

Growing the Pasture-Grazed Dairy Sector in Wisconsin

Summary of findings and recommendations



The vast majority of dairy cattle in the United States never see the outdoors while they're lactating. Over 50% of the milk produced in the US comes from just 1750 large farms, primarily in California, Idaho, New Mexico, and Texas.

In contrast, about 22% or more than 3000 of Wisconsin's dairy farmers use managed grazing. Can the unique features of milk from pastured cows contribute to the resurgence of an artisan dairy tradition?

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This report summarizes results of a four year study investigating the properties of the milk from pastured cows conducted from 2009 to 2012.

Partners include the Wisconsin Department of Agriculture, Trade, and Consumer Protection, PastureLand Dairy Cooperative, Uplands Cheese Company, Inc., and Cedar Grove Cheese, Chefs Leah Caplan and Jack Kaestner, and the University of Wisconsin Food Science, Agronomy, and Dairy Science Departments.

Why pasture-based dairy?

The North Central region of the United States has long had a strong dairy industry and is still home to seven of the top 10 states in numbers of dairy farmers. In today's global marketplace, the dairy industry in this region has struggled to compete with other regions that have advantages in high volume milk production. A good strategy for this region may be to capitalize on its strengths in value-added artisan products and pasture-based dairy.

A cow on pasture has become a rare thing in the American dairy industry. The vast majority of dairy cattle in the United States never see the outdoors while they're lactating. Over 50% of the milk produced in the U.S. comes from confinement farms with more than 1000 cows. All of this milk is produced on a total of just 1,750 farms, primarily in California, Idaho, New Mexico, and Texas (2007 Census of Agriculture).

In contrast, about 22% or more than 3,000 of Wisconsin's roughly 11,000 dairy farmers use managed grazing as their system for providing the bulk of feed for their cattle (Paine and Gildersleeve). In terms of environmental performance and profitability, these farms can excel. And as a number of farmstead processors have found, the milk from pastured cows is different from what Americans have come to consider "conventional" milk.

Can the unique features of this milk contribute to the resurgence of an artisan dairy tradition focused on high-value, specialty products? The emergence of several companies in the region that are successfully marketing grass-based products suggests that the answer is "yes." One key to supporting growth in this sector is to identify the unique properties of the milk from pastured cows and to explore the potential of developing premium products from this milk, which we will refer to as "pasture milk" throughout the report (as compared to "conventional milk" from confinement-fed cattle).

Wisconsin has a tradition of artisan, value-added dairy production. As a national leader in specialty cheese, producing 48% of the specialty cheeses in the U.S., it makes sense to build on this foundation. The longstanding pasture-based family farming tradition and existing relatively small scale, regional dairy processing expertise and infrastructure typical of this region can support this goal. In 2008, the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP) received a U.S.D.A. North Central Region Sustainable Agriculture Research and Education (SARE) grant to explore pasture-based systems as a source of "specialty milk" for value-added dairy processing.

Saxon Homestead Creamery:

A successful, pasture-based farmstead creamery

The Klessig family established Saxon Creamery in 2007 after a decade of planning. The successful multi-generational farm has been grass-based since 1989. Milking about 400 cows, the farm supports the families of Karl and Robert Klessig, as well as their sister Elise's family. Elise's husband, Jerry Heimerl, has taken on the cheesemaking while Karl and Robert concentrate on the cattle and pastures. The farm has been home to two previous cheese factories in its 160 year history. For this most recent venture, the family chose to purchase and renovate an empty warehouse in nearby Cleveland, WI for the cheese factory. Jerry has been aided in learning the cheese-making trade by a hired Master Cheese-maker. They started out with two cheeses and have plans for several more.





Cheesemaking: vats of pasture milk whey (top), conventional milk whey (bottom).

Preliminary research by Dr. Scott Rankin in 2005 showed that pasture milk produces cheddar cheese that has a creamier texture and a natural golden color that was preferred over cheese from confinement-fed cows in consumer taste testing (Rankin 2006). This project seeks to build on these initial results. To explore this opportunity, we took a value chain approach, bringing together pasture-based dairy farmers, processors, chefs, and researchers. Guided by this team, we have conducted a comprehensive investigation of the chemical and physical properties of this unique milk when made into cheese, butter, or other products. In addition, we explored the marketing and positioning of such products, conducting focus group discussions and consumer taste testing to assess consumer interest.

One thing that the project did not focus on was the so-called “healthy fats” that have been associated with pasture based meat and dairy products. Recent research on these fats (conjugated linoleic acid (CLA) and omega 3 fatty acids) has shown health benefits from their inclusion in the diet. Several studies have shown that milk and meat from animals grazed on fresh

pasture have higher levels of these fats than those on a stored feed diet that is high in grain. To date, however, no research has documented a direct link between consuming pasture milk products and health outcomes in humans related to these “good fatty acids” (Clancy 2006). In the meantime, we feel that the flavor, color, and texture of milk from pastured cows have great value in the production of artisan products and in the long run, will have a greater “staying power” in the marketplace. Thus, this project has focused on understanding the unique qualities of this special milk.

The overall goals of the project were to develop 1) a definitive understanding of the unique physical, chemical, and flavor qualities of grass-fed milk and 2) an ability to manage seasonal changes in pasture milk flavor and physical properties to improve processing quality. Over the long term, we seek to create 1) an increased awareness among dairy processors of the opportunities and appropriate uses for pasture milk and 2) a strategy for establishment of a premium market for pasture milk products.

Structure and Scope of the Project

This document summarizes results and analyses of four years of research investigating the challenges and opportunities of a pasture-based dairy market. The key sources for this report include:

- *Three years of research by chefs and University of Wisconsin scientists on the chemistry and culinary performance of pasture-based products.*
- *A series of interviews with pasture-based dairy marketing startups, summarized in a publication titled: Grass-based Dairy Products: Challenges and Opportunities (2009).*

- *Consumer taste panels conducted by UW Food Science.*
- *Two informal “tasting sessions” attended by self-selected pasture-dairy enthusiasts.*
- *A professional focus group conducted by Ady Voldedge Marketing Consultancy.*
- *A market research report created as part of this project (Caplan, 2009).*
- *A “Discovery Session” that brought together a group of 25 individuals from across the specialty dairy supply chain for a discussion on how to move the industry forward.*

Study Design and Research Methods

The research involved direct comparisons of pasture milk products with the same products made from conventional milk. We collected milk from five pasture-based dairy members of the PastureLand Cooperative (formerly Edelweiss Graziers of Belleville, WI) three times during the grazing season in 2009, 2010, and 2011. The farms were managed according to a protocol that required at least 60% of the animals’ diet be comprised of fresh pasture. The farms were required to have at least 1.5 acres of pasture per cow to ensure that all farms were able to remain on pasture for the duration of the growing season. All farmers fed a small amount of grain (five to ten pounds). No silage was fed.

The three sampling times coincided with the spring flush of pasture (May), mid-summer after pastures had been clipped and were in vegetative growth (July), and in fall, when cooler, moister conditions returned (September). Information on the sampling schedule and participating farms can be found in Appendix 1.

For the mid-summer sampling in each year, we also collected milk from a confinement farm for comparison. Batches of two to four dairy products were made at each sampling time. These included fluid milk, butter, yogurt, and cream. All products were made in the University of Wisconsin Food Science Department’s dairy lab by Dr. Rankin and his staff.

“All in all, I was quite amazed when working with the pasture products. It seemed like a completely different substance at times. Working knowledge of the products will help showcase these and other attributes. Some of the natural flavor affinities between cheeses and fruits, nuts, sweeteners and herbs should be looked at.”

Chef Jack Kaestner

The products were then compared side-by-side in three ways: analysis of the chemical composition, evaluation of consumer preferences, and investigation of cooking qualities. Dr. Rankin conducted testing to measure differences in chemical composition including fat, true protein, somatic cells, lactose, and other compounds that contribute to milk processing quality. Testing was also done on product physical properties such as texture, melting temperature, and color. Consumer sensory analyses were conducted on some of the samples as well. Samples were provided to the participating chefs for evaluation in culinary applications.

Market assessment. Three market assessment activities were conducted. The first was a market survey and report conducted by team member Leah Caplan. She conducted interviews with dairy processors, retailers, and consumers in the region to assess the interest in a “specialty milk” for value added products and explored in-store marketing opportunities for grass-fed products. A focus group was conducted by Ady Voldedge Marketing Consultancy, and our team held a “discovery session” involving local food industry leaders in the Madison-Milwaukee-Chicago area. Results are summarized in this publication.

Background

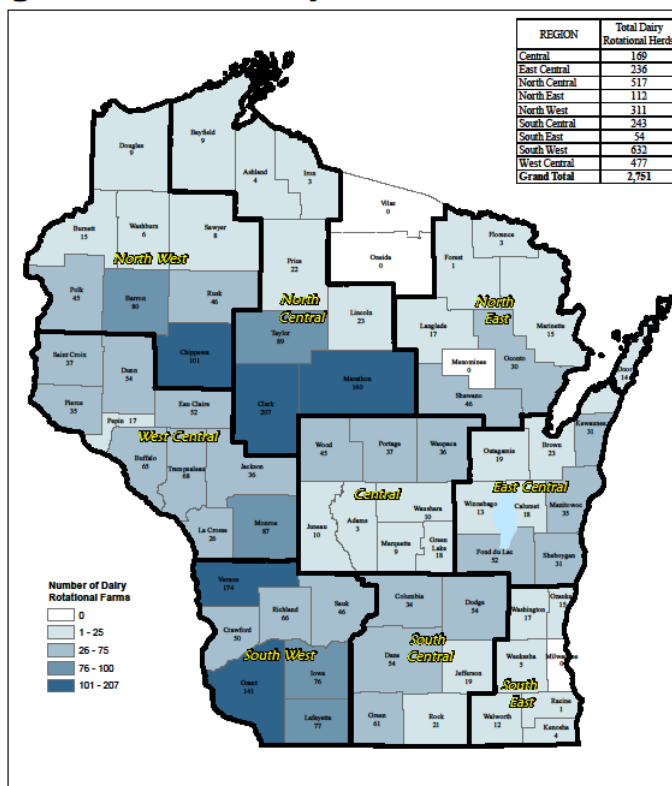
History of the pasture-dairy industry

Wisconsin has led the eastern United States in the adoption of managed grazing for over two decades. More than 22 percent of the state's dairy farmers use grazing as a primary source of forage (Paine and Gildersleeve 2010). Although there are concentrations of grass-based dairy farms in some areas, they are found throughout the state (Figure 1). As markets for grass-fed foods develop, entrepreneurial farmers in the Upper Midwest are working to capture a premium for grass-fed milk, cheese, and butter products. These farmers have experienced struggles and successes along the way to developing their products and markets (Paine 2009).

Farms using managed grazing can be environmentally sound (Paine et al. 1995; Lyons et al 2000) and profitable (Kriegl and McNair 2005). Studies have shown higher levels of some beneficial fatty acids (conjugated linoleic acid or CLA and Omega 3s) in dairy products made with milk from cows on managed pastures (Parodi 1994; Pariza 1997; Dhiman et al. 1999; Clancy 2006), but have not yet shown direct links between pasture-based dairy products and human health (Clancy 2006). While there is a small, but growing, number of health enthusiasts who are seeking out pasture-based products, health claims tend not to be strong selling points for the average consumers. In contrast, flavor is a selling point that can always be counted on (CIAS 2003; Pirog 2004). Studies have shown that grass-fed dairy products have different flavors, textures, and other characteristics compared to products made from the milk of conventionally fed cows (Bendall 2001; Couvreur et al. 2006; Rankin 2006; Martin et al. 2005).

The flavor of pasture dairy products appears to be affected by the unique characteristics of the climate, soils and forages of the places from which they originate. These unique characteristics are called *terroir*, a term first used in the wine industry. *Terroir* is considered the sum total of the local ambience, the factors that influence flavors and qualities of a food handcrafted in a particular place (Cazaux 2011). It is a concept that is gaining recognition in the food industry and among consumers (Black 2007). There is tremendous opportunity for local artisanal, pasture-based dairy producers to market premium products based on their unique, place-based flavors and textures (Scott Rankin, 2008 pers. comm.).

Figure 1. Distribution of Wisconsin grass-based dairy farms



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Wisconsin Department of Agriculture, Trade & Consumer Protection

What is Managed Grazing?

By Bert Paris, Dairy Grazier and Co-owner of PastureLand Cooperative (formerly Edelweiss Graziers Cooperative)

This seems like a simple question with a relatively simple answer. However, if you have 12 people in a room and their areas of expertise include a cheese-maker, a food scientist, dairy and crop professors, Extension, ag marketers and veteran grass dairy farmers, you may get six different definitions. That was one of the first obstacles we faced in starting our pasture based versus conventional milk project. What we needed to ask was how does the grass intake affect the character of the milk?



Everyone in that room has seen Management intensive Grazing (MiG) in action or has a basis for how it works to create pasture grazed milk. The basic idea of MiG is to put cows on a subdivision of the pasture to consume the forage and then get them off of that “paddock” within three days. When the grass has re-grown to approximately 12” in height, or about 30 days of growth, we return the cows to that paddock to harvest the fresh forage. This process is repeated throughout the growing season. However, it was when different people started to explain their process of a MiG operation for pasture grazed milk that we started having questions.

What should or shouldn't be in the ration of a cow producing pasture grazed milk?

Can we feed them corn and/or hay silage? If we do feed silage, how much can they get in a day? Can we feed hay and if so how much? Can cows be fed grain and how much? If a cow is eating 60% stored feed and 40% pasture, is the milk “pasture grazed”?

All of these questions have made for some very interesting debate. It also made us realize that there is no definition of pasture grazed milk. Eventually we came to a consensus on a definition for the milk we wanted to use. Our “pasture milk” had to have a minimum of 60% fresh pasture in the cow’s daily diet. We chose this so the milk would be predominantly grass by makeup. Silages were not allowed because of the effect it would have on the flavor of the pasture milk. We chose to allow grain in the cow’s diet because this type of supplement is common among pasture based dairy operations in the region.

By answering our initial question: “What is Managed Grazing?,” we answer two more important questions in our study:

1. While people understand the concept of MiG, the way farmers implement the practice can vary greatly.
2. What makes up a pasture-grazed, grass-based or grass-fed dairy product, is still open to interpretation.

In conclusion, we may find out that it is the consumers’ wallet that eventually defines a grass dairy product.

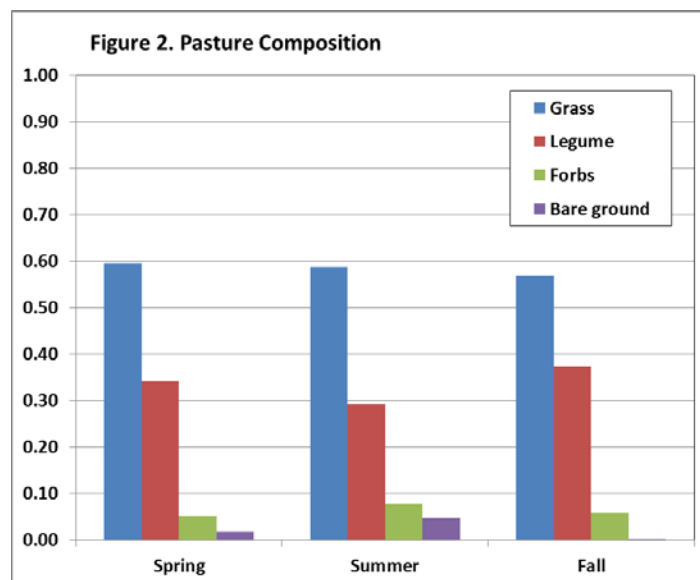
Flavor and culinary characteristics of pasture milk are not well defined, but many recent anecdotal observations among makers of many artisan dairy products have confirmed flavor, chemistry and physical differences in products made with milk from pastured cows. The goals of this project are to explore the chemistry and culinary characteristics of these products and assess the potential for a market for pasture milk as a specialty ingredient for artisan dairy products.

Research Results

Pasture Characteristics

Pastures on the five participating farms were sampled prior to each milk collection in late spring, mid-summer, and fall in 2009, 2010, and 2011. Pasture composition was consistent across years and within each season. Depending on the time of year, pastures were 55 to 60% grass, 29 to 37% legume, with the remainder comprised of broadleaf weeds (Figure 2). Legume content was lowest in midsummer at 29% and higher in spring (34%) and fall (37%). Primary grass species included orchardgrass (45% of grasses), with smaller amounts of Kentucky bluegrass, quackgrass, smooth brome, and timothy. Ladino clover comprised 54% of legumes, with red clover and alfalfa also present. Dandelions comprised 70% of the broadleaf plants in the pastures. Other broadleaves present included curly dock, burdock, plantain, thistles, and Queen Ann's lace. Most of the pastures contained ten or more species. We found no evidence that specific pasture species have an

Our research suggests that a dense, diverse pasture with many species heightens what Dr. Rankin describes as the “grassy note” that we observed in the pasture milk.



influence on the flavor of the milk, although there is anecdotal information suggesting that strongly flavored plants such as wild onions or mustard species can impart “off-flavors” in milk. This research suggests that a dense, diverse pasture with many species heightens what Scott Rankin describes as the “grassy note” that is observed in the pasture milk.

General Product Characteristics

Products made from pasture milk are yellower in color, softer in texture, and have been described as having a more “complex” flavor and a stronger “dairy aroma” than conventional milk. Milk is a complex product with more than twenty fatty acids and potentially thousands of volatile compounds contributing to flavor, aroma, and texture. Differences in color, texture, melting point and other attributes have been quantified between pasture-grazed and conventional milk, but pinpointing specific sources for those differences may elude us in the end. We have concluded that it is unlikely that a single compound or “smoking gun” that explains the differences will be identified. Perhaps determining the cause may not be nearly as important as characterizing these differences and qualities, and assessing how best to use this unique product.

The product characteristics section below combines comments and information from both laboratory analysis of products and chefs' evaluations and other observations from working with these products for three years.

Color

The most obvious characteristic of milk from pastured cows is the color. There is a creamy tone to the pasture milk as opposed to the more pure white that the public has become accustomed to, and many people expect, in conventional milk.

Chef Jack Kaestner notes that, in general, a yellower color was noted in all pasture milk products when compared to conventional products, with color intensity increasing from milk to yogurt to cream to butter. This suggests that the pigment is in the butterfat and, as water is removed and the fat becomes concentrated in products, the color gets yellower. In informal tastings of pasture butter with various groups, Chef Jack has often heard the comment, "That is what butter use to look like." The chefs also observed that in many finished baked products, the items made with pasture butter had a more appetizing look and golden hue. The browning action was excellent in terms of appearance and flavor as will be noted later.



Clockwise from top: PastureLand butter, Pasture butter from our project, two conventional butters, Organic Valley pasture butter.

By the third year of the study, Chef Jack had developed an eye for that deep hue in butter products and observed subtle changes even in commercial "conventional" butter. When melting butter in large quantities (15 pounds per week) in the restaurant where he was Executive Chef, he noticed that it had a very deep hue even though it was not labeled as pasture butter. Since it was late July, it could have been from conventional cattle being grazed during the summer months, which is very common in Wisconsin. For about five weeks, the butter was deep yellow; then it slowly lost that deep rich hue going into fall and winter.

Axis	Pasture butter	Conventional butter
L	92.87	96.97
a	-3.07	0.25
b	19.74	2.38

The scientific assessment of color in this study was conducted using an instrument called a colorimeter. In essence, the colorimeter assays reflected light from the surface of the material and assigns values to that reflected light based on a three dimensional space. The space is defined by three axes, 'L', 'a' and 'b'. The 'L' axis is regarded as a lightness scale running

from 0 (black) to 100 (pure white). The 'a' axis has a central value of zero and depicts hues running from green (negative 'a' values) to red (positive values). The 'b' axis also has a central value of zero and depicts hues running from blue (negative 'b' values) to yellow (positive values).

Table 1 displays the L-a-b values measured for pasture versus conventional butter assayed using a colorimeter. In general, the pasture butters are darker (lower 'L' values), are higher in green hues (more negative 'a' values), perhaps from the presence of chlorophyll, which is a green pigment in live plants, and are substantially more yellow (much more positive 'b' values).

The color of pasture dairy products appears to be dictated by the concentrations of β -carotene and other compounds and pigments, deposited into the lipid phase of the milk from the cow's ingestion of green, grassy materials. In fact, the research determined that concentrations of β -carotene, a yellow pigment, were substantially higher in the grass-based butters (Table 2), even in winter when the cattle were on a dry hay diet. β -carotene is a precursor of Vitamin A and may contribute to the nutritional value of pasture milk.

Because β -carotene is a fat-soluble compound, the color is concentrated in butterfat, making pasture butter so yellow that it reminded some of the participants of the artificial yellow color of margarine. Modern conventional butter is almost white because of the lack of fresh pasture in most cows' diets. Conventional butter has color added, which contributes to uniformity of color from package to package. Pasture butter is likely to be variable in color depending on when it is made during the growing season. Consumer education may be needed to get people comfortable with this variability. The intense yellow color contributed positively in products such as cheeses, with the pasture-milk cheeses exhibiting a warmer, more golden hue than those made with conventional milk.

Table 2. β -carotene content of butter from cows under different feeding regimes

Animal diet	Beta-Carotene (mg/100 gm)
Conventional	0.116
Pasture butter-fall	0.541
Pasture butter-winter	0.521



Melted pasture butter (left), conventional butter (right).

Texture

This and other research suggest that the relative proportions of the many fatty acids differ between pasture milk and conventional milk. The kinds and proportions of fatty acids influence texture in dairy products, with butter being influenced most obviously. Less pronounced effects were observed for other products such as cream and yogurt.

Although not documented through testing, the chefs observed that pasture butter seems to maintain a more stable texture and consistency over a broader range of temperatures than conventional butter. Both chefs reported finding it softer at refrigerator temperatures, making it easier to work with in pastries

without fracturing. The proportions of various fatty acids differed between pasture milk and conventional milk in this study, but no pattern of differences explained the physical texture differences that were observed (Appendix 2).

Chef Jack observed that the texture of the pasture dairy products was different from the conventional ones, but how they differed depended on the product being compared. For example, pasture milk crème fraîche was thicker and created a creamier sensation on the tongue when compared to that made with conventional milk. In making a classical French Beurre Blanc or butter sauce, the pasture-based butter sauce was more viscous after being made and in coating food items. Both chefs observed that pasture butter tends to be more pliable than conventional butter, especially at refrigerator temperatures as noted above.

For some recipes, it is important to pay attention to keeping the butter well chilled before and during production of bakery items, especially in laminated doughs like croissants. For these recipes, the pasture butter was easier to work with. Conventional butter is firmer and less pliable at refrigerator temperatures, making it more difficult to work/roll/shape these pastry doughs. We observed that pasture butter maintains its shape and doesn't break (or lose its emulsion) as readily at room temperature. The pasture butter is soft, pliable, and stable at room temperature, so it doesn't need to be ice cold when making pastries. If it is chilled, it is easier to work with because it isn't as brittle.



Cupcakes with buttercream frosting made with conventional butter (foreground) and pasture butter (rear).

“When serving a cake frosted with conventional buttercream, it is a delicate balance between being too soft and beginning to melt and deflate or too cold, hard and brittle. The buttercream made with pasture butter was light and silky across a broader spectrum of cool and warm temperatures.”

Chef Leah Caplan

Buttercream made with pasture butter seems to have a more satiny texture, carries the flavorings well, and finishes well in the mouth. In making classic buttercream, conventional butter needs to be at room temperature so that when it is introduced into the warm meringue, it doesn't get too hard too quickly. It must be whipped until it is thoroughly cooled and stable. Because of its more pliable texture, the pasture butter can be added at a cooler or lower temperature, thus hastening the cooling and keeping the mixture more stable. When serving a cake frosted with conventional buttercream, it is a delicate balance between being too soft and beginning to melt and deflate, and being too cold,

hard, and brittle. The buttercream made with pasture butter was light and silky across a broader spectrum of cool and warm temperatures. Cookie dough made with pasture butter was more crumbly before baking. After baking, the chocolate cookies seemed to dry out more quickly, while short bread cookies had a very agreeable crumbly texture and flavor.

Texture of foods is a complex phenomenon with numerous sensory attributes (e.g. gummy-ness, hardness, crispness, etc.) affected by numerous chemical and physical properties. With pasture dairy products, differences in texture were more noticeable in products with higher milkfat content, such as butter. Hardness of butter was measured using a common instrumental assessment of food texture called the Warner-Bratzler Shear Force Procedure. This method involves determining the peak force required to cut or deform the product. The force is displayed in “g” or grams of force required to

penetrate the product. The harder the product is, the greater number of grams of force it will take to penetrate the surface.

The structure of the final dairy product differs as a result of processing. The structure of ice cream, cheese, and butter are very different. Our research suggests differences in structure not only between product types, but in the same dairy product made from pasture milk versus conventional milk. A most significant textural feature is the softening of pasture butter as the temperature increases. The texture of butter is greatly dependent on the ratio of solid to liquid material or “solid fat index.” As the butter is heated, the solid material melts, the ratio shifts in favor of the liquid fraction and the butter is texturally softer. Thus, when evaluating butter for texture, it is important to evaluate it at several temperatures, such as refrigeration and room temperature.

Table 3. Hardness of butters made from pasture milk or conventional milk at room and refrigeration temperatures.			
Refrigerated		Room temperature	
Pasture	Conventional	Pasture	Conventional
68,000	69,000	2200	5300

At refrigeration temperatures, there was little difference in hardness values, however, at room temperatures, the pasture butters were substantially softer than the conventional samples (Table 3). Such differences are thought to be the result of changes in fatty acid and triglyceride structures. In general, a more liquid or softer structure is indicative of smaller, more unsaturated fatty acids and smaller, potentially more heterogeneous triglycerides. The practical implications of this softening phenomenon reside in the functionality of the butter in culinary applications (such as baking) as well as in other foods where milkfat may contribute part of the structure, such as ice cream, cheese, or butter.

Aroma

Cooperating chefs observed a unique aroma when working with pasture milk products. Chef Kaestner states, “As standalone items, the pasture dairy products had varying degrees of more intense smells. Common adjectives used by colleagues included more dairy smell, creamier, and more buttery smell. This was also noted during handling. When mixing doughs, creams, and buttercream, more intense dairy aromas were noted for the pasture products. One example of the intense aroma was when whipping pasture-milk cream. The cream literally filled the kitchen with this incredible cream aroma. Another time, we were amazed when mixing the different butter creams. The kitchen literally smelled more like butter when the pasture butter was used, while the conventional butter cream smelled more of the added vanilla flavoring. Finished items also seem to carry the enhanced “dairy smell.” We observed this in pancakes, cookies, pastries and pie doughs.”

“This is what butter used to look like”

When I conducted informal tastings with groups I often heard the comment “That is what butter used to look like.” During the third year of the study, I had developed an eye for that deep hue in butter products. I noticed when melting some butter (15 pounds-- which I do on a weekly basis) that it had a very deep hue even though it was more of a commodity-type butter. Since it was late July it could have been from conventional cattle being grazed during the summer months, which is very common in Wisconsin. It lasted for about five weeks before that deep rich hue slowly faded.

Chef Jack Kaestner

Anyone working with milk from a grazing dairy will most likely note the distinctive aroma. Historically this aroma has been noted most significantly in products manufactured in the spring season when cows first returned to pasture after winter confinement feeding. To some, this aroma is a great complement to dairy foods and reminiscent of grazing practices. To others, this grazing aroma competes with the

clean, bland notes manifest in conventional dairy products. In general the aroma is subtle, yet distinctive and fairly consistent in intensity over the grazing season. Numerous labs have worked to identify the chemical cause of grazing aroma. Some thought was aligned with the presence of a category of naturally-occurring alkyl phenol compounds; more recent work on this subject has not been as conclusive. Nonetheless, work published on this subject has yet to definitively characterize the chemical cause of grass aroma. It remains one of several aroma mysteries.

Regardless of its elusive origins, some work has been conducted on determining the consumer response to pasture flavor in dairy foods. In general, the blander the background flavor of the product, the more significant the impact of the “grassy note.” This work is described in the section below on consumer sensory testing.

Flavor

Probably the most significant difference observed between the pasture milk products and conventional milk products is the flavor. While hard to quantify or describe, tasters easily distinguish what Dr. Rankin has termed a “grassy note” in the pasture milk. It is a more complex flavor according to the tasters, compared to a simple, cleaner flavor for conventional milk. This flavor, not surprisingly, works well in some foods and less well in others.



“Sometimes conventional butter or cream enrobes or masks flavors in recipes using herbs, onion, or garlic, but the pasture butter seems to bring out those green, herbal, grassy flavors—it’s a beautiful marriage.”

Chef Leah Caplan

In general, pasture dairy products seem to contribute a more intense dairy or cream attribute to foods. It is most notable when recipes are compared side by side. Even the buttermilk generated from the butter-making process gave a creamier note or flavor to pancakes when incorporated in as an ingredient.

Pasture milk products also enhance and brighten herbal, onion, and vegetal flavors. A ranch-style dressing of yogurt, chives, dill, salt, pepper, and mayonnaise was much livelier when made with pasture yogurt than with conventional yogurt.

Chef Jack differentiates between pasture butter characteristics based on how it is used, either by itself, in its raw form or when it is an ingredient in a food product. The pasture butter by itself has a fuller flavor than conventional butter. The “grassy note” seems to hit you in the upper middle palate while the overall butter flavor lingers in your mouth. In contrast, the conventional butter flavor dissipated quickly.

Pasture butter also lends itself very well in compound butters (softened butter that has had flavorings such as herbs, spices or citrus added to it). The flavors carry through on tastings even with smaller amounts of seasonings added. Combining the butter with shallots made for a wonderful flavor combination. Chef Jack notes that many classical French dishes use butter and shallots together.

In items where butter was incorporated into a food product there seemed to be a flavor enhancing effect. Chef Jack likens it to an *umami* effect. He describes it this way:

- A good example is browned butter with sage and garlic over pasta, which is a very classic Italian dish. With the conventional butter, this dish is good, but with the pasture butter the dish just “pops” in your mouth. The brown butter and sage were much more intense. The browning action really adds a “nuttness” to dishes made with pasture butter.
- A second example is when raw butter is swirled into a sauce right before serving. This is another classical French technique. Here again, the conventional butter was good in this type of recipe, but the pasture butter really made the flavors pop. A shiitake mushrooms sauce was most striking.
- A third example is in a classic French buttercream. The conventional was good, but the pasture butter recipe just seemed to have more overall flavor and married well with the vanilla.

Umami, a savory taste, is one of the five basic tastes, together with sweet, sour, bitter and salty. A loanword from the Japanese, umami can be translated "pleasant savory taste". The human tongue has receptors for L-glutamate, which is the source of umami flavor. For that reason, scientists consider umami to be distinct from saltiness.

<http://en.wikipedia.org/wiki/Umami>

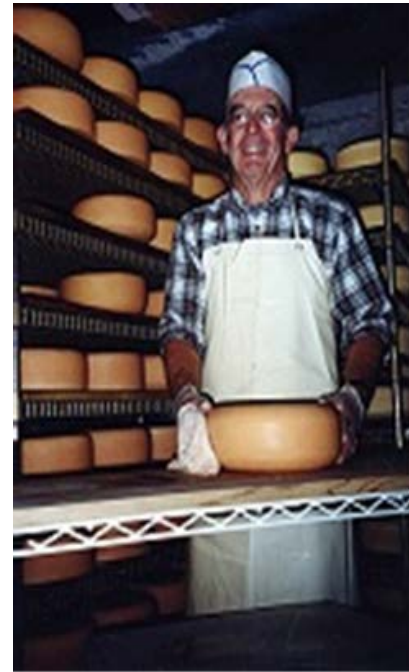
Chef Jack relates that when he was just starting out in his career as a chef, he wondered what the big deal was about simple French dishes like Chicken Kiev, but when he uses pasture butter in the simple sauces for such dishes, he understands how they gained their prominence in the culinary world.



Pasture composition and cheese flavor

By Mike Gingrich, Uplands Cheese Company

The relationship between pasture quality and cheese flavor was well known to consumers and cheesemakers years ago when all cheese was produced on farms and all cows were pastured. When cheese factories became the norm and most cows were kept in confinement and fed machine harvested feeds, the knowledge of the relationship of pasture quality to cheese flavor was lost. Cows' natural diet is fresh pasture grasses and they have evolved to be very selective when they graze, seeking out those grasses that are most palatable and nutritious for them. This natural selectivity yields milk with flavor properties that, when expressed in finished cheeses, has exceptional flavor complexity and intensity. In our experience with Pleasant Ridge Reserve, our alpine style cheese, when pastures are stressed, there is little for the cows to select from and cheese quality suffers. When pastures are lush with many species at ideal stages of growth for the cows to pick through, cheese quality is at its best.



This observation was not a surprise. Many books describing cheeses and how they are made, make the same point. To quote a French book, *Guide to Cheeses*, written by Pierre Androuet in the first half of the 1900's, "...there are three special moments within the pasturing season when the cows give milk that can make the best cheeses truly sublime. These three moments correspond to: 1. The sprouting of the grass, 2. The prime flowering of the meadows, and 3. The second growth of grass." All three of these stages are when the pasture forages are growing vigorously, not yet having reached maturity. We manage our pastures so each day the cows have pasture available at this lush stage when the pasture grasses are optimum from a cow's point of view. Their natural grazing selectivity yields milk from these pastures that makes cheese "truly sublime" in the words of Pierre Androuet.



Cows don't always select the same species of grass but rather will select those grasses that are at the stage of growth that is most palatable to them. When released into a new pasture, cows will slowly wander through the pasture grazing those grasses they find most palatable. After an hour or so of grazing, they will lie down and chew their cud for another hour or so and then get up and repeat the cycle of grazing and resting. They will do this repeatedly as long as they have pasture available. We leave them on a pasture until they have grazed about half of the available forage and then move them to a new pasture letting the old one regrow. This way cows always have the most palatable grasses available to them. They never have to eat the grasses with less palatability which would dilute the flavor complexity and intensity of the finished cheese. Managing pasture quality and only making cheese when pastures are at their best and most diverse yields cheese flavors that are unattainable with conventional milk.

Other culinary observations

Chefs Leah Caplan and Jack Kaestner have been involved in the project since the beginning and have become very familiar with pasture products. Their observations can be summarized as follows:

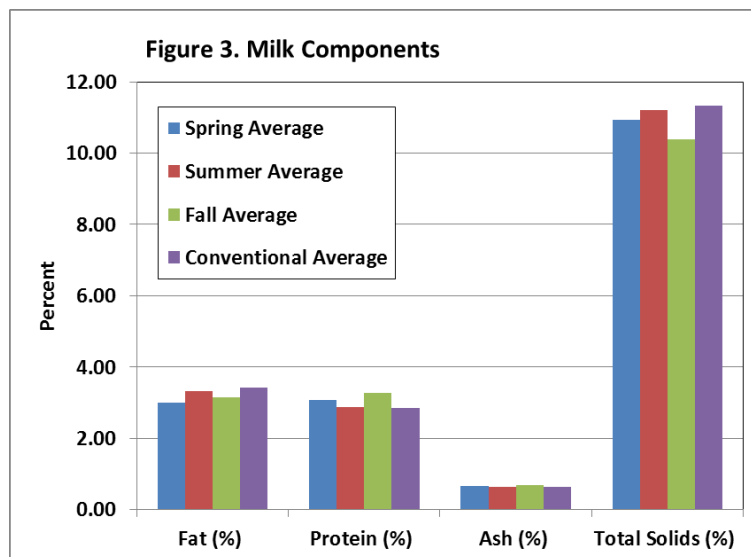
- Occasionally, especially in the spring sampling times, the fluid milk collected had an oniony flavor. It wasn't pleasant for drinking, but according to participating chefs, in cooking, it was phenomenal. This complex flavor combined well with the flavors in soups and other savory foods. The spring milk yielded a remarkably deep vegetal ramp soup when compared to one made with conventional milk, which seemed to have a more one-dimensional flavor. Interestingly, ramps, chives, spring onions, and green garlic are all in season when the milk has this flavor, making it slightly less desirable to drink, but extra desirable to add as cream, butter, milk or cheese to dishes with these ingredients. Nature seems to know what tastes good together!
- The differences between pasture and conventional milk seem to be concentrated in the butterfat. For that reason, much of our research has been focused on unsalted butter. Curiously, most commercially available unsalted butter has "flavorings" listed as an ingredient. According to Scott Rankin this is an addition added to make it taste more like butter.
- Conventional butter and cream tend to mask other flavors when used in cooking. Pasture dairy products enhance and complement the herbal, vegetable and fruit flavors of many recipes.
- Pasture butter seems to maintain a more stable texture and consistency over a broader range of temperatures. It is much softer at cold temperatures, which makes it easier to work with in pastries and other recipes without fracturing. It also doesn't melt as readily at room temperature.
- One of the products investigated was yogurt. Chefs think of yogurt as a "young cheese." Working with yogurt, the chefs remarked on its tangy and earthy flavor that is much more complex than conventional. This works well in many recipes such as yogurt salad dressing. Leah Caplan made a frozen yogurt with just yogurt and honey as ingredients. It was delicious, with a tangier flavor and creamier texture than that made with conventional yogurt.
- Jack has observed that the enhanced flavors imparted by the pasture dairy and meat products have allowed him to reduce portion size by about 1/3 on his menus. Customers just seem to be satisfied with a smaller portion. There seems to be some "satiety effect." This helps with his budget and allows him to purchase more locally produced, pasture product because he can use less and feed more people. About 30% of his food budget goes toward local foods.

"When I was just starting out in my career as a chef, I wondered what the big deal was about simple French dishes like Chicken Kiev, but when I use pasture butter in the simple sauces for such dishes, I understand how they gained their prominence in the culinary world."

Chef Jack Kaestner

Fatty Acid Composition

We measured milk components at each sampling period (Figure 3), as well as the breakdown of fatty acid composition. Total fat content of the pasture milk was slightly higher in mid-summer than in spring or fall, and averaged 3.15%, somewhat lower than that of the conventional milk sampled in summer (3.41%). Total solids followed a similar pattern, averaging 10.79% for the pasture milk and 11.32% for the conventional milk. Protein followed the opposite pattern, measuring lower in mid-summer than in spring or fall, and averaging higher (3.08%) than the conventional milk level (2.85%).



Fatty acid composition is detailed in Appendix 2. Twenty-two fatty acids were measured in the pasture and conventional milk. While the ratios of the fatty acids were different between the two types of milk, there were no obvious patterns that readily explain the differences in texture, aroma, and flavor that was observed.

Fatty acid breakdown among saturated, mono-unsaturated, and poly-unsaturated fats was similar between pasture and conventional milks (Appendix 2). Here again, we saw no significant differences between the conventional and pasture milk or among the sampling periods, with saturated fats averaging about 68%, mono-unsaturated fats averaging 28%, and poly-unsaturated fats averaging about 3.5%.

For all milk samples, there were distinct differences in specific fatty acids between the pasture and conventional milks. Fatty acid levels are listed in Appendix 2. Figure 4 illustrates pasture milk fatty acids (blue bars) that were significantly higher or lower than those of the conventional milk, which is set at zero for comparison. Elaidic acid (C18:1t) and stearic acid (C18:0) were more than a percentage point higher in the pasture milk, whereas palmitic acid (C16:0) was more than two percentage points lower.

The herds in this study had a diet of at least 60% fresh pasture plus up to 12 pounds of grain per day. For comparison, Figure 5 shows pasture milk from this study (blue bars) plus fatty acid levels of 100% pasture milk, with no grain in the diet, as measured by researchers at the University of Minnesota (red bars). The patterns are more accentuated in the 100% pasture milk than in the 60% pasture diet from our study. One significant difference between the two pasture milk types was oleic acid (C18:1), which was lower than conventional in our study and higher than conventional in the 100% pasture milk (Heins 2012). More research is needed to determine whether these differences in fatty acids are responsible for the texture differences seen in the butter made from these milk types.

Figure 4. Pasture milk fatty acid percent difference from conventional milk

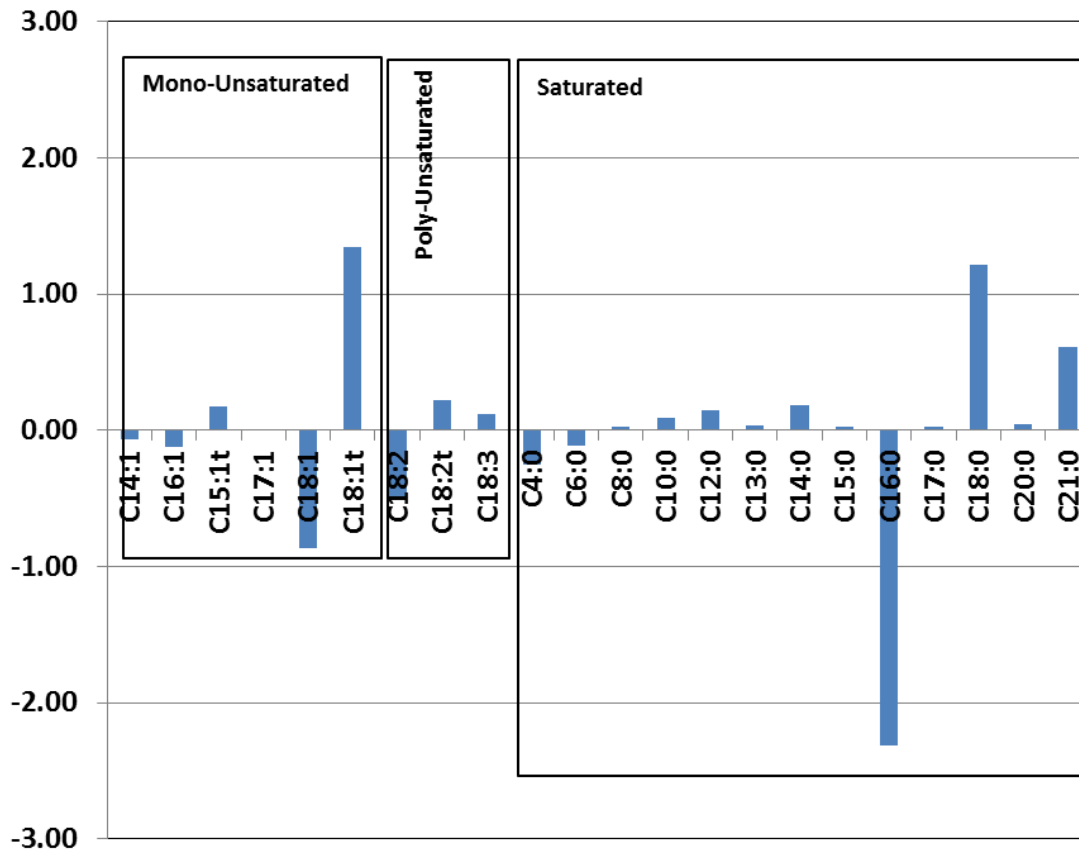
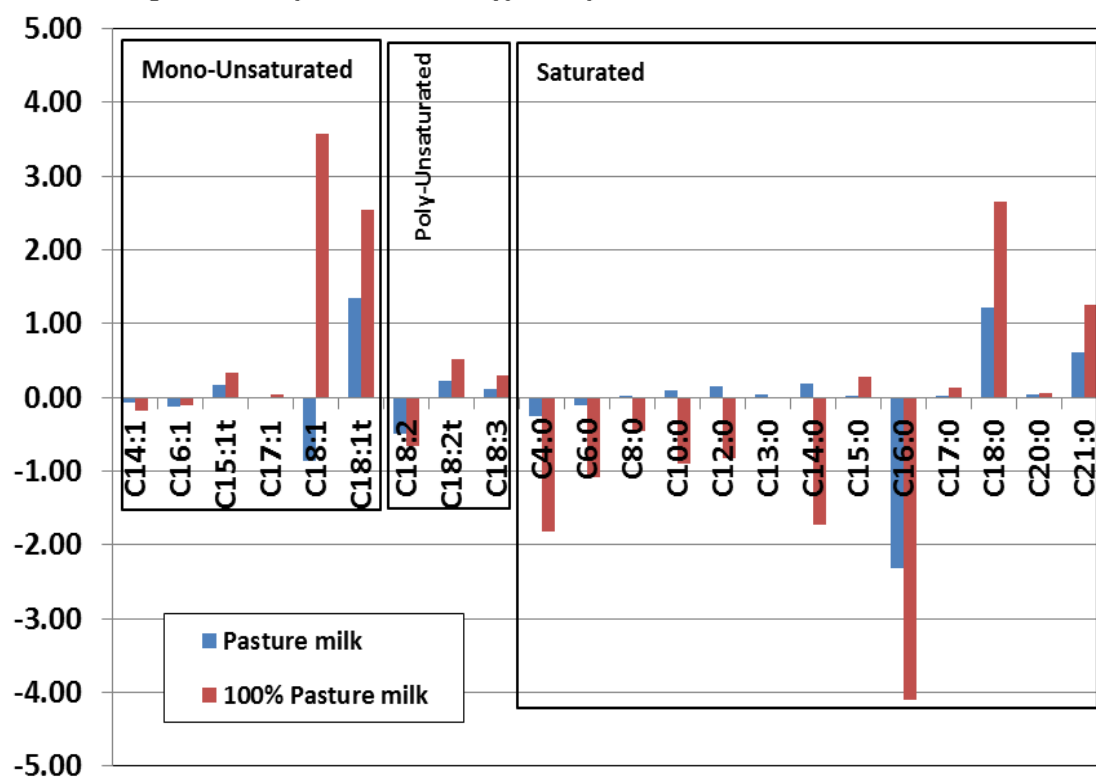


Figure 5. Comparison of two types of pasture milk with conventional milk



Consumer Response

We conducted several formal and informal evaluations of consumer attitudes toward pasture-based products. Formal processes included consumer sensory panels and focus groups. We also conducted informal “tasting sessions,” comparative side-by-side tastings with self-selected volunteers including grazing farmers and other interested parties.

Table 4. Average consumer responses towards fluid milk from grazing and conventional feeding systems.					
Milk Type	Flavor	Aroma	Appearance	Aftertaste	Purchase?
Pasture	5.8	5.6	6.7	5.6	3.1
Conventional	6.3	5.7	6.3	6.3	3.4

Consumer Sensory Panels

Consumer sensory panels were conducted using conventional and pasture homogenized milk, plain yogurt and cheese. The milk and yogurt panels are reported here. Such studies involve the recruitment of average consumers who consider themselves dairy product consumers. Volunteer consumers evaluate the products at a campus-based sensory facility with controlled lighting in individual booths. Data is collected using a variety of scales and assessments designed to determine critical opinions; in general, a single consumer panel will collect data from approximately 100 panelists and the data is summarized with a variety of statistical evaluations. For the milk, the consumers were asked to rate their degree of liking of several attributes, namely: overall flavor, aroma, appearance, aftertaste (1-9 point scale, where 9 is most desirable), and purchase intent (1-5 point scale, where 5 is most desirable). Average values are presented in Table 4. As you can see, these panelists preferred the flavor, aroma, and aftertaste of the conventional milk to the pasture milk. In contrast, participants in a different focus group preferred the pasture milk to conventional milk (see below).

Plain yogurt samples were evaluated using a similar approach wherein the consumers were asked to rate their degree of liking of the attributes, overall flavor, aroma, appearance, acidity (1-9 point scale, where 9 is most desirable), and purchase intent (1-5 point scale, where 5 is most desirable). Average values are presented in Table 5. For this product, participants slightly favored the pasture-based samples, suggesting that the pasture milk “grassy note” combines well with the tangy flavor of yogurt.

Table 5. Average consumer responses towards yogurt from grazing and conventional feeding systems.					
Yogurt Type	Flavor	Aroma	Appearance	Acidity	Purchase?
Pasture	4.8	5.6	5.6	5.0	2.6
Conventional	4.8	5.5	5.4	5.1	2.6

Focus Group

In July 2011, we contracted with Ady Voldedge, a market research firm run by Janet Ady, to conduct a formal focus group with pasture products. While the consumer sensory panels provide a good assessment of general consumer acceptance of a product, the focus groups that Ady conducts test the products on a targeted audience of “foodies,” individuals who are likely to be the first to try a new, value-added dairy product. This evaluation helps determine which new products are likely to be well-received initially, and as a result, are more likely to succeed in the marketplace. The focus group allows for not only tasting and rating foods, but more in-depth exploration of consumer attitudes and interests.

The focus group compared pasture-grazed and conventional milk, butter, and two types of cheese. In contrast to the consumer sensory panel, the focus group preferred the pasture fluid milk over the conventional milk (Table 6). Comments included: creamier, sweeter taste; it has an interesting flavor note; buttery taste, tasted sweeter to me; tasted superior; both were good but the pasture milk was creamier.

Responses to the other products were mixed (Table 7). Panelists preferred the conventional product in cheeses, but preferred the unsalted pasture butter. Tasters remarked on the bright yellow color of the pasture butter, with one describing it as “unnaturally yellow.”

Table 7. Focus group overall evaluation of pasture versus conventional dairy products (scale of 1=poor to 5=excellent).		
	Pasture	Conventional
Salted butter	3.5	4.0
Unsalted butter	4.0	3.4
Muenster Cheese	3.8	4.4
Emmentaler cheese	3.2	3.5

Informal taste testing

As part of a “Grass-fed Tasting Event” in October 2010, about 60 participants rated side-by-side samples of pasture and conventional butter and cheese, as well as butter and buttermilk used in recipes.

While participants were self-selected grass-fed advocates (farmers, agency staff, and a few consumers), rating differences among the foods are useful, as well as general themes in comments.

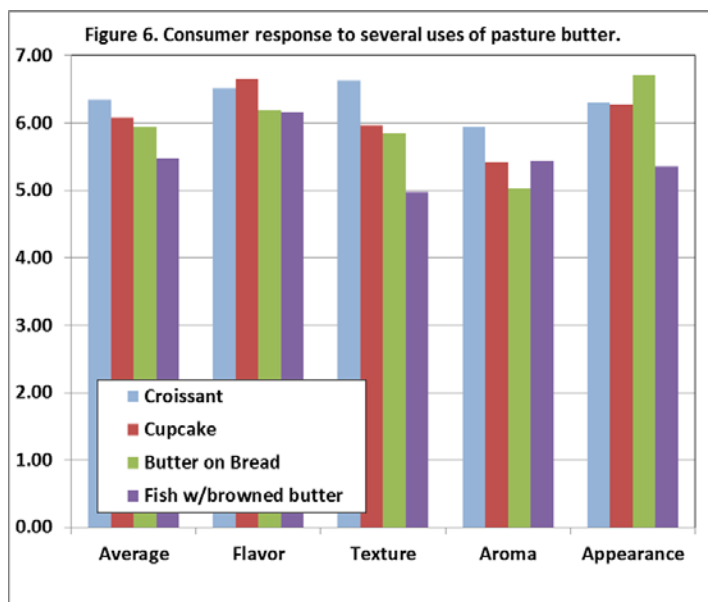
Table 6. Focus group evaluation of pasture versus conventional milk (scale of 1=poor to 5=excellent).		
	Pasture milk	Conventional milk
Taste	4.4	3.6
Appearance	4.4	3.9
Mouth feel	4.2	3.5
Saltiness	3.8	3.3
Aroma	3.9	3.7
Overall	4.4	3.8

In contrast to the Focus Group, participants in this session compared Gouda and Emmentaler cheeses preferring the pasture milk cheeses to conventional ones by an average of 36.5% or two points on a scale of one to seven.

Participants also tasted four products made with pasture butter: croissant, cupcakes with buttercream frosting, bread with butter, and fish with a sage-garlic browned butter sauce. They were asked to compare them to conventional products on a scale from 1=much lower ranking to 7=much greater ranking for four traits: flavor, texture, aroma, and appearance (Figure 6). The majority of this admittedly biased group rated the pasture butter recipes higher than the conventional ones, but the graph provides insights into which products are the best fit for pasture milk. Overall, the croissant (light blue bars) scored the highest, with highest ratings for texture and aroma, reinforcing the Chefs’ observations that pasture butter contributes to the texture of recipes that have high butterfat content.

The cupcake with buttercream frosting scored the highest for flavor (red bars), and participants observed that “the grass-fed sweetness unfolded slowly, but was more whole than the ‘cheaper’ sweetness of the conventional frosting” and “the conventional hit my tongue as sugary, almost candy-like. The grass-fed was smooth, deep, and very non-offensive. I was not overpowered by the sugar as I was with the conventional.”

The butter on bread scored the highest for appearance (green bars). While most consumers have gotten used to and prefer the pale color of conventional butter, this audience appreciated the bright yellow color of the pasture butter, describing it as a “nice mellow yellow color” and “more eye appealing”. Some participants appreciated the “earthier flavor” and “longer, lingering taste” and many commented on texture differences between the two, describing the pasture butter as smoother and creamier. Not always considered a positive, some participants described the texture as oily or greasy.



Marketing: Positioning pasture-based dairy

What resonates with consumers?

Several sources were used to provide insights into consumer interest in and attitudes toward pasture dairy products. Published consumer surveys suggest that, in general, pasture-based dairy and meat products are viewed positively for a number of reasons. A 2008 Michigan State University survey (Table 8) found that features such as “environmentally sustainable,” “humane animal handling,” and absence of antibiotics and synthetic hormones in the feed of the animals, resonated with consumers.

The surveys conducted as part of this project targeted “opinion leaders” or cutting edge buyers, with the assumption being that this demographic can provide a bell-weather for future trends in the industry. Respondents were selected based on their interest in and experience with, local, pasture-based, and artisanal foods.

Table 8. Consumer attitudes toward pasture-based products (Connor, 2008).		
Product feature	Survey responses	
	Very important	Somewhat important
Environmentally friendly	64.6%	28.2%
No antibiotics or hormones	63.2%	24.1%
Humanely raised	62.7%	28.8%
Family farm	29.2%	33.2%
Locally raised	23.1%	29.2%
Knowing the farmer	16.8%	17.3%
Healthy fats (CLA, Omega 3s)	Question not asked	

Focus Group

For the focus group, we assessed participant responses to terms and concepts surrounding pasture-based products. Ady Voldedge focus groups are always given a list of about 30 labeling terms to respond to. Over the years, different terms have come in and out of favor with consumers. The terms “pasture fed” and “grass fed” both ranked about in the middle of the terms with scores of 3.26 and 3.23 out of 5.0. Currently, among the 30 terms used, “ethical treatment of animals” and “hand crafted” are at the top and health related terms such as “glycemic index” and “gluten free” rank at the bottom of the list. Not surprisingly, “pasture fed” and “grass fed” clustered together with “certified organic” and “organic.” This reflects confusion among consumers as to the nature of these farming systems and the foods produced under them.

Focus group participants preferred the term “pasture grazed” over “grass-fed” or even “pasture-fed”, with “grass-fed” conjuring up images of confined cattle being fed grass versus “pasture grazed” more clearly creating the image of cows harvesting their own feed on pasture.

Concept statement for “pasture-grazed”

developed by Ady Voldedge for the project’s focus group

“Dairy cows in green pastures, grazing on lush, tender pasture grasses for their forage and nutrition. This is the natural, time-honored way for these animals to produce exceptional milk, not only to nurture the cows’ own calves but for the farm family’s livelihood. Grazing involves a complete food cycle – from building healthy soil, nurturing green pasture grasses, and allowing the cows to harvest their own feed at their own pace – all contributing to a balanced diverse farm ecosystem, healthy animals and sustainable family-run dairy farms.

Grass-based milk, produced in harmony with Wisconsin’s landscape, is nutritious, wholesome, healthy, and more flavorful than today’s standard milk supply. For example, grass-based milk has been associated with higher levels of ‘good’ fats such as conjugated linoleic acid (CLA) and omega 3 fatty acids. Dairy products produced from grass-based dairy products support sustainability for the farm, farm families, and the environment in which we

Janet Ady says that the theme that connects the trend she’s been seeing over a decade of surveying consumers is “authenticity.” Although it may sound trite, her data suggests that a growing number of consumers really do want to “know where their food comes from.” The terms that resonate with consumers change over time, but all revolve around the theme of knowing and trusting the food system. The diversity of labeling terms and eco-labels create confusion for the consumer, so establishing a specific set of terms for pasture raised products and a standard that is consistent is a means of protecting this sector over the long term.

Ady’s focus group participants are asked to respond to a product “concept statement” that uses terminology and images likely to be used in marketing materials. The focus group scored the “pasture grazed concept” very highly, with a 4.9 out of five. Key aspects of the concept that resonated with them included that it is perceived as healthy for cows and people, sustainable, natural and chemical free. Aspects that were not appreciated included the scientific nature of the concept, including the “healthy fats” concept.

Focus group participants preferred the term “pasture grazed” over “grass-fed” or even “pasture-fed.” “Grass-fed” conjured up images of confined cattle being fed grass in a feed bunk versus “pasture grazed,” which more clearly created the image of cows harvesting their own feed on pasture.

Eric Snowdeal from Organic Valley shared information on a more detailed survey of 1,000 consumers of organic milk conducted by Organic Valley nationally. These participants also felt that the term “pasture-raised” was a better description of the product than “grass-fed.” More than 50% of the respondents viewed pasture raised milk as being significantly different than the organic milk they were currently drinking.

Organic Valley asked consumers how much more they would be willing to pay for a pasture dairy product. Responses ranged from 10 to 15% more up to 75% more, although at least one respondent asked the question: why should the product cost more if it is cheaper to produce? A question on purchase intent for pasture milk ranked 4.6 out of five.

Market assessment

Another source of consumer information is Leah Caplan’s 2009 survey of 35 customers of Willy Street Co-op in Madison. Her data supports some of the conclusions of other surveys and digs deeper into the motivations and preferences of consumers.

- The vast majority of consumers believe that all dairy cows are pastured. This creates a challenge in differentiating pasture milk, as it requires the marketer to first educate the consumer on conventional dairy farming practices so that they will understand why pasture milk is different.
- Organic is the upper price threshold currently. Consumers did not express willingness to pay more for pasture dairy products than they would for organic products.
- Purchasing considerations in order of importance:
 - Environmental impact, humane treatments of animals, and nutrition
 - Prices, locally sourced
 - Taste
 - Brand, seasonality, color and appearance
- When asked which pasture dairy products they would like to have available for purchase, consumers responded based on their current purchasing habits:
 - Milk
 - Butter
 - Yogurt
 - Artisanal cheeses

Restaurant perspectives

The restaurant industry has changed over the years to focus on cost cutting, to the detriment of using high quality, artisan products. Even butter has been replaced by cheaper sources of fat that work well in a more automated kitchen. As this evolution was occurring, a lot of flavor was lost and that has impacted cooking. There is a growing counter trend, however, among chefs in white tablecloth restaurants who are refocusing on artisanal products and local foods.

Chef Jack has used grass-based products for more than seven years. He observes that they are so flavorful that he finds that he can reduce portion sizes to about half what he’d previously served and his customers are fully satisfied. He has adapted his cooking style to make best use of the stronger flavors of both grass-fed meats and dairy products.

Many of these chefs understand the value of grass-fed or pasture-based products both from a flavor perspective and from a farmer-story perspective. Jack Kaestner has used grass-based meat and dairy products for more than seven years. He observes that they are so flavorful that portion sizes can be reduced to about half what he’d previously served and his customers are fully satisfied. He has adapted his cooking style to make best use of the stronger flavors of these products.

Many chefs are seeking out artisan ingredients to revive the role these foods played in traditional recipes. Jack has experimented with classic French and Italian dishes and has found that pasture meats and dairy products make a huge difference in flavor. These foods bring out and complement the other flavors in these traditional dishes. It's a one-plus-one-equals-three effect, as he says.

Both Chefs Jack and Leah have observed that customers are beginning to notice the difference in pasture dairy products and ask for them. Leah observes that customers in Metcalfe's Market, where she works, gravitate toward the cheeses from pasture milk even if they don't ask for them specifically.



Other restaurants interviewed for this project included white table cloth restaurants, such as L'Etoile, Harvest, and Sardine in Madison, Wisconsin and two less expensive Madison restaurants, Bluephies and Marigold. Most of the restaurant owners expressed confusion similar to that of consumers, assuming that, if a product is organic, it is pasture-raised and if it is pasture-raised, it must be organic.

The white table cloth restaurateurs interviewed make it a point to serve at least some local foods and appreciate pasture dairy products primarily from the perspective of appearance and flavor, terroir, and the story of the local product. All three use primarily cheese and butter, both for cooking

with and for serving. They observed that these products had more stability at room temperature, as was noted above. They commented on the need to educate consumers, especially with regard to the above mentioned assumption consumers have that all cows are out on pasture.

Bluephies and Marigold chefs didn't have much experience with pasture dairy products and felt that the price made them impractical in their menus in items like cheese sandwiches. However, both felt that cheese would be a good gateway product for them to try these products for both staff and customers.

Distributors and retailers reinforce the importance of story and flavor

A growing number of distributors and retailers are looking for products with these attributes: flavor and a good story. These smaller scale distributors are interested in making a connection with the producers and processors because they market the products based on their stories. The stories sell the product.

Participants in the Discovery Session are part of the evolution of the local and artisan foods movement. Starting with chefs and consumers, such trends are also drawing distributors and retailers toward this sector. Cesar Olivares, representing retailer Pastorale in Chicago, and Scott Dickenson, owner of the distribution company Natural Direct, reinforced Mike Gingrich's observations on what is resonating with consumers. Both focus on the 'know the farmer' approach to representing

Pastorale takes their staff on "field trips" to visit the farms where the products are produced so that they really understand how it is made and can effectively share their stories with their customers.

the products that they market. Their customers are looking for artisanship, flavor, and a good story behind the product. Pastore even takes their staff on “field trips” to visit the farms where the products are produced so that they really understand how it is made and can effectively share their stories with their customers.



This is a vital building block in development of this market. At the direct market level, each farmer has the opportunity to represent his or her product accurately to customers. Once that direct connection is broken as is necessary in the scaling up process, something else must be in place to give the consumer that connection or that sense of authenticity. Logos and certifications can help, but having the distributor or retailer well-versed in the product and the story preserves the personal connection and in the long run, is probably more effective.

How have consumer preferences evolved?

As a relatively new market, the demographic of pasture dairy consumers is not clearly understood and is a moving target. Mike Gingrich of Uplands Cheese, has observed this evolution over the more than ten years since he introduced his Pleasant Ridge Reserve cheese. For the most part, he does not talk about his cheese being from pasture milk. He talks about how his cows are managed and how his cheese is made. He emphasizes the flavor of the cheese. He has been successful because he is the farmer and he answers the phone. Buyers get to talk directly to the person who milks the cows and makes the cheese. Since the beginning, he has had a small but increasing number of buyers interested in the nutritional aspects of grass-fed products (“healthy fats,” including Omega 3s and CLA or conjugated linoleic acid). Lately, he is also getting an increasing number of customers interested in raw milk cheeses, also for health reasons.

Some products on the market are made from 100% grass-fed milk—the cows are fed no grain. For example, Organic Valley is producing a 100% grass-fed milk and marketing it in California. Steve Young-Burns, an industry consultant observes that there is a growing customer base for this kind of product for health reasons. Both Steve and Mike agreed that the health aspects will take a product only so far, though. Consumers may purchase a product once for health reasons, but if the flavor and quality aren’t there, it won’t be purchased again, no matter how healthy it is for you.

What’s in a name?

Ironically, the name “Grasslands” has long been owned by a dairy company in Wisconsin that does not have a current connection to pasture-based products. The company, in existence since 1904, is the world’s largest producer of butter. It does not make any claims with regard to the diet of the cows whose milk is used in their products and, while it probably benefits from the image that the name ‘Grassland’ conjures up, the product has little or nothing to do with pasturing.

Opportunities, challenges, and recommendations

Developing a pasture dairy brand

Developing a brand is about differentiating your product from others on the market. This is critical to this emerging market because there is clearly confusion among consumers about pasture-based versus conventional systems of dairy production. However, all of the panelists in the discovery session expressed concern about needing to draw comparisons between their product and conventional production systems. For most non-food product marketers, this wouldn't be an issue—companies are expected to differentiate their products through marketing. In the food sector, this is less common. In fact, for a number of commodities, there is a “we're all in this together” approach that precludes

Pasture Milk Protocols

- Our research suggests that to achieve the unique properties that we observed in pasture milk, the protocol should include:
 - No less than 60% fresh pasture—more is better.
 - Remainder of diet should be grain or dry hay.
 - No ensiled feeds in diet.
- Pasture diversity and density contribute to the flavor of products made from pasture milk.
- Ample pasture acreage (1.5 acres per cow) so that all farms in the program have adequate pasture to last the entire season.

organizations like the Milk Marketing Board from providing support to specific “niche” products even when they have the potential to develop into major markets for Wisconsin dairy. Grass-dairy producers may need to establish their own marketing organization to promote their product, similar to the Organic Trade Association or other niche market organizations.

Working with milk from pastured cows

What is the ‘right’ balance of feed sources in the cow’s diet?

Most dairy cows in the United States are fed a ration that may include forages (dry hay and/or pasture), ensiled forages such as silage (corn stalks and grain) or haylage (ensiled hay), and grains and

oil seeds. Anecdotal observations from several cheesemakers suggest that ensiled feed in the diet of the cows can have a significant negative effect on cheese quality. Most groups producing pasture dairy products have protocols prohibiting members from feeding ensiled feeds.

Although there is a trend among some dairy farms to provide a 100% forage and pasture diet with no grain, the vast majority of dairy graziers do feed some grain along with pasture and hay. Most of the successful pasture-based dairy products are made with milk from cows that receive some grain in their ration. Mike Gingrich, maker of Pleasant Ridge Reserve Cheese, feels that the grain he feeds contributes to the unique flavor of the product. He shoots for 80% pasture intake and makes cheese only when the pasture is available and in good condition. The PastureLand Cooperative (formerly Edelweiss Graziers) has a minimum standard of 60% of the cow’s diet from pasture. In contrast, the National Organic Standard requires dairy farmers to provide no less than 30% of their cows’ diet. At this level, the unique qualities of pasture milk are not consistently present. While our study didn’t attempt to quantify the level of pasture needed in the cows’ diet, we suggest that it should be a minimum of 60%.

Seasonality and other sources of variability

While variability can be a positive attribute in artisan products, some level of standardization will be needed as the pasture dairy market grows. One key to success may be making sure not only that the cows are pastured, but that their diet is managed to consistently produce the excellent flavor and other unique characteristics that consumers of these products expect. A balance needs to be struck between consistency and the value of the inherent variability resulting from pasturing cattle.

Uplands' cheese is made from the milk of a single herd of cows. This approach has pros and cons. On the positive side, it reduces variability and makes the product more predictable. On the other hand, production and growth of the business are limited by the size of the farm.



As the pasture-grazed dairy industry scales up, protocols will become increasingly important. Consistency among batches of product can be achieved on a single farm fairly readily because just one farmer controls the management of the cattle. It is also easily achieved when many farms are contributing to a milk pool, averaging out extremes. Small companies and cooperatives involving just a few farms are most likely to be challenged as milk composition may be influenced by variability as individual farms make ration changes.

Mike Gingrich's template may be a good one to follow. His goal is for 80% of his cows' intake from pasture while he's making cheese. Cattle are fed 5 to 8 pounds of grain per cow per day, and are sometimes supplemented with hay. If hay feeding gets above 3 to 5 pounds a day, Mike stops making cheese. He also grazes his pastures relatively tall and allows the cows to be selective. Diversity rather than specific species of grasses is the goal for his pastures. Mike feels that the cows' process of choosing what to graze contributes to the unique flavor of his cheese. He says that chefs get this and there is little need to educate them. Dairy processors may have a harder time grasping the value of a different sort of milk to work with that imparts unique qualities to the final product. The industry has worked for years to make milk more uniform, which makes the manufacturing process simpler from their perspective.

PastureLand Cooperative (formerly Edelweiss Graziers) has a protocol that all five of their farmers follow. It sets pasture intake at 60%, requires at least 1.5 acres of pasture per cow, and allows no silage feeding. If one farm runs out of pasture before the end of the grazing season, all production of their pasture-based products must stop for the season. To reduce the possibility of this happening, the Coop requires members to maintain at least 1.5 acres of pasture per cow. Most processors of pasture milk have found that feeding ensiled feeds influences product quality negatively, so these are not allowed among the producers of pasture dairy products.

Addressing seasonality through marketing

Seasonal changes in pasture milk are known anecdotally among the farmer-processors who work with this product, and our research documents significant differences. There are several examples of how this variation can be addressed. Mike Gingrich's positioning and cheese-making practices are integrated to help address this challenge. Pleasant Ridge Reserve cheese is aged at least 60 days. Each batch ages differently and the complexity of the flavors is enhanced with aging. His target market appreciates this variability. When purchasing Pleasant Ridge Reserve, Cesar Olivares from Pastoral selects specific

batches that will age well, and then purchases a whole batch to be sold at Pastore over the course of the year. This addresses the seasonality of the pasture-based product.

Another pasture-grazed dairy marketer, Otter Creek Organic Farm, seeks to capitalize on seasonality by producing four seasonal cheeses, each with its own unique flavor, packaging design, and marketing messages (see box on page 29).

Grass Point Farms takes a different approach. While the majority of pasture dairy products on the market today are made only when the cows are on pasture, Grass Point Farms focuses less on the unique flavor and other characteristics of the milk of pastured cows and more on marketing grass-based as a sustainable farming system. In their marketing, they compare the systems side by side: grass-fed, conventional, organic, and other Eco labels. Their marketing encompasses the triple bottom line definition of sustainability—environment, economics, and social benefits. This is a complex message to get across. To help with that, their farms are third-party certified to ensure that they are managed according to their protocol.

Growing the Market: what are the challenges?

Product selection

Most of the successful pasture dairy products to date have been cheeses. Its character fits with the complexity of flavors in pasture milk and the aging process seems to enhance this synergy. Cheeses that work well are those that have more earthy flavors, such as aged cheeses. Commodity cheeses such as mozzarella and cheddar might not be the best choices, both because of the need for standardization and the low price point associated with these commonly used staple products.

The small-batch production characteristic of this early stage of development argues in favor of high-value, premium products with longer shelf-lives.

Milk and other more perishable products may be challenging. Not only is milk highly perishable, but it is very price sensitive as well, being a dinner table staple in many households. The recent volatility in the organic milk market during the 2008-2010 recession provides insights into what could happen in the pasture fluid milk market. In a poor economy, low cost staples are substituted for higher priced items like organic milk.

Butter is the product that was most prized by the chefs on our team. Although it is clear that pasture butter is an excellent product, it comes with a logistical challenge. Butter can be frozen, which reduces the challenges of seasonality. However, products like butter, which utilize only part of the milk, leave the processor with by-products to sell or dispose of. Developing a product mix that fully utilizes the milk is a key to success. The original Minnesota-based PastureLand Cooperative struggled for years and finally went out of business, not because they're having trouble selling their award-winning butter, but because they couldn't find a market for the organic skim milk that was a by-product of the butter making process. The PastureLand label has been purchased by the former Edelweiss Graziers Cooperative.



Otter Creek Organic Farm: Marketing seasonality

Established in 2007, this is one of the newest pasture based dairy companies. Otter Creek cheese is made by Bob Wills at Cedar Grove using only milk from Otter Creek Farms. The basic recipe is from a cheesemaker who made cheese in a now long-abandoned factory on Otter Creek farm.

Products: Otter Creek sells four seasonal Cheddars, reflecting the changes in cattle feeding throughout the year. They are labeled “Spring,” “Summer,” “Fall,” and “Winter,” and each package lists what the cattle eat during that season. Otter Creek also makes Cheddars flavored with garlic, pesto and other products in partnership with other local farmers.

Marketing: Family member Bartlett Durand is responsible for marketing. Otter Creek is currently selling through local upscale markets, as well as a few outlets in Chicago and Minneapolis.

It has formed a unique partnership with a large Community Supported Agriculture (CSA) farm to offer Otter Creek cheese as part of the weekly share. It is also working with this farm to incorporate extra vegetables into flavored cheese recipes.

Product positioning: Otter Creek’s message focuses on the connection between healthy soils, healthy plants, healthy cows and healthy food. Otter Creek is certified organic and promotes the environmental benefits of its farming practices.

Current status: Otter Creek has successfully placed its products in stores and established some strong partnerships with other farmers.

Otter Creek sales are expanding, particularly on the West Coast, in Chicago restaurants and to Whole Foods. Otter Creek is working with national distributors and brokers to expand its markets. It received a USDA value-added producer grant to increase its inventory and build sales to bigger retail chains.

While the bright yellow color of pasture butter is appealing, this isn't always an asset with other products that consumers expect to be white. The cream from pastured cows also has a yellowish color that some chefs did not like.

Other products, such as yogurt and ice cream should be considered, but with caution. The small-batch production characteristic of this early stage of development argues in favor of high-value, premium products with longer shelf-lives.

Product quality and consistency

Product consistency will become more of an issue as we move forward. For farmstead operations, it isn't as much of a problem, but if the industry is to scale up the production of pasture based products and grow the market, consistency will become more important. While a diversity of small processing plants is a benefit for this young industry, diversity among producers may create problems. Pooling larger numbers of farms will reduce variability from batch to batch, or having one or more large "anchor" farms in the pool would help.

Creating a standard, and protocol to meet that standard, will go a long way toward providing a producer pool capable of producing a consistent product. This can reinforce consumer recognition of key characteristics unique to grass-fed products.

This research should provide an understanding the seasonal variability that can provide useful information to processors interested in using pasture milk in their products. Marketing the products based on broader sustainable farming attributes as Grass Point Farms does may be an effective tool as well in helping understand seasonal variability in the product.

Logistical challenges

- One logistical challenge that was brought to light in the interviews we conducted is related to delivery. With little shelf space for these perishable products, weekly or special order delivery of product is not practical. The small scale manufacturers of these products are challenged by their need to have more frequent deliveries.
- Establishment of an efficient means of pooling milk from multiple farms that may not be in close proximity to each other or to the processing plant. Twenty-two percent of dairy farms in Wisconsin are pasture-based, but there are not necessarily clusters of them within a convenient distance of any particular plant.
- Other logistical problems are associated with contract processing. Investment in processing facilities is an option that some of the new companies have used, but others have tried to reduce investment by contracting for their processing with existing companies. Having the right kinds of facilities in close proximity to milk sources is another challenge. Hauling milk to partnering plants may end up impacting the final product if multiple pasteurizations are needed. While Wisconsin has a large number of cheese plants, processing capacity for other products is more limited.
- Building a brand is a slow process and several of the pasture-dairy startups needed to maintain alternate channels (conventional channels) for their milk production for times when they are not producing their pastured product (winter) or when the demand doesn't warrant production of that product.

Recommendations:

- **Organize:** organize pasture-based dairy farmers to facilitate pooling milk, marketing efforts, branding.

Only a small percentage of the more than 3,000 pasture based dairy farmers in Wisconsin have the capacity to individually establish their own processing facility to market pasture-grazed products. At this stage, a reasonable next step is to engage the dairy processing community in collectively promoting this specialty milk. With many, relatively small pasture-based dairies in the region, pooling milk among these farms and offering it as a premium raw product to dairy processors may be an appropriate approach to make the unique qualities of this milk available for artisan products. Pasture milk may be used similar to goat or sheep milk, either in its pure form or blended with conventional cows' milk to create a unique product.

- **Generate funds:** Develop a checkoff to generate funds for marketing.

Development of this new product category would benefit from targeted marketing. Marketing would need to target both processors and consumers. An appropriate way to finance such marketing would be for those who stand to benefit to provide support, similar to what the Milk Marketing Board or Beef Checkoff program currently do. These broad commodity marketing programs, by their nature, are unable to promote any specific niche market within their generic product category. A separate fund would need to be established to support promotion of pasture milk.

- **Create a standard:** Work together to create a standard that ensures integrity of the product. Our research suggests that a "pasture milk" protocol should require at least 60% pasture in the diet with the remainder made up of grain or dry hay, and no ensiled feed. Additional research should be conducted to verify these recommendations to ensure that the milk sold as "Pasture Milk" will have the unique qualities that this study has documented. Only with such a standard in place can the industry "scale up" this sector. For farmstead scale processing operations, it is relatively simple to ensure consistency among batches, because the processor controls the animals' diets. As the pasture dairy sector moves to the next level, a standard and protocol needs to be in place to ensure consistency.

- **Terminology:** come to a consensus on what terms will be used to describe pasture milk.

We recommend using the phrase "pasture milk" or "pasture-grazed milk". Participants in the focus groups felt that this terminology best captures the unique features of the production system and would most effectively tie it with the product qualities. In addition, the phrase "grass-fed" is already widely used in marketing meat, and for that product, "grass-fed" means no grain in the diet. This research and our participating processors' experience suggests that some grain in the diet is beneficial both to the health of the animal and to the quality and flavor of the product. Selecting a different term than "grass-fed" will reduce confusion among consumers and allow the "pasture dairy" sector to differentiate itself in the marketplace.

References

1. Black, J. 2007. The Geography of Flavor: bringing a European idea down to earth: producers, farmers pin hopes on the appeal of 'terroir'. Washington Post, August 22, 2007.
2. Cazaux, Gersende. 2011. Application of the Concept of Terroir in the American Context: Taste of Place and Wisconsin Unpasteurized Milk Cheeses. Unpublished Master's Thesis.
3. Census of Agriculture, 2007. USDA National Agricultural Statistics Service. Accessed 12/6/2012. http://www.nass.usda.gov/Statistics_by_State/Wisconsin/index.asp
4. Center for Integrated Agricultural Systems. 2003. Flavor, not health claims, key in marketing pasture-based cheese. CIAS Research Brief #66. <http://www.cias.wisc.edu/>.
5. Clancy, K. 2006. Greener Pastures: How Grass-fed Beef and Milk Contribute to Healthy Eating. Union of Concerned Scientists. http://www.ucsusa.org/food_and_agriculture/solutions/advance-sustainable-agriculture/greener-pastures.html.
6. Conner, D.S. and D. Oppenheim, 2008. Demand for Pasture-Raised Livestock Products in Michigan: Results of Consumer Surveys and Experimental Auctions. Journal of Food Distribution Research 01/2008; 39(1).
7. Dhiman, T.R., G.R. Anand, L.D. Satter, and M.W. Pariza. 1999. Conjugated linoleic acid content of milk from cows fed different diets. J. Dairy Sci. 82: 2146-2156.
8. Heins, B. 2012. Effect of organic grain supplementation on economic, behavior, and pest management strategies of organic dairy cows. Unpublished research report.
9. Kriegl, T and R McNair. 2005. Pastures of Plenty: Financial performance of Wisconsin grazing dairy farms. UW-Madison Center for Integrated Agricultural Systems. <http://www.cias.wisc.edu/pdf/pastplenty607.pdf>
10. Lyons, J., BM. Weigel, LK. Paine, and D.J. Undersander. 2000. Influence of Intensive Rotational Grazing on Bank Erosion, Fish Habitat Quality, and Fish Communities in Southwestern Wisconsin Trout Streams. J. Soil and Water Cons. 271-276.
11. Martin, B., I. Verdier-Metz, S. Buchin, C. Hurtaud, and J.B. Coulon. 2005. How do the nature of forages and pasture diversity influence the sensory quality of dairy livestock products? Animal Science, 81: 205-212.
12. Paine, L.K., Gerald A. Bartelt, Daniel Undersander, and Stanley A. Temple. 1995. Agricultural Practices for the Birds. Passenger Pigeon pp. 77-86.
13. Paine, L. 2009. Grass-based dairy products: challenges and opportunities <http://www.cias.wisc.edu/wp-content/uploads/2009/09/gbdairyreportfinalowres.pdf>
14. Paine, L.K. and R. Gildersleeve. 2011. A Summary of Dairy Grazing Practices in Wisconsin. <http://datcp.wi.gov/uploads/Farms/pdf/2011DairyGrazingSummary.pdf>.
15. Pariza, M. 1997. Conjugated linoleic acid, a newly recognized nutrient. Chem. Ind. (Lond.) No. 12: 464-466.
16. Parodi, P.W. 1994. Conjugated linoleic acid: an anticarcinogenic fatty acid present in milk fat. Aust. J. Dairy Technol. 49: 93-97.
17. Pirog, R. 2004. Consumer perceptions of pasture-raised beef and dairy products: an internet consumer study. Leopold Center for Sustainable Agriculture, Iowa State University. <http://www.leopold.iastate.edu/pubs/staff/pasture/pasture.htm>
18. Rankin, S.A.. 2006. Pasture-Based Cheese Research Project Final Report. Unpublished.

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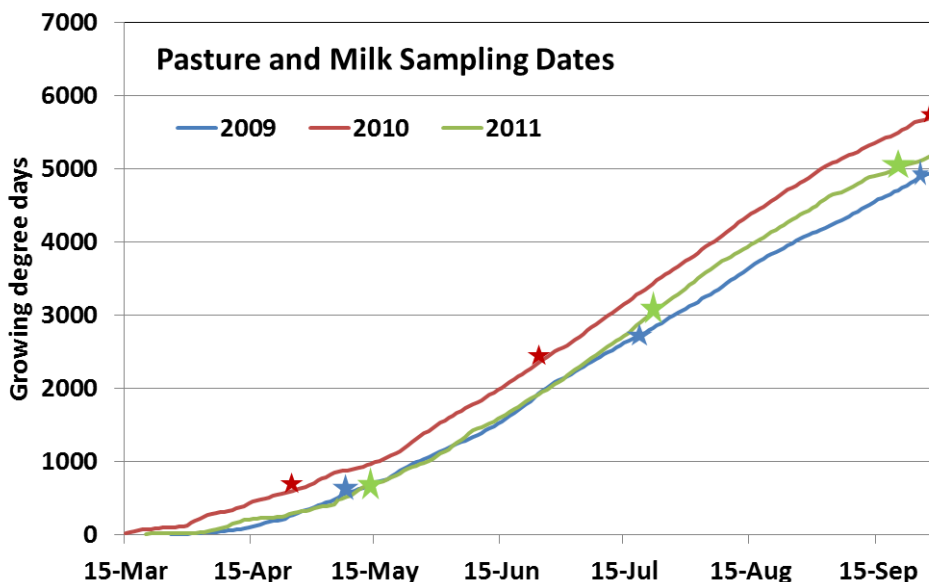
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Appendix 1. Participating farms and sampling protocols

Farmer	
Bill and Roz Gausman 2314 Keenan Road McFarland, WI 53558	66 milking cows. 160 acres, 98 permanent pasture, raise some of their own grain. 8 lb grain per day--corn or distillers grain with salt, mineral, vitamins. Offer hay during milking, but the cattle don't eat much.
Cory Brekken 4256 County Road B McFarland, WI 53558	64 milking cows. 70 acres of pasture/hay ground. 8 lb grain per day--corn with corn gluten, trace minerals, salt. Offer hay, but very little consumption.
Tim Pauli 387 Fritz Road Belleville, WI 53508	27 milking cows. 72 acres tillable, 60 acres pasture each year. Pastures in rotation with field crops, average 5 years in pasture. 12 to 13 lb grain per day, shelled corn and ground ear corn, with mineral & vitamins.
Jamie and Deanne Holmstrom N9276 Hay Hollow Road Blanchardville, WI 53516	33 milking cows. 200 acres: 50 acres permanent pasture, 110 acres seeded hay/pasture, 15 acres corn silage. 12 lb grain/day, 12% concentrate, free choice mineral/salt.
Bert Paris W3443 County Road W Belleville, WI 53508	70 milking cows. 120 acres of pasture/hay. 8 to 10 lb grain/day-corn, distillers grain (1 lb), mineral and vitamins. Access to hay, seldom eaten.

Sampling times for pasture and milk were standardized based on growing degree days. Growing degree days are a calculation using daytime and nighttime average temperatures and accurately reflect growth responses of plants. The goal of using this measurement was to ensure that the pastures were at approximately the same growth stage at each of the sampling times over the three years. As the graph below shows, the sampling dates varied with different weather patterns in each of the years.



Appendix 2. Fatty acid analysis of pasture and conventional milk samples.

			Pasture Milk				
Fatty Acid	Structure	Fatty Acid Type ¹	Spring average	Summer average	Fall average	Growing season average	Conventional Milk
			<i>Percent of total fat content</i>				
Myristoleic	C14:1	M	0.7	0.73	0.93	0.79	0.87
Palmitoleic	C16:1	M	1.05	1.17	1.33	1.18	1.30
Palmitelaidic	C15:1t	M	0.6	0.50	0.63	0.58	0.40
Margaroleic	C17:1	M	0.2	0.20	0.20	0.20	0.20
Oleic	C18:1	M	19.3	20.67	20.57	20.18	20.90
Elaidic	C18:1t	M	6.2	4.93	5.10	5.41	4.03
Linoleic	C18:2	P	1.65	1.90	1.47	1.67	2.13
Linoelaidic	C18:2t	P	1.15	1.03	1.00	1.06	0.83
Linolenic	C18:3	P	0.8	0.67	0.77	0.74	0.60
Butyric	C4:0	S	4.3	5.33	4.47	4.70	5.10
Caproic	C6:0	S	2.6	2.67	2.50	2.59	2.73
Caprylic	C8:0	S	1.4	1.30	1.23	1.31	1.30
Capric	C10:0	S	3.25	2.77	2.60	2.87	2.80
Lauric	C12:0	S	3.65	3.03	3.03	3.24	3.10
Tridecanoic	C13:0	S	0.2	0.20	0.20	0.20	0.17
Myristic	C14:0	S	10.9	10.20	10.87	10.66	10.50
Pentadecanoic	C15:0	S	1.15	1.17	1.30	1.21	1.20
Palmitic	C16:0	S	25.35	26.57	27.97	26.63	28.93
Margaric	C17:0	S	0.75	0.67	0.77	0.73	0.70
Stearic	C18:0	S	12.75	12.90	11.03	12.23	10.97
Arachidic	C20:0	S	0.15	0.17	0.20	0.17	0.13
Heneicosanoic	C21:0	S	1.3	0.70	1.33	1.11	0.50

¹M = mono-unsaturated; P = poly-unsaturated; S = saturated.

Fatty acid content of pasture and conventional milk					
Fatty Acid Type	Spring Pasture	Summer Pasture	Fall Pasture	Growing season average	Conventional
	<i>Percent of total fat content</i>				
Mono-Unsaturated	28.05	28.20	28.77	28.34	27.70
Poly-Unsaturated	3.60	3.60	3.23	3.48	3.57
Saturated	67.75	67.67	67.50	67.64	68.13

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Final report availability and other resources

The final project report, fact sheets, and other results will be available in early 2013 at the following websites:

- The Wisconsin Center for Dairy Research:
<http://www.cdr.wisc.edu/>
- The Wisconsin Department of Agriculture, Trade, and Consumer Protection:
<http://datcp.wi.gov/Farms/Grazing/index.aspx>
- Publication: Grass-based dairy products: challenges and opportunities
<http://www.cias.wisc.edu/wp-content/uploads/2009/09/gbdairyreportfinalowres.pdf>
- YouTube video on the project:
<http://youtu.be/O6-Y-E5UD0o>, <http://youtu.be/WLR1FdtSolw>

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