" category as well because not enough information is out there to separate specialty, artisan, and farmstead. Specialty cheese is known for its higher quality compared to commodity cheeses. Specialty dairy products, especially specialty cheeses, give retailers and restaurants a higher profit margin for their foods because the addition of unique flavors to each dish.

In the dairy industry, cheese consumption has dramatically increased over the past 30 years going from 11.3 pounds per person in 1970 to 32 pounds per person in 2006 (Hutchison, no date). Wisconsin, the largest cheese producer produces approximately 26% of the total U.S. production while California, the second largest cheese producing state manufactures 23% followed by Idaho at 8%, and New York at 7% (Hutchison, no date). In 2006 the total cheese sales for the US was $12.8 billion (Hutchison, no date).

The increase in sales of cheese in the US has in large part been because of the new niche market, specialty, artisan, and farmstead cheese. In California, the specialty cheese product category grew by 4% annually from 1996-2000 (Ellerby, 2010). By 2005 in California the specialty cheese category rose to 11%, or 240 million pounds of the total cheese processed in California (Dryer, 2006).

Growth and Promotion

The main market in the specialty dairy products category would be cheese. Specialty, artisan, and farmstead cheeses come in many different varieties and unique flavors. Most of the data available is on specialty cheese, but with the growth of production and consumption of specialty cheese may in the later future come the growth of other specialty dairy products.

United States specialty dairy products extraordinary growth through out the past twenty years seems to be affected by many different factors. First off, with the variation in texture and flavors specialty cheeses are a perfect fit for today's more adventurous consumer (Food Processing Center, 2001). Consumers seem to be looking for a more adventurous and different taste rather than the same traditional American style cheeses. Due to the unique taste and variety, specialty products have a variety of uses such as, foodservice, high end restaurants, supermarkets, farmer's markets, ingredients in other foods, and are a great companion for wine and beer (Ellerby, 2010).

Growth has also been because of the quality of the product and the price that accommodates it. Specialty cheese in particular is a value added product. Due to the fluctuating milk prices some producers and even processors are having a hard time

staying in business in the large production commodity scale. This in the past was a major problem in Wisconsin because of its milk deficient status (Wisconsin Department of Agriculture, Trade & Consumer Protection, 2012). The specialty market then becomes a value added initiative for them. Some producers are using their milk to produce artisan or farmstead cheeses. In Wisconsin, the dairy industry is pushing what is called the Value Added Dairy Initiative, which in part is dedicated to growing the specialty and artisan cheese business while promoting small to medium sized cheese plants (Wisconsin Department of Agricultural Trade and Consumer Protection, 2012). This is where non-profit organization and government funding programs server to provide processing technology equipment, business planning and finance, product development, and market development (Wisconsin Department of Agricultural Trade and Consumer Protection, 2012).

Shopping Habits of Consumers

Specialty or artisan dairy products sales have increased dramatically. Between 1993 to 2001, the production of specialty cheese alone increased from 26.9 million pounds to 54.5 million pounds (Reed and Bruhn, 2003). The demand for specialty cheeses by consumers has put cheese makers on the front line to find out information on what will drive product sales and what would be the right way to market their product Barbara A. Reed and Christine M. Bruhn conducted a project under a USDA Western Region Sustainable Agriculture Producer/Marketing Grant to gather information about the shopping habits of artisan cheese consumers to help artisan cheese makers with their marketing of their products (Reed and Bruhn, 2003). They gathered information through telephone surveys, focus group interviews and in-store consumer evaluation of point of sale materials (Reed and Bruhn, 2003). Participants for this survey were selected from

the Chico, Sacramento, and San Francisco area through sign- up sheets that were posted at specialty food stores in those areas. The questions that were developed for the phone interviews and focus groups were done with the help from dairy farmers who produce their own cheese, CMAB marketing personnel and independent food industry consultants (Reed and Bruhn, 2003).

Surveyors were asked questions about their purchasing habits and preferences. When asked about cheese made from raw milk 45% did not know if the cheeses that they purchased were made from raw or pasteurized milk and 38% knew that they did purchase raw milk cheese, but were not worried about health problems (Reed and Bruhn, 2003). Because of the health concern involving raw milk, cheeses that are sold in the United States that are made from raw milk have to be aged for 60 days or more. From the survey conducted small- scale cheese makers were able to clue in on some ideas for marketing their products. First off, consumers did not rely on the packaging for their initial purchase, although packaging is an eye catcher (Reed and Bruhn, 2003). They instead love the idea of having samples of the product available to them. Also, store employees have an affect on the sells of the product due to recommendations. Consumers thought it helpful when the staff was knowledgeable about the product they had for samples that they were trying to sell (Reed and Bruhn, 2003). Specialty cheese consumers look for the description of the cheese flavor and characteristics, country of origin, storage, ripening, and aging information, food pairings and sell by dates instead of low fat products (Reed and Bruhn, 2003). These consumers have the romantic cheese making image in their head when cheese making was on a small scale farm where the milk came from their own cows and the families worked together to make their own cheese.

Foodservice

Specialty cheese sales have been in part driven by the foodservice industry. At restaurants cheese courses are being offered on menus, which has led consumers to recreate the specialty cheese dishes at home. The California Milk Advisory Board conducted a survey in the wine region of California concluding that 2 out of 3 fine restaurants feature some sort of cheese course on their menu (Food Processing Center, 2001). Table three shows some of the highlights of the survey (Food Processing Center, 2001).

Table 3: CMAB survey highlights

Question	%
Percentage of restaurants offering some sort of cheese course on menu	65%
Traditional cheese course offered where guest choose?	28%
Restaurants listing artisan or farmstead cheese as ingredients?	30%

By pairing specialty and artisan cheese with wines or fruits it is a way to get different variety and flavors out of the cheese and establishing cheese as a complementary to other products so that when consumers buy a bottle of wine they think about pairing specialty cheese with it to bring out the flavor in the cheese and wine. Also, when cheese courses and platters are marketed correctly in restaurants not only can it help the cheese processors, but it also will help establish a name for the restaurant (Food Processing Center, 20010. Specialty cheese can help distinguish the restaurant from other competitors, make a firm statement about the quality of products used in their restaurant, show that they are supporters of locally produced products if they choose to select only from local processors, and help increase their profit at the restaurant (Food Processing Center, 2001). In the food service industry restaurants have reported their top cheeses

that costumers prefer. These cheeses include, Fresh Mozzarella, French Brie, Parmigiano-Reggiano, Blue Cheese, Cheddar, Feta, Swiss Emmental, French Chevre, Mascarpone, and Provolone (Food Processing Center, 2001). As stated before aged and fresh cheeses are the most commonly produced. This is related to the consumer preference of the products. Consumers are interested in specialty fresh cheese and aged cheese and the manufactures act on that demand.

Education

Effective selling of specialty cheese requires not only the processor of the cheese to be educated on the product inside and out, but also for the staffing who are selling the cheese if it is possible. If selling a product at a small local store of farmer's market, a knowledgeable staff can drive sales of the product. Consumers want to know about the how the specialty dairy product is made, what are the practices that go along with it, and information about the background of the company. Sales are able to increase just by the faculty and staff that are knowledge.

Retail

Retail stores have been a big driving factor for the sales of specialty, artisan, and farmstead dairy products. Usually located in the deli section of a grocery store are the specialty cheeses located on display. Although retail is an important channel for specialty dairy products, it is also very hard to get into (Ellerby, 2010). Shelves at retail stores in the deli section are stocked with a variety of different specialty dairy products (Ellerby, 2010). Retail stores can also be reluctant to let another brand in their store due to inconsistency over time (Ellerby, 2010).

If specialty dairy product producers want to break into the retail market, private label products through store brands are becoming an increasingly important channel (Ellerby, 2010). Figure 3 shows how the private label Boar's Head is the majority of the Ralph's specialty cheese and deli cases. Now, 80% or retail cheese is now sold through private labels (Ellerby, 2010). However, if turning to private-label arrangements most stores want a large volume of product which smaller processors are not able to accommodate (Ellerby, 2010). If large retail store are not able to accommodate for other specialty dairy products another good location would be specialty local markets. They are a great niche market, besides a farmer's market where specialty, artisan, and farmstead dairy products can be displayed and differentiated from commodity cheeses.

Figure 3. Picture taken of Ralph's Deli Case in San Luis Obispo.

RAW VS. PASTUERIZED SPECIALTY DAIRY PRODUCTS

Raw milk versus pasteurized milk has been a hot topic in the dairy industry for years now. Raw milk is milk that is not heat treated to high temperatures for a short amount of time to kill pathogenic bacteria (U.S. Department of Food and Agriculture, 2012). Pasteurized milk is milk that goes through heat treatment to kill off pathogenic bacteria's that can be harmful to a human's health. Bacteria's such as *Salmonella, E. coli, Listeria*, and *Campylobacter* are the types of harmful bacteria most often found in raw milk (U.S. Department of Food and Agriculture, 2012). Some consumer's prefer to eat raw milk dairy products because they believe it is higher in nutrient content, an unaltered natural food, does not cause allergic reactions, and is just a safe for consumer's as pasteurized milk.

Recent outbreaks advertised in the news of *Listeria* and *Campylobacter* in raw milk in the news have sickened many. Some states are allowing the sales of raw fluid milk while others are not because of the potential hazard with consuming raw milk products. Cheese's can be made from raw milk, but have certain regulations that they have to follow. Cheeses made with raw milk have to be aged for at least 60 days or more and greater than or equal to 35°F (American Cheese Society, 2011). A new survey by the American Cheese Society found that 59% of cheese makers produce some type of raw milk cheese (Cheese Reporter, 2013). Raw milk dairy products are growing in popularity, but extra caution should taken when purchasing and consuming it because the risk of pathogens in the product is much higher than in pasteurized products.

Safety of Artisan, Farmstead, and Specialty Dairy Products

An area of concern for Artisan, Farmstead, and Special Dairy Products is the lack of regualtions and Hazard Analysis and Critical Control Points (HACCP) plans established for the processing of specialty dairy products. In the survey by American Cheese Society, only half of the cheese makers have an established HACCP plan in place (Cheese Reporter, 2013). More thank half responded of having a product recall or crisis management plan in place, and 61% have documented GMPs established (Cheese Reporter, 2013). Forty- eight percent of respondents conduct some sort of testing, and nearly half of the cheese makers reported random audits or inspections done by the FDA (Cheese Reporter, 2013). The specialty cheese industry should have it be mandatory to have a HACCP plan in place to help monitor and control the safety of specialty dairy products. Raw milk carries many harmful pathogens that can cause illness or disease. Specialty dairy products should have process dairy products under regulated and safe practices to ensure that the product is safe for human consumption.

IS IT PROFITABLE TO BE IN THE SPECIALTY DAIRY INDUSTRY

Various studies and surveys have been done on the consumer preferences and what they are willing to pay for specialty cheeses. The information available is primarily from four types of studies as Nicholson and Stephenson state (2006). Surveys, descriptive case studies, studies of market potential or willingness to pay, and ex ante assessments are the four types of studies usually conducted, but limited information on the financial performance of the actually processor of the specialty products are out there.

A recent survey done by the American Cheese Society found that 71% of the respondents manage and milk their own animals (Cheese Reporter, 2013). In the survey conducted there were 211 artisan, specialty, and farmstead cheese makers that responded to the survey. Out of the 211 respondents, 62% of them were ACS members. Sixty-three percent of them use cow's milk to process their cheese, 56% use goat's milk, 17% sheep's milk, and only 2% use buffalo milk (Cheese Reporter, 2013). Thirty percent used more than one type of milk on their operation and 19% made cheeses by mixing different types of milk (Cheese Reporter, 2013).

According to the American Cheese Society survey, 59% of participants describe their production practice as organic but, only 10% are actually certified organic (2013). Processors that described themselves as organic tended to be smaller operations that were producing 25,000 pounds of cheese or less (Cheese Reporter, 2013). This seems to be a marketing gimmick to persuade consumers into thinking their ways of practice are organic even though they are not certified. In order to market a product as organic it should be certified organic.

Most of the businesses that were surveyed produced more than one type of cheese. Aged and fresh cheeses are the most common types of artisan, farmstead, and specialty cheese produced (Cheese Reporter, 2013). The survey also evaluated how many pounds of cheese were produced in a year. Seventy-one percent of the respondents produced 25,000 pounds of cheese or less annually (Cheese Reporter, 2013). Cheese makers that produce less that 100,000 pounds of cheese per year were more likely to produce cheese with raw milk while operations that produced more than 100,000 pounds of cheese were less likely to produce cheese with raw milk (Cheese Reporter, 2013). This could be due to the health risk issues involved with producing raw milk cheese.

Processors making more than 100,000 pounds of cheese might want to be more cautious because of the liability risk associated with raw milk dairy products. The survey by the American Cheese Society is one of many different surveys that can be administered about the production of specialty cheeses. On the contrary to many other surveys about specialty dairy products, this survey reports financial information about specialty cheese production instead of the usual survey of consumer preference.

Descriptive case studies are known to a sense as just a formal descriptive discussion with and individual farms or small cooperatives of their processing enterprise. These types of discussions usually never discuss the actually profitability and financial performance but more along the lines of farm characteristics, product lines and the types of customers that by their product (Hulcoop, 2003; Ebel, 2002). In most cases this information is usually in newsletters or articles conveyed to an agricultural audience the is interested in local and value-added opportunities (Morrison, 2001a; Ebel, 2002; Estrada, 2002). These types of studies really do not do anything to describe financial performance but rather potential considerations to other processors (Nicholson and Stephenson, 2006).

Studies of market potential and consumer behavior examine the specialty dairy industry by "exploring size of the market, perceptions of consumers or retailers about new, farm-processed dairy products, or competitive assessments of how easily new businesses can enter dairy processing" address Nicholson and Stephenson (2006). The University of California conducted a market potential and consumer behavior study to examine the market the marketing strategies of specialty cheeses. This study was driven by the consumer's preferences and what they want to know about the product in order to establish information of the potential growth.

The last example is ex ante analyses, which is a forecast on budgeting approaches or economic engineering methods (Nicholson and Stephenson, 2006). These are often predicted assumptions and analyses done prior to the initial business endeavor (Nicholson and Stephenson, 2006). An example of this type of study was one the Novakovic (1986) and Novakovic and Alexander (1987) on the financial feasibility of on-farm ultrafiltration. This study was done to examine the economic impact of on-farm filtration and show the UF can increase storability of milk and reduce farm milk hauling charges. Novakovic concluded that UF would be more profitable for large farms at the time (400 cows) "when cost savings to cheese plants are larger and shared to a greater extent with farmers (1986). A more recent study my Stephenson (1998) suggests UF usage on farms is only profitable for farms with 7,000 cows located in low milk price areas. This suggests that UF is not feasible for most dairy producers. Ex ante analysis usually on focus on the costs of processing and suggests that after the face financial performance of on- farm processors would be "a useful complement to existing information" (Nicholson and Stephenson, 2006).

Those are usually the studies found but in a latter study done by Nicholson and Stephenson, they analyze survey collection and actually statistical analysis of the financial performance of small on-farm processors in New York, Vermont, and Wisconsin.

Financial Study of On- Farm Processing

Charles Nicholson and Mark Stephenson performed a study on the financial performance of value-added dairy operations in New York, Vermont and

Wisconsin by survey data collection and statistical analysis of a total of 27 on-farm processing or farmstead businesses in the three states. Seven farms were from New York, 12 in Vermont and 8 businesses were in Wisconsin (Nicholson and Stephenson, 2006). The value-added dairy operations processed milk from cows, goats, and sheep. The most common product that on-farm processors produced was cheese, followed by fluid milk products and yogurt (Nicholson and Stephenson, 2006). Ice Cream, butter or cream were produced in addition to a main product (Nicholson and Stephenson, 2006).The sample size was very small in this study and needs to be taken into consideration when evaluating the study results. The type of data collected from each business included farm receipts and expenses, processing enterprise receipts and expenses, farm and processing assets and liabilities, labor provided by the owner operator, family members and hired labor for the farm, processing or marketing (Nicholson and Stephenson, 2006). The participants also provided information about the sales of their products and what prices they were getting and various outlets and markets (Nicholson and Stephenson, 2006).

The key objective in performing this study was to determine the actual financial performance of on-farm processing (Nicholson and Stephenson, 2006). Nicholson and Stephenson were trying to evaluate on farm processing on the financial scale. This study was able to grasp the actual economic background of farmstead products instead of the usual analysis of customer preference. Nicholson and Stephenson constructed many different figures, but the key analyses of their research included a net income statement for the farm enterprise, the processing and the overall business, a per-hundredweight income statement, and the calculation of costs and returns per-hundredweight of milk (Nicholson and Stephenson, 2006). When Nicholson and Stephenson gathered all their information about each business they were able to construct an average from all the data.

Although this study was a small sample size it gave insight into the financial situation of farmstead processing.

In the results of this study Nicholson and Stephenson found that the average milk production was about 600,000 lbs. per year, and about 11,500 lbs. per cow per year (2006). For on-farm processing for cows more than half the milk was sold rather than processed on farm (Nicholson and Stephenson, 2006). For goat and sheep milk producers only about 15% of milk was sold to other processors (Nicholson and Stephenson, 2006). The average for the total number of years that all the on farm processors was 6 years (Nicholson and Stephenson, 2006). Seventeen had been processing for three years or less while six of the on-farm processors had been processing dairy products for more than 10 years (Nicholson and Stephenson, 2006).

For the farming side of the operation the major income come from raw milk sales and transfer value to processing. The farm net income for cow's milk producers averaged about $15,000, and was negative for the goat and sheep producers (Nicholson and Stephenson, 2006). Sheep and goat producers were on average -$13,000 (Nicholson and Stephenson, 2006). For the on-farm processing side the main source of revenue was the sales of dairy products (Nicholson and Stephenson, 2006). The range of all the collected data from business to business varied significantly. For cow's milk processor the range of the overall net income was $300,000 (Nicholson and Stephenson, 2006). The overall net income for cow's milk processors ranged from -$150,000 to $190,000 (Nicholson and Stephenson, 2006). Out of all 27 businesses surveyed, 20 fell in the range of the overall net income between -$50,000 to $50,000 (Nicholson and Stephenson, 2006). Overall, in this study a conclusion was made that it is relatively difficult to run and manage both a farm and a processing enterprise with both being in positive revenue. Out of all the

businesses evaluated only one of them earned a positive net income for both the farm and the processing enterprises (Nicholson and Stephenson, 2006).

A question to be asked and observed would be what are the factors the affect the pattern of having at least one of the enterprises being in a negative net income? Nicholson and Stephenson came up with some variables when conducting their financial analysis that could explains the patterns of the net income on on-farm processing dairies. Processors with experience had much larger net income from those with only three years or less experience. Another, factor established was whether a dairy made a transition from a traditional dairy to an on-farm processing dairy, or if the on-farm processing dairy was built from scratch from the ground up. Surprisingly, the net income for a transitional dairy was significantly lower than the dairy that was built from scratch or "new" (Nicholson and Stephenson, 2006). Another factor that was found was the pricing of the product had a significant outcome on the overall net income. The processing net income suggests that the value per cwt. of milk processed should be around $100 (Nicholson and Stephenson, 2006). That implies the dairy products produced should be about $10 per pound and approximately $8.60 per gallon of milk on order to generate the income to cover the costs (Nicholson and Stephenson, 2006).

When looking at income statement per hundredweight in their analysis, Nicholson and Stephenson were able to establish the difference between on-farm processing goat and sheep dairies versus on-farm processing cow dairies. They evaluated elements of the income statement per cwt. to establish an additional perspective of on-farm processing. According to Nicholson and Stephenson, on average the on-farm processing dairies in New York had a larger total farm receipts per cwt. of milk produced than 201 New York dairy farms under the DFBS (2006). The total farm receipts per cwt.

or milk is calculated by the value of raw milk sales plus the transfer value of milk used in processing (Nicholson and Stephenson, 2006). DFBS stands for Dairy Farms Business Summary and Analysis. DFBS is a system that can help a dairy farmer establish its business and analysis its financial records. DFBS also allows New York dairy farmers to be able to compare their benchmarks for their business against other business established in the DFBS program.

The difference was approximately $10.76 more per cwt. for on-farm processors than for DFBS in 2003 (Nicholson and Stephenson, 2006). Although the milk receipts per cwt. were higher, the operating expenses for on-farm processors was much more expensive. After the expenses were accounted for, DFBS farms net income per cwt. was positive and on-farm processing were in the negatives (Nicholson and Stephenson, 2006). Milk receipts for the goat and sheep operations were even higher than cow's milk receipts per cwt., but when factoring the small amounts of milk given by goats and sheep, and the feed and labor expenses the average net incomes for goat and sheep operations were highly negative (Nicholson and Stephenson, 2006).

Although the farm enterprise net income per cwt. for on-farm goat and sheep processors were in the negative, the processing net income per cwt. for goat and sheep processors had a positive income. Goat and sheep processors received on average nearly double of the processing net income per cwt. over dairy cow processors (Nicholson and Stephenson, 2006). Dairy cow processors were in the negative.

Many factors and variables were considered and analyzed in Nicholson and Stephenson's study on financial performance of value-added dairy operations. Conclusions were drawn from this study about from the many different areas of the financial statement analyzed. There are ways that a value-added business can be

profitable, but different aspects should be evaluated first before starting a value-added business such as on-farm processing.

Location of Production of Specialty, Artisan and Farmstead Dairy Products

Location of the specialty, artisan, or farmstead operations is key in the different factors in production. Deciding what state to operate in is a factor to specialty, artisan, and farmstead producers but also, the location within that state is a key factor. For smaller cheese plants it seems to be wiser to establish a business in the Midwest or East. Due to the continuous pricing crisis of milk over the years, especially in California because of the different class prices of milk marketing orders, establishing a business in the West seems to be harder than establishing a specialty, artisan or farmstead dairy product operation in the Midwest or East.

California is a much tougher area to start a specialty, artisan, or farmstead business, as is any other business trying to establish its roots in California. Although California is thriving in producing commodity cheese products, specialty, artisan, and farmstead cheese makers are having trouble making ends meet and stay financially stable. Milk prices in the west are lower, land costs and delivery costs are higher, less experienced personnel are harder to find, and the plants infrastructures are no as well developed as they are in the mid-west and eastern part of the Untied States (Schiek, 2011).

It's hard to compare states to each other, especially ones that are in different milk marketing orders. According to William Schiek, an economist for the Dairy Institute of California, there are to many factors impacting cheese plant prices in Wisconsin that are not relevant to California cheese plants (2011). Wisconsin has made a major switch in the cheese industry. Instead of producing commodity cheeses they have been pushing the

production of specialty and artisan cheeses. This push is due to the competitive cheese production in the west. Wisconsin is a milk deficient state; where as California and other states in the west are not (Wisconsin Department of Agriculture, Trade & Consumer Protection, 2012). Wisconsin is not able to compete with the commodity cheese production that has now in recent years been happening in the west, so they have switched and the "cheese state" has pushed the production of specialty cheese.

For small dairy processing plants, Wisconsin has a number of factors that help plants operate in their state (Schiek, 2011). Since 2001, 25 new cheese plants have been established in Wisconsin (Schiek, 2011). Eleven of the twenty- five plants opened are farmstead operations (Schiek, 2011). This is an indication that smaller cheese plants are doing just fine paying for whey in their regulated price, something that California processors do not pay for (Schiek, 2011). Cheese plants in Wisconsin and other Mid-West states have a number of advantages that Western states do not.

First, Wisconsin cheese plants are closer to the eastern markets establishing a location advantage (Schiek, 2011). Secondly, dilute or concentrated whey from small and large processors are bought from companies that are able to make whey products (Schiek, 2011). This is an advantage that smaller specialty and farmstead processors in California do not get to enjoy benefits from. One major problem in California is experiencing is the pricing system in class 4b. Right now, processors do not have to pay for whey in the prices paid to producers. This is not a problem for large commodity cheese plants in California because, they are able to permeate their whey to produce whey concentrates and lactose (Nicholson, 2012). This is helpful for large processors, but not for small specialty or farmstead processors who are not able to permeate their whey into whey

concentrates because purchasing the system would be to expensive for their small plants (Schiek, 2011).

Wisconsin's specialty and farmstead cheese processors are able to make a profit from their whey because, local geography and density of cheese plants makes hauling whey aggregators short and less expensive (Schiek, 2011). The problem with hauling whey from small specialty and farmstead cheese plants is that plants are spread farther out in California, which generally makes the shipping price of whey to larger processing plants who are willing to take it infeasible because of the hauling costs. Thirdly, although in the Midwest the cost of producing milk is higher, the cost of producing cheese and whey is lower (Schiek, 2011). Also, in Wisconsin, more government programs are utilized to promote and establish the specialty cheese industry (Schiek, 2011). The Wisconsin Dairy Business Innovation Center, which worked hard on promoting Wisconsin's specialty cheese industry is an example of how the state and dairy industry have worked together to help establish the specialty cheese and dairy product industry (Schiek, 2011).

Finally, as stated previously, California is a hard place to establish and operate a newly founded business. A national news service recently ranked states on its respect to business environments (Schiek, 2011). Different factors were ranked including, the "cost of doing business" and "business friendliness"(Schiek, 2011). California was ranked near the bottom for both categories (Schiek, 2011). A majority of the most "business friendliness" and "cost of doing business" states resided in the Midwest (Schiek, 2011).

CONCLUSION

After writing this literature review it is evident that there are many factors to consider when establishing or running a specialty, artisan, or farmstead dairy business. In depth research should be reviewed before starting or transitioning over to processing a value-added dairy product. The specialty dairy products industry, which includes artisan, and farmstead dairy products is a growing industry and it is quite possible to have and run a successful business due to the demand of the product. Due to the lack of financial information on running a small specialty dairy product operation it is hard to draw a direct conclusion on whether it is profitable or not to enter into the specialty dairy product industry.

As stated by Nicholson and Stephenson, the value-added dairy processing industry is not a solution for struggling dairy farms (2006). If a dairy farm is transitioning over to an on-farm dairy processor it is more applicable to be financially stable. Also, being an on farm processors is ideal for the romanticized consumer view, but is actually very hard to run and operate because of the layers of complexity. On-farm or farmstead dairy processing requires running two businesses, the farm and the processing plant, plus the sales and marketing. In the financial analysis done by Nicholson and Stephenson, only 1 out of 27 on-farm processing business had a positive income for both the farm and the processing business (2006). This could be an indicator in going the route of producing specialty or artisan dairy products, which are produced in small batches but without the farms side. This makes it less of a struggle because there is only one business being managed instead of two. Also, on-farm or any other value-added dairy processor should consider not producing cheeses that will compete with low priced commodity cheese such as mild cheddar cheese.

Consumers are driving the demand for specialty dairy products because of the push in products being produced at a smaller, local scale instead of in large bulk. Although, specialty dairy products are sold at a higher price than commodity products the cost of production is much higher and when establishing a value-added dairy processing business, many factors need to be evaluated before pursuing.

REFERENCES

American Cheese Society. 2011. Cheese glossary. Accessed Feb. 4, 2013. http://www.cheesesociety.org/i-heart-cheese/cheese-glossary/

Cheese Reporter. 2013. ACS survey finds most cheese makers manage own milk supply, use raw milk. 137:31.

Department of Agriculture, Food and Drug Administration Department of Health and Human Services. 21 CFR 131.112. Fed. Regist.

Dryer, Jerry. 2006 "The Specialty Cheese Business: Opportunities and Challenges for California Cheese Makers." Commissioned by California Milk Advisory Board. Print.

Ebel, Holly. 2002. Farmers Go Another Route to Produce "Artisan" Butters. Associated Press, September 14, 2002.

Ellerby, Justin. 2010. Challenges and Opportunities for California's Dairy Economy. California Center for Cooperative Development. Accessed Feb. 3, 2013. http://www.academia.edu/2533129/Challenges_and_Opportunities_for_Californias_Dairy_Economy

Estrada, Richard T. 2002. People in Business: Tasty Cheese Takes a Farm. Modesto Bee, July 31, 2002. Accessed at modbee.com.

Food Processing Center. 2001. The specialty cheese market. Institute of Agriculture and Natural Resources University of Nebraska- Lincoln. Accessed on Feb. 2, 2013. http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1008&context=fpcreports

Foster, Richard. 2011. Cheese types, nutrition and consumption. Nova Science

Gloy, Angela and Mark Stephenson. 2006. A Value-Added Opportunity: Market Potential for Specialty Cheeses in Select New York Markets. Department of Applied Economics and Management, Cornell University. [EB 2006-01]

Gomes, Sharlene. 1995. 100 years 1895-1995.Danish Creamery Association. Danish Creamery Association, Fresno, CA.

Greenberg, Laurie. 2005. Specialty cheese in Wisconsin: opportunities and challenges. UW- Madison Center for Integrated Agricultural Systems. Accessed Feb. 3, 2013. http://www.cias.wisc.edu/wp-content/uploads/2008/07/spcheeseweb1.pdf

http://datcp.wi.gov/uploads/Farms/pdf/VADI_media_fact_sheet.pdf

Hulcoop, Les. 2003. Town and Country Tour—A Success. *Dutchess Land & Living.* Cornell Cooperative Extension Dutchess County, November, p.7.

Hutchison, Mark. Specialty cheese report: executive summary. Food Processing Center

University of Nebraska-Lincoln. Agricultural Marketing Resource Center. Accessed Feb. 15, 2013. http://www.agmrc.org/commodities products/livestock/dairy/speciality-cheese-report-executive-summary

Lee, W.J., J.A. Lucey. 2010. Formation and physical properties of yogurt. Asian-Aust. J. Anim.Sci. 23:1127-1136.

Morrison, E. M. 2001a. Bottle at Your Own Risk. *AURI Ag Innovation News,* pp. 4 and 12, April 2001, Waseca, MN: Agricultural Utilization Research Institute.

Nicholson, Charles, Mark Stephenson. 2006. Financial performance and other characteristics of On-Farm Dairy Processing Enterprises in New York, Vermont and Wisconsin. Department of Applied Economics and Managements.

Novakovic, Andrew M. and Craig S. Alexander. 1987. The Economic Feasibility of Ultrafiltration and Thermalization of Milk on Wisconsin Farms. Department of Agricultural Economics, Cornell University. [Report to the Wisconsin Milk Marketing Board]

Novakovic, Andrew. Potential Economic Implications of On-Farm Ultrafiltration. Paper Presented at the Northeastern Dairy Conference, Syracuse, NY, April 1986.

Publishers, Inc. NY.

Reed, Barbara A., Christine M. Bruhn. 2003. Sampling and farm stories prompt consumers to buy specialty cheese. California Agriculture. 57(3): 76-80.

Roadhouse, Chester Linwood, and James Lloyd Henderson. 1950. The Market-Milk Industry. 2nd ed. McGraw-Hill Book Company, Inc, NY.

Schiek, William A. 2011. June 30- July 1, 2011 Class 4a and 4b Hearing—Post Hearing Brief. Dairy Institute of California. Accessed Mar. 6, 2013. cdfa.ca.gov › Institute%20Post%20Hearing%20Brief.pdf

Slee, R. W. 1991. Farm Diversification and On-Farm Processing. *Scottish Agricultural Economics Review,* 6:39-49.

Sodini, I., F. Remeuf, S. Haddad and G. Corrieu. 2004. The relative effect of milk base, starter, and process on yogurt texture: a review. Crit. Rev. Food Sci. Nutr. 44:113-137.

Straete, Egil Petter. 2008. Modes of qualities in development of speciality food. British Food Journal. 110: 62-75.

Talaro, Kathleen Park. 2012. Foundations In Microbiology. 8th ed. The McGraw-Hill Book Company, Inc. New York, NY.

Tamime, A. Y. and R. K. Robinson. 1999. Yoghurt: Science and Technology. 2nd ed. CRC Press, Boca Raton, FL.

Tetra Pak. 2003. Dairy Processing Handbook. 2nd ed. Tetra Pak Processing Systems, Lund, Sweden.

U.S. Department of Food and Agriculture. 2012. The dangers of raw milk. The U.S. Food and Drug Administration Center for Food Safety and Applied Nutrition Food Information.

Vedamuthu, E. R. 1991. The yogurt story-past, present and future. Dairy Food Environ. Sanitation. 7:371-374.

Vedamuthu, E.R. 1991. The yogurt story: past, present and future. III. Dairy Food Environmental Sanitation. 6:310-311.

Werlin, Laura. 2000. The new American Cheese: Profiles of America's Great Cheesemakers and recipes for cooking with cheese.

Wisconsin Department of Agriculture, Trade & Consumer Protection. 2012. Information of the value added dairy initiative. Accessed Mar. 5, 2013.

Wisconsin Specialty Cheese Institute. Statistics. Accessed Feb, 20, 2013). http://www.wispecialtycheese.org/stat

APPENDICES

Table 2. Specialty, Artisan, and Farmstead Dairy Product processors

Name	Style and Variety of Products	Type of Milk
Ariza Cheese Company, CA	Mexican Varieties: Asadero Cotiga Cotija Molido Queso Blanco Queso Fresco	Cow
Bravo Farms Cheese , CA	Artisan Cheeses (All Styles) Cheddar (Original Chipotle, Raw Milk, Silver Mountain Clothbound) Edam (Whole Milk) Gouda (Dutch Style)	Cow
California Polytechnic University Creamery, CA	Baby Swiss Baby Swiss (Plain, Lowfat) Cheddar •Gouda• Natural Smoked Cheddar Natural Smoked Gouda Reduced Fat Baby Swiss Chipotle Jack Spicy Cheddar	Cow•

California State University Fresno Dairy Processing, CA	Cheddar (White & Regular) Fresh Curd Monterey Jack (Plain & Flavored)	Cow
Cowgirl Creamery, CA	Clabbered Cottage Cheese Crème Fraiche Fromage Blanc Pierce Point Red Hawk St. Pat Mt. Tam	Cow
Dairy Goddess Farmstead Cheese, CA	Fromage Blanc	Cow
Fiscalini Cheese Co. , CA	Cheddar (Bandage Wrapped) Cheddars (Flavored) Lionza Alpine Style Purple Moon CHedder San Joaquin Gold	Cow
Garden Variety Cheese, CA	Black-Eyed Susan Moonflower Beau's Blend Hollyhock Cosmos, Sheep Milk Yogurt	Sheep

Marquez Brothers International, Inc. , CA	Mexican Varieties: Asadero Cotija Manchego Queso Fresco Casero Queso Quesadilla Etc.	Cow
Shamrock Artisan Goat Cheese, CA	Plain Garlic Basil Dill Chives Black Pepper Jalapeno Chevre Feta Tome duCorbier Tomette Ashed Tomette Shamrock Bouchon Redwood Log	Goat
Sassy Cow Creamery, WI	Farmstead Bottled Milk	Cow
Alcam Creamery, WI	Butter	Cow
Vermont Farmstead Cheese Company, VT	Lille' WindsorDale Vermont Farmstead Cheddar	Cow

	Vermont Artisan Cheddar	
	AleHouse Cheddar	
	Spiced Edam	
	BrickHaus Tilsit	
Blue Ledge Farm, VT	Chevre	Goat
	Crottina	
	Dunmore	
	La Luna	
	Lake’s Edge	
	Riley’s Coat	
Lazy Lady Farm	Bi Partisan	Blend
	Condisend	
	Demi Tasse	
	Mixed Emotions	
	Sweet Emotions	
	Trillium	