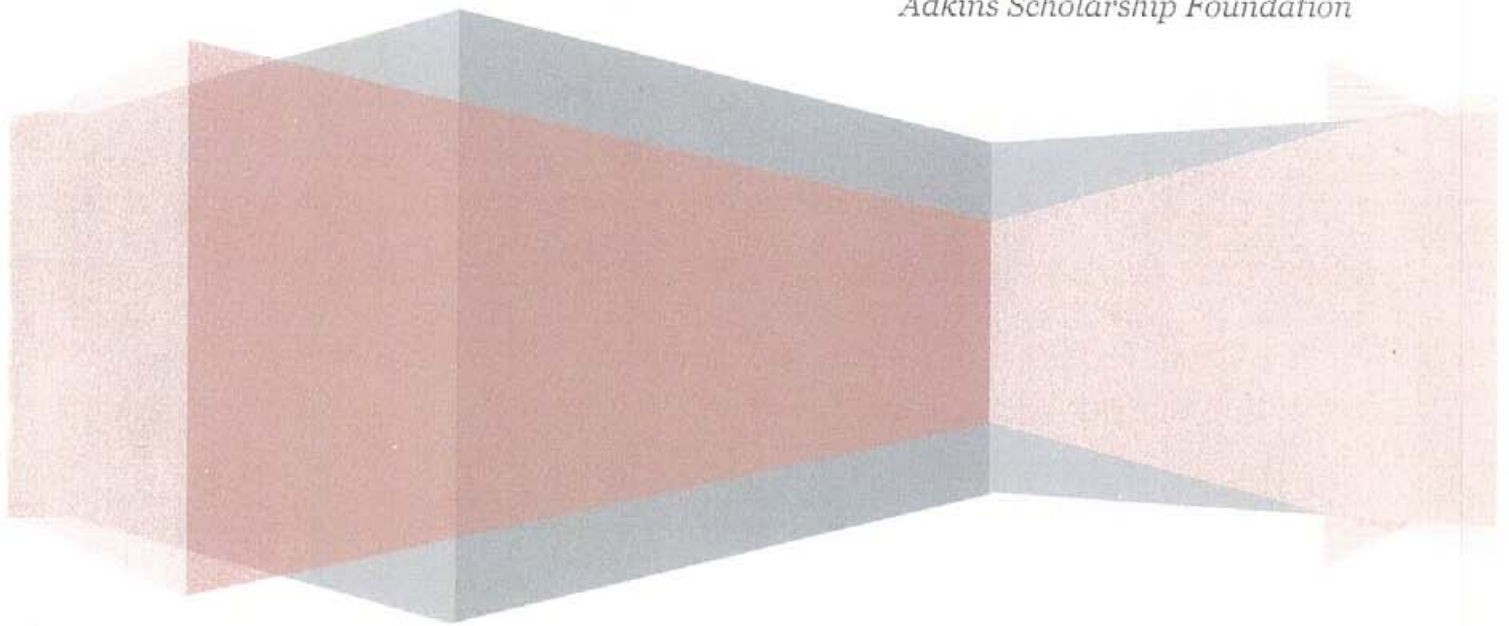


“Milk: the Amazing Process of Becoming a Product”

Adkins Scholarship Foundation



By

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Introduction

Every morning I drink a glass of milk to start a day. Milk not only has great taste, but also provides me many beneficial nutrients in varying quantities. One of the most well-known nutrients of milk is probably calcium, which helps healthy bones and teeth¹. Milk also contains many other essential nutrients that people are unaware of, such as phosphorous, magnesium, and protein that help maintain our healthy daily lives².

Because of these positive characteristics of milk, I know for sure that I am not the only one who enjoys drinking milk every day. Historically people have been drinking milk for thousands of years ever since its origin from East Asia about 9000 B.C.³. Because of its easy access to gain from domestic animals such as cows, sheep, and goat, milk has played a role of convenient daily product that is inseparable from our everyday life. Today between 650 and 700 billion kilos of milk are produced each year all over the world⁴. With today's growing worldwide demand for food, milk certainly provide essential supply to meet such a demand.

As I was going over the interesting facts about milk, I decide to choose milk as my research topic for *Adkins Scholarship Research Project*. Milk is a good example of mass product that everyone buys at the store without giving much thought about where it comes from. As I was looking through the store refrigerator and variety of dairy products, I realize that milk is indeed interesting topic that I can choose to reveal the simple question of "where did it come from and, "how did it get here?" At the same time, as a student who plans to become a medical doctor, milk is an ideal topic that I can relate my future understanding of health issue. Milk also has been always my favorite drink. It provides great flavors to many of my favorite food including ice cream, cheese, and chocolate. I want to learn everything about where milk comes from and appreciate the beauty of whole process that milk goes through to.

Before I start my research, it was important to notice varieties of different milk brand such as Darigold, Organic Valley, Nestle, etc in Guam's local stores. Among them, I decide to follow the trace of milk brand named 'California Sunshine Ultrafresh™,' because it seems to be most common brand compare to other brand milks. With my local pride, I also follow the trace of where our 'foremost^R' milk comes from. I started my research from the local store and all the way to the natural resources of where milk comes from.

^{1,2} "The Importance of Milk and Dairy Products as part of a healthy Balanced Diet." *The Dairy Council*. 2007. < <http://www.milk.co.uk/page.aspx?intPageID=131>> March 18, 2008

³"Milk." *How Products are Made*. 2007. Advameg Inc. < <http://www.madehow.com/Volume-4/Milk.html>> March 18, 2009

⁴"Milk and the economy-Milk wiki A-Z index." *FrieslandCampina*. <<http://www.en.frieslandcampina.com/about%20milk/wiki%20a-z%20index/m/milk%20and%20the%20economy.aspx>> March 15, 2009

Wholesaler, Retailer and Store operations

Guam's most local store functions as both wholesaler and retailer for consumers. Milk is actually the easiest product everyone can find in most local stores. The store place the milk in different place based on the way milk is packaged. There are three different types of milk packaging:

1. Packed in bacteria-free carton for preservation of "up to 8 months"
2. Packed in normal paper carton for preservation of about a month
3. Canned milk or powdered milk.

The stores usually put the bacteria-free carton packaged milk and canned or powdered milk on the normal-everyday shelf (Appendix A), while other paper carton packaged milk is put into the refrigerator in order to slow the growth of bacteria (Appendix B)⁵. The temperature of refrigerator is somewhere between 35 and 38 degrees F (about 1.7 to 3.3. degrees C)⁶. The local store does not order the milk, because distributors decide how much milk they are going to put in the store⁷. When store sells milk, they earn about 20% to 30% of profit out of total milk price⁸.

Shipping from Distributors to Wholesalers

Milk is delivered to local store on regular basis. The distributor decides how many milk it is going to put on each store based on the number of milk that store had sold. To make the information more accurate though, the average time interval for delivery is about once and twice a week depends on the size of refrigerator that each store has⁹. The truck that delivers the product (Appendix C) is required to keep the temperature of certain percent close to 36 degree F (about 2.2 degree C)¹⁰. The reason behind it is, again, to slow down the growth of bacteria in order to preserve the milk without spoiling it before it reaches the customers. Especially because of Guam's hot temperature, it is very important to keep certain temperature for the delivery trucks. The drivers deliver about 8 cases of milk to approximately 20+ stores per day¹¹. The deliverers are usually assigned to one region and take care of stores around that area¹². This is reason why deliverer cannot really say how much milk they deliver per day, because everything is depend on how much stores really sell¹³.

^{5,6} Jeannine Meyers. "Food Storage: Ideal refrigerator and freezer temperature." *Essortment*, 2002. <http://www.essortment.com/food/foodstorageref_sapw.htm> March 16, 2009

^{7,8,9} An, Jung Sun. Owner. Grocery Store in Astumbo Garden. March 30, 2009. Guam470s@hanmail.net

^{10,12} Tchanlas, Roy. Truck Driver (Wrap). Foremost Foods. April 4, 2009 royts@foremost.com.

^{11,13} Quintalla, Frank. Truck Driver (Wrap). Foremost Foods. April 9,2009. frankq@foremost.com

Distributors

'California Sunshine Ultrafresh™' milk is distributed by Unified Grocers, Inc¹⁴. Unified Grocers is a retailer-owned wholesale grocery cooperative that provides grocery products and services to independent retailers throughout the United States. Unified and its subsidiaries offer independent retailers all the resources they need to compete in today's supermarket industry¹⁵. Thus most of 'California Sunshine Ultrafresh™' milk is delivered directly from the Unified Grocers located in Hawaii every month¹⁶. No other local distributor involve in process of distributing the milk. This is probably the reason why some of small local store does not have 'California Sunshine Ultrafresh™' milk. We can find them only in big stores such as PayLess and Cost-U-Less.

Foremost also fits under the distributor category. Foremost does not manufactures milk, because Guam does not have ideal place to produce fresh milk. Instead it simply imports the powdered milk from New Zealand and distributes them¹⁷. However, it is not an easy process. For the distribution, Foremost recombines the powdered milk into liquid, creating reconstituted milk. It also takes charge of packaging them by new Ultra Pasteurization process.

In order to make the reconstituted milk, it is necessary to mix the powdered milk with cool water first, because powder tends to dissolve more readily in cool water¹⁸. By using the machine, it is important to stir the milk a lot so that the milk powder will dissolve. Then the milk sits for a little while and stir again, because the protein in the milk powder blends most easily if it gets a chance to stand after mixing¹⁹. During the process, it is very important to chill the milk whenever possible by using the bulk milk cooler (Appendix D). The whole process is done by the machine that keeps the balanced ratio of water and powder²⁰. For the final stage before its delivery, milks are packaged scientifically by the new Ultra Pasteurization process ensuring freshness and good taste for moths without refrigerator²¹. Foremost orders the milk container from Tetra Pak, Inc.

¹⁴ Barcinas, Trudy. Assistance Store Manager. Pay-Less Store. April 9, 2009. pmimicromall@paylessstore.com

¹⁵ Unified Grocers, Inc. 2007. < <http://www.agsea.com/update/default.aspx>> March 21, 2009

¹⁶ Barcinas, Trudy. Assistance Store Manager. Pay-Less Store. April 9, 2009. pmimicromall@paylessstore.com

¹⁷ Lee, Sun-Ok. Owner. S-J Mart. March 27, 2009. soojinparkklurz@hotmail.com

¹⁸ ¹⁹ Murrell, Julie. Office General Manager. Foremost Foods. April 6, 2009 juliem@foremost.com.

²⁰ Susanne aka The Hillbilly Housewife. "Reconstituting Powdered Milk." Home Cooking From Scratch. 2007. April 3, 2009. < <http://www.hillbillyhousewife.com/reconstituting.htm>>.

²¹ Tchanlas, Roy. Truck Driver (Wrap). Foremost Foods. April 4, 2009 royts@foremost.com.

Shipping from Manufacturer to Distributors

After milk has been processed, milk is packaged into different types and sizes for shipping, using Tetra Pak, Inc.'s containers. The company package all of their dairy products through the combination of two processes which allow their product to stay for more than sixty-plus (60+) days of shelf²². Their dairy products go through an ultra-pasteurization process (time and temperature)²³. The milk carton also plays important role, since it is put in to a bacteria-free environment, ensuring that the products have the longest shelf life possible²⁴. This milk is shipped from California to Unified Grocer Inc. in Hawaii on container ship, using temperature controlled shipping container (Appendix E). For 'California Sunshine Ultrafresh™' milk, stores in Guam imports two different sizes: one quart and half gallons. There are also five different types of milk: homo milk, 2%low fat milk, 1% extra lite milk, non-fat milk, and 1% chocolate milk.

The powdered milk goes through different process compare to liquid milk. After milk becomes fine particles of powdered milk solids in the evaporator, milk powder is put into a spray dryer²⁵. By definition, spray drying is the transformation of feed from a fluid state into a dried form by spraying the feed into a hot drying medium²⁶. Cyclone dryers [Appendix F] have been used most commonly to process powdered milk.

In a Cyclone dryer, the powder is first separated from the moist air in cyclones, generated by the increase in air speed when the mixture of particles and air enters the cyclone system²⁷. The dense powder particles are forced toward the cyclone walls while the lighter, moist air is directed away through the exhaust pipes²⁸. The powder settles to the bottom of the cyclone where it is removed through a discharging device. Sometimes the air-conveying ducts for the dry powder are connected with cooling systems which admit cold air for transport of the product through conveying pipes²⁹. After powders are cooled, they are put into a packaging machine, where it is separated into different sizes of bags[Appendix G]. After they are put into bags, they are shipped from New Zealand to Guam, using Matson company vessels.

²² *California Sunshine*. 2004. Hidden Villa Ranch. <<http://www.calsunshine.com/>> March 12, 2009

^{23,24} Schneider, Greg. Chief Operating Officer. California Sunshine. gschneider@calsunshine.com. March 5, 2009

²⁵ "Spray Drying." *Ohio-State University*. 2005.<http://class.fst.ohio-state.edu/Dairy_Tech/14Spraydrying.htm> March 16, 2009

²⁶ *HowStuffWorks*. October 30, 2008. HowStuffWorks, Inc. < <http://recipes.howstuffworks.com/question147.htm>> March 12, 2009

²⁷"Milk." *How Products are Made*. 2007. Advameg Inc. < <http://www.madehow.com/Volume-4/Milk.html>> March 18, 2009

^{28,29} "Spray Drying." *Ohio-State University*. 2005.<http://class.fst.ohio-state.edu/Dairy_Tech/14Spraydrying.htm> March 16, 2009

Manufacturing Plant

When the milk is pumped from milk truck into a storage tank in the refinery plant, raw milk is sampled and checked again for its quality³⁰. Next, the milk is sent to the homogenizer and the pasteurizer. Pasteurization and homogenization are two different processes. Louis Pasteur discovered pasteurization in the mid-1800s, while homogenization is developed more recently³¹.

In Homogenizer, the fat globules (in other word: butter fat) in milk is breaking up into a small size that they remain suspended evenly in the milk rather than separating out and floating to the surface (Appendix H)³². Usually before when refrigerated milk is put into a homogenizer, the cream of milk is completely separated from milk, leaving skim milk and a layer of cream³³. This is reason why homogenization is very important, because it prevents cream to be separated from milk by breaking the size of fat globules in milk. Especially in order to make 2% fat milk, it is necessary for cream to stay suspended in the milk. The process of homogenization is actually divided into two different following stages:

As milk first enters the valve of homogenizer, it then moves into the gap between the valve and the valve seat in homogenizer (Appendix I) ³⁴. The milk then moves across the face of the valve seat (the land) and exits. The homogenization is completed before it leaves the area between the valve and the seat. The milk may then pass through a second stage valve similar to the first stage. While most of the fat globule reduction takes place in the first stage, there is a tendency for clumping or clustering of the reduced fat globules³⁵. The second stage valve permits the separation of those clusters into individual fat globules ³⁶.

Unlike Homogenization, Pasteurization is rather simple. During the process of pasteurization, milk is quickly heated to 145 degrees Fahrenheit (62.8 degrees C) for half an hour or 163 degrees F (72.8 degrees C) for 15 seconds, which kills any bacteria that are in the milk³⁷. However during the process of pasteurization, some of nutritional

³⁰ MooMilk. Margo Souza. 2002. MooMilk Team: a California Corporation. <<http://www.moomilk.com/>> March 12, 2009

³¹ "Milk." How Products are Made. 2007. Advameg Inc. <<http://www.madehow.com/Volume-4/Milk.html>> March 18, 2009

³² Daily Science and Technology. Douglas Goff. 1995. University of Guelph. <<http://www.foodsci.uoguelph.ca/dairyedu/home.html>> March 12, 2009

³³ "Milk." How Products are Made. 2007. Advameg Inc. <<http://www.madehow.com/Volume-4/Milk.html>> March 18, 2009

³⁴⁻³⁵⁻³⁶ Daily Science and Technology. Douglas Goff. 1995. University of Guelph. <<http://www.foodsci.uoguelph.ca/dairyedu/home.html>> March 12, 2009

³⁷ HowStuffWorks. October 30, 2008. HowStuffWorks, Inc. <<http://recipes.howstuffworks.com/question147.htm>> March 12, 2009

value of the milk is also killed along with bacteria. The taste of the milk also changes, because when pasteurization occurs, the milk is heated high enough to kill certain bacteria and to disable certain enzymes that is related to the taste of milk³⁸.

There are two basic methods of pasteurization: batch and continuous. The batch method has very little use for milk but some use for milk by-products such as creams, chocolate, and ice cream³⁹. For milk manufacturing, continuous pasteurization is commonly used⁴⁰.

In the process of continuous pasteurization, cold raw milk at is drawn into the regenerator section of pasteurizer. Here it is warmed to approximately 57° C - 68° C by heat given up by hot pasteurized milk flowing in a counter current direction on the opposite side of thin, stainless steel plates⁴¹. The raw milk then passes through a timing pump which delivers it to the heater section where hot water on opposite sides of the plates heat milk to a temperature of at least 72° C. After it is heated, the milk flows through the holding tube to enter flow diversion device (FDD)⁴². The FDD detects improperly heated milk and let it flows back to the raw milk tank. Properly heated milk, on the other hand, flows through the FDD to the pasteurized milk regenerator section where it is cooled to approximately 32° C - 9° C. Now these warm milk goes into cooling section where it is cooled to 4° C or below. The cold, pasteurized milk passes through a vacuum breaker then on to a storage tank filler for packaging (Appendix J).

Some of the pasteurized milk is concentrated in an evaporator (Appendix K) to about 50% milk solids. The resulting concentrated milk is sprayed into a heated chamber where the water almost instantly evaporates, leaving behind fine particles of powdered milk solids⁴³.

In case of Foremost milk, the manufacturing plant of milk powder is actually located in New Zealand, which is the world's biggest milk exporter based on the statistics based on the figures for 2007⁴⁴.

On the other hand, the refinery plant and manufacturing plant of 'California Sunshine Ultrafresh™' milk are owned by a Hidden Villa Ranch Company, which

³⁸ [HowStuffWorks](http://recipes.howstuffworks.com/question147.htm). October 30, 2008. HowStuffWorks, Inc. < <http://recipes.howstuffworks.com/question147.htm>> March 12, 2009

^{39,40} "Milk." [How Products are Made](http://www.madehow.com/Volume-4/Milk.html). 2007. Advameg Inc. < <http://www.madehow.com/Volume-4/Milk.html>> March 18, 2009

^{41,42} [Daily Science and Technology](http://www.foodsci.uoguelph.ca/dairyedu/home.html). Douglas Goff. 1995. University of Guelph. < <http://www.foodsci.uoguelph.ca/dairyedu/home.html>> March 12, 2009

⁴³ [HowStuffWorks](http://recipes.howstuffworks.com/question147.htm). October 30, 2008. HowStuffWorks, Inc. < <http://recipes.howstuffworks.com/question147.htm>> March 12, 2009

⁴⁴ "Milk and the economy-Milk wiki A-Z index." [FrieslandCampina](http://www.en.frieslandcampina.com/about%20milk/wiki%20a-z%20index/m/milk%20and%20the%20economy.aspx). 2009. Friesland Campina. < <http://www.en.frieslandcampina.com/about%20milk/wiki%20a-z%20index/m/milk%20and%20the%20economy.aspx>> March 15, 2009

operates from corporate offices in Fullerton, California. Hidden Villa Ranch is known as one of the most innovative food companies in the nation⁴⁵. Their daily business is comprised of marketing, trading, wholesaling, producing, exporting and distribution, which means that they are in charge of manufacturing and shipping 'California Sunshine Ultrafresh™' milk to distributor.

Shipping of Raw Materials to Manufacturer

Raw milk farmers obtain through milking machine is stored in refrigerated storage tank and cooled to 38 degrees for a truck to pick up the milk daily and take it to the processing plant⁴⁶. The truck driver usually sample tests the milk before pumping it into the truck to make sure it's safe to drink⁴⁷. Milk trucks have very large shiny metal tanks to carry the milk, which somewhat looks similar to gasoline tankers (Appendix L). Each truck has a special feature to keep milk cool. You can imagine milk truck as a thermos on wheels.

Natural Resources

Before we start talking about natural resources of milk, it is important to understand what kind of milk we are drinking. There are certainly many different types of milk including soil milk, etc. Milk we are normally drinking is produced by dairy herd. The high yielding and highly bred Holstein-Friesian, the ubiquitous black and white cow, now makes up more than half of dairy herd in today's milk industry (Appendix M)⁴⁸.

In usual dairy farms, cows are fed up to eight times a day. Their feed is a combination of hay and silage⁴⁹. This mix is known as a TMR, or Total Mixed Ration. This TMR generally consists of: hay, corn, barley, field grasses, cotton seed, bakery or grocery by-products⁵⁰. Cows eat approximately 80 pounds a day and drink 30 to 40 gallons of water each day. It is very crucial to keep the cow healthy, because it determines the overall quality of milk too.

⁴⁵ Hidden Villa Ranch. 2005. Hidden Villa Ranch. <<http://www.hiddenvilla.com/about/company.html>> March 12, 2009

⁴⁶ Woodlaw Dairies. Les Keeper. 2009. Woodlaw Dairies. <http://www.woodlawdairies.co.nz/images/dairy_prices.gif&imgrefurl=http://www.woodlawdairies.co.nz/dairy-prices.php> March 11, 2009

⁴⁷ MooMilk. Margo Souza. 2002. MooMilk Team: a California Corporation. <<http://www.moomilk.com/>> March 12, 2009

⁴⁸ Winter, M., Fry, C. and Carruthers, P., 1997. Farm animal Welfare and the Common Agricultural Policy in Europe. Compassion in World Farming Trust. Petersfield: Hampshire.

^{49,50} MooMilk. Margo Souza. 2002. MooMilk Team: a California Corporation. <<http://www.moomilk.com/>> March 12, 2009

The actual milk is not provided until the cow gives birth to a calf. The raw milk is actually a liquid secreted by the mammary glands of the adult female cow to nourish her young calf until weaned⁵¹. The milk that mother cow provides is also called colostrum. Colostrum has extra vitamins and protein and is very good for the calf (Korhonen 76)⁵². However, it is hard to imagine providing so much amount of milk only from cows that gave birth recently. To answer this question, it is important to know that the mother cow can still make milk even after the calf is weaned. In fact, milk cows produce up to 8 gallons of milk per day. Milk is stored in the cow's udder, which is a large bag with four teats (Appendix N)⁵³.

When the udder is full, the farmers let the cows to enter from a holding pen through doors at the one end of the milking parlor⁵⁴. Then the cow's udders are cleaned and stimulated so that their bodies naturally release hormones that cause muscles in the udder to contract and give the milk. A milking machine with four cups is attached to the cow. The milking machine's functions is divided into two categories:

1. It massages the teat in an effort to relieve the effects of a continuous milking vacuum, which is called massage phase.
2. It causes milk to flow from a teat by exposing the teat end to a partial vacuum, which is called milking phase.

A milking machine is composed of pulsator, teat cup shells and liners(inflations), and milk receptacle, which is consist of bucket and teat-cup claw that is attached to a floor pail milker or to a pipeline⁵⁵. As the pulsator operates, it causes the chamber between the shell and the liner to alternate regularly from vacuum to air source. Inside of the teat-cup liner is under a milking vacuum at all times. So when air is admitted between the shell and liner, the line collapses around the cow's teat. The pressure of the collapse liner causes a massaging action of a machine to cow's teat. This is called the rest or massage phase(Appendix O)⁵⁶. Interestingly, milk does not flow during this phase.

After massaging phase, the space between the liner and the shell is exposed to the vacuum by way of the pulsator, starting the milking phase. The equal pressure on both sides of the liner causes pulsator to open, while the end of the cow's teat exposed to the

⁵¹ MooMilk. Margo Souza. 2002. MooMilk Team: a California Corporation. <<http://www.moomilk.com/>> March 12, 2009

⁵²Vegan Society. Lymbery, Philip. 13th April 2001. Turnstone Campaigns. < http://www.vegansociety.com/animals/exploitation/cows/dairy_cow.php>6 March 2009

⁵³ MooMilk. Margo Souza. 2002. MooMilk Team: a California Corporation. <<http://www.moomilk.com/>> March 12, 2009

⁵⁴ Foster Dairy. Gary& Lynda Foster. August 27, 2005. Foster Dairy Farm. < <http://www.fosterdairy.com/milking.html>>12 March, 2009

^{55,56} Garland, G.A. "Understanding the Basics of Milking Machines." Fact Sheet. 470/725 (September, 1996): 89-103. Ontario < <http://www.omafra.gov.on.ca/english/livestock/dairy/facts/89-103.htm>> March 12, 2009

vacuum and the internal milk pressure within the cow's udder causes the milk to be drawn out through the teat opening (Appendix P)⁵⁷.

This milking process consists of opening (milk phase) and closing (massage phase) the teat-cup liner repeats over and over again until the cooled milk is pumped into a large storage tank.

Health Benefits

The importance of milk as a part of a healthy balanced diet has been emphasized so many times. Milk could be considered a “superdrink” with all its health benefits⁵⁸. One glass of milk alone can make a contribution to the daily recommended intake of many important nutrients for all age groups⁵⁹. There are six basic categories of how milk can help our health:

1. For help with hair, skin and nails: Thanks to vitamins A and D, and lactic acid, milk softens even the driest skin, helps grow healthy hair and nails.
2. For help with muscle rebuilding: Magnesium and Vitamin C helps muscle function and growth of connective tissues.
3. For help with symptoms of premenstrual syndrome (PMS): rich calcium helps prevent the pain of menstruation⁶⁰.
4. For help with sleep: a protein naturally occurring in milk may improve sleep quality and next-day alertness⁶¹.
5. For help with strong bones: calcium and protein that helps maintain the strong bones.
6. For help with cavities: milk contains calcium and other tooth friendly nutrients that help cavities.

Besides this health benefits from milk, the scientist also discovered that there is possible links between low-fat milk consumption and reduced risk of arterial hypertension, coronary heart disease, colorectal cancer and obesity⁶². One study has shown that for women desiring to have a child, those who consume full fat dairy

⁵⁷ Garland, G.A. “Understanding the Basics of Milking Machines.” *Fact Sheet*. 470/725 (September, 1996): 89-103. Ontario < <http://www.omafra.gov.on.ca/english/livestock/dairy/facts/89-103.htm> > March 12, 2009

⁵⁸*Got milk?*. 2008. California Milk Processor Board. March 14, 2009 < <http://www.gotmilk.com/#/home/benefits/> >

⁵⁹“The Importance of Milk and Dairy Products as part of a healthy Balanced Diet.” *The Dairy Council*. 2007. < <http://www.milk.co.uk/page.aspx?intPageID=131> > March 18, 2008

⁶⁰*Got milk?*. 2008. California Milk Processor Board. March 14, 2009 < <http://www.gotmilk.com/#/home/benefits/> >

⁶¹ Markas, C Rob, Jonkman, Lisa, Lammers, Jan, etc. “Evening intake of {alpha}- lactalbumin increases plasma tryptophan availability and improves morning alertness and brain measures of attention.” *The American Journey of Clinical Nutrition*. 81.5 (2005) : 1-13. March 16,2009

⁶²“Milk.” *Wikipedia*. Wikimedia Foundation, Inc. 2004. < http://en.wikipedia.org/wiki/Milk#Modern_production > March 16,2009.

products may actually slightly increase their fertility, while those consuming low fat dairy products may slightly reduce their fertility due to interference with ovulation⁶³. Milk is also a source of Conjugated linoleic acid that has been shown to kill human skin cancer, colorectal cancer and breast cancer cells. Milk also may help lower cholesterol.

Economic Aspects

To understand the relationship between milk and economy, it is very necessary to grasp the concept of what influence supply and demand curve for milk. We could say that they are simply determined by the volume of milk demanded by consumers and the amount supplied by cows. However in reality, we have to look at the bigger picture of the world as a whole, because milk and milk constituents form the basis of many of the dairy products that are traded in international markets⁶⁴. After all A roaring global economy is probably the biggest force driving up milk prices, just like it has driven up prices for conventional commodities like iron ore and copper⁶⁵. Rising incomes in emerging economies from China and India to Latin America and the Middle East are lifting millions of people out of poverty and into the middle class.

It turns out that, along with zippy cars and flat-panel TVs, milk is the mark of new money, a significant source of protein that factors into much of any affluent person's diet⁶⁶. Global demand for protein has been on a structural uptrend for some time, soaring the milk product prices over the past five years (chart 1)⁶⁷. Milk also goes into infant formulas, chocolate, ice cream and cheese. Most baked goods contain butter, and coffee chains like Starbucks sell more milk than coffee.

Obviously demand for milk is influenced by various factors, such as the size of the global population and its purchasing power. Consumer preferences are also a key driver of demand for milk. Supply is influenced by the feed given to the cow and by seasonal changes. Another factor is whether farmers decide to expand their herd when milk (dairy product) prices are good. And ultimately, the most important factor of all is that enough calves are bred into mature milking cows⁶⁸.

Indeed the milk production and number of dairy herd have been growing past twenty years (chart 2). Despite this increase in number of supply, the price of milk

⁶³ "Fat ice cream and milk may help woman shoot or pregnancy" *Pravada*. 1 March, 2007. < http://english.pravda.ru/news/science/01-03-2007/87904-ice_cream-0 > 15 March, 2009

⁶⁴ "Milk and the economy-Milk wiki A-Z index." *FrieslandCampina*. 2009. Friesland Campina. < <http://www.en.frieslandcampina.com/about%20milk/wiki%20a-z%20index/m/milk%20and%20the%20economy.aspx> > March 15, 2009

^{65,66} Arnold, Wayne. "A Thirst for Milk Bred by New Wealth Sends Prices Soaring" *New York Times*. 4 September, 2007. < <http://www.nytimes.com/2007/09/04/business/worldbusiness/04milk.html> > March 18, 2009

⁶⁷*Woodlaw Dairies*. Les Keeper. 2009. Woodlaw Dairies. <http://www.woodlawdairies.co.nz/images/dairy_prices.gif&imgrefurl=http://www.woodlawdairies.co.nz/dairy-prices.php> 11 March, 2009

⁶⁸ Morrison, E.M. "The milk-fed economy." *AG Innovation News* April 2001, vol.10: 2. 14 March,2009

products are still increasing, causing the crisis among working poor and underclass population. In some part of U.S., the price of milk is higher than the price of gasoline⁶⁹. The future of milk industry is bright. The growth of milk industry is unstoppable. However, the government's interference will be predicted soon especially for those in lower-income class, who is not going to be able to purchase more milk if the price of milk does not stop soaring.

Conclusion

Throughout my research, I was amazed by the complexity of process that milk goes through. There are certainly lot of time and hard work that were involved in order to create a simple one product that everyone buys without giving much thought to it. Now when I look back at my research and think about it, milk indeed goes through more than five machines and came across continent and the half of the world just to reach us. If I were to live in Guam 100 years ago, I would never imagine drinking milk that was produced in the opposite side of the world. Again I want to thank all of those who involve in the milk industry.

What also amazed me during my research was the size of milk industry, because I never thought so many people involve in milk business. Usually when I had to think about the milk production, I only thought about milk farmers and cows. I never picture the whole process of refining the milk and packaging the milk in appropriate container for its preservation. So many machines that were invented in order to help process the milk are other aspects of this research that fascinated me. Most memorable one is probably the milking machine that actually 'massages' the cow's teats in order to get milk from a cow.

After my research, whenever I drink a cup of milk, I think of so many people who help this milk to reach me so that I can enjoy it with so much pleasure. As long as those people are there to support the milk industry, we will always have easy access to milk that is both great in taste and beneficial for our health. The future of milk industry is always bright, because there are always people, who are working together to accomplish the amazing journey of milk production every day. I want to thank everyone who helped me finish this project. Without those help, this project was not possible. Remember: just like the future of the milk industry is bright, the future of our home, the most beautiful island in Pacific—Guam--is very bright too.

⁶⁹ Arnold, Wayne. "A Thirst for Milk Bred by New Wealth Sends Prices Soaring" *New York Times* 4 September, 2007. <<http://www.nytimes.com/2007/09/04/business/worldbusiness/04milk.html>> March 18, 2009

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