

CHOCOLATE

A Serendipitous Journey of the Senses

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Introduction

In our generation today, many people,—young and old, male and female—enjoy the soothing and scrumptious taste of a Hershey’s milk chocolate bar (Appendix A). The Hershey Company (Appendix B), currently the biggest chocolate manufacturer worldwide, produces about 38 percent of all chocolate manufactured in the United States.¹ The chocolate giant is a source of income to about 13,000 people worldwide.² The Hershey Company made a great impact in the US confectionary industry when it started in 1927.³ Since then, it has become one of the most well-known chocolate industries in the world, grossing around \$5.1 billion in 2008 alone.⁴

Chocolate, itself, has had a rich and storied history. The word cacao, meaning “God Food” in Mayan, indicates that cacao was a very highly recognized food at that time.⁵ The Aztecs prized this bean so highly that they considered it even more valuable than gold or silver. Once the Spanish got a hold of Xocolatl!—chocolate from the New World—they improved the bitter taste by adding sugar and vanilla to the chocolate bean.⁶ Spain prized this “new” food and kept it a secret from the rest of Europe for nearly a century.⁷

¹ Margolin, Steven, The Chocolate Market Unwrapped, Brand Channel, January 23, 2010
<http://www.brandchannel.com/features_effect.asp?pf_id=71>.

² FAQ, The Hershey Company, February 13, 2010
<http://www.hersheys.com/faqs/faq-corporate.asp#faq_top>.

³ FAQ, The Hershey Company, February 13, 2010
<http://www.hersheys.com/faqs/faq-corporate.asp#faq_top>.

⁴ Hershey Company, Hoovers, February 26, 2010
<http://www.hoovers.com/company/Hershey_Company/rfktti-1-1njea5.html>.

⁵ A History of Chocolate, Aphrodite, February 12, 2010
<http://www.aphrodite-chocolates.co.uk/history_chocolate.htm>.

⁶ A History of Chocolate, Aphrodite, February 12, 2010
<http://www.aphrodite-chocolates.co.uk/history_chocolate.htm>.

⁷ All About Chocolate: History of Chocolate, January 11, 2010
<http://www.fieldmuseum.org/Chocolate/history_european.html>.

The first noted mention of chocolate was in the mid-1600s by English bakers.⁸ More than two centuries later, the first chocolate bar was produced in 1847 by Fry and Sons of Bristol in England.⁹ Finally, by 1875, Daniel Peters, a Swiss manufacturer, found a way to combine the necessary materials in order to form the first milk chocolate bar.¹⁰

I chose to do my Adkins Foundation project on Hershey's milk chocolate because of its ubiquity. Almost every store on Guam stocks Hershey's milk chocolate on its shelves because it is also one of the most famous chocolates in the world. My personal endearment for chocolate has also led me to do my research project on this topic. I realized, after doing the project, that something as simple as one chocolate bar goes through many steps around the world just to be developed for world consumption. Our society really does take things for granted, and this project opened up a new world of manufacturing to me.

⁸ A History of Chocolate, Aphrodite, February 12, 2010
<http://www.aphrodite-chocolates.co.uk/history_chocolate.htm>.

⁹ Chocolate History Time Line, Chocolate Month Club, January 22, 2010
<<http://www.chocolatemonthclub.com/chocolatehistory.htm>>.

¹⁰ A History of Chocolate, Aphrodite, February 12, 2010
<http://www.aphrodite-chocolates.co.uk/history_chocolate.htm>.

Retailer and Store Options

Throughout Guam, there are many small “mom and pop” stores, grocery stores, and huge retailer stores, such as Cost-U-Less (Appendix C). Whatever store it is, it is sure to have at least one Hershey’s milk chocolate bar inside. The seemingly universal chocolate bar is stored on shelves of stores, in either box forms or individual bars (Appendix D). Costs range from 85 cents to a dollar for one bar. A king size bar, a bigger-sized chocolate bar, may cost up to \$2. After customers grab one of these delicious candy bars, they struggle through lines to make their way towards the front of a cash register in order to pay for their treat (Appendix E). The customers then pay and leave with their Hershey’s bar enjoying its savory tastes.

Shipping from Wholesaler to Retailer

Because Guam is a small island in the western Pacific, there are not as many wholesalers that sell Hershey’s products as there are in the mainland or even elsewhere. Of the wholesalers that do, J&G and Cosmos are among the more admired.¹¹ Workers of the wholesale company will load their trucks with Hershey’s chocolates and possibly other merchandise and make their way to select retailers. The employees of both the retailer and the wholesale company unload the items into the retailer’s store. Inside, the employees start

¹¹ Interview with Kanada Market owner, Moon Gi Cho, January 12, 2010.

to stock up the shelves with chocolate or may possibly store it in a cool place, so it does not melt.¹²

Shipping from Distributor to Local Wholesaler

Lying at the crossroads of Asia and North America, Guam receives its Hershey's from overseas, mostly from the United States. Most of the items arrive through the Matson Navigation Company. The chocolate orders arrive in containers of various sizes and are distributed to the local wholesale companies, such as Cosmos. According to the manager of Cosmos, chocolate is shipped in regular 20 foot or 40 foot unrefrigerated containers.¹³ It is placed in the center of the container when shipped and surrounded by paper towels or tissues to prevent melting.¹⁴

With the advancements made in technology, it is now possible to track your shipment container by using radio frequency identification devices and a microchip.¹⁵ The container is tracked throughout its voyage and, when it arrives, the chocolate inside is carefully taken out and placed in trucks to be shipped to the local wholesaler.

¹² Interview with Kanada Market owner, Moon Gi Cho, January 12, 2010.

¹³ Interview with Brian Lee, Cosmos Distributors, February 29, 2010.

¹⁴ Interview with Brian Lee, Cosmos Distributors, February 29, 2010.

¹⁵ The Shipping Deck: A Glossary of Terms, March 1, 2010, Assembly Magazine, March 1, 2010.

<http://www.assemblymag.com/Articles/Web_Exclusive/e6c20a86f06c9010VgnVCM100000f932a8c0_____>.

Shipping From Manufacturer to Distributor

After the milk chocolate is wrapped and organized into its boxes, the chocolate boxes are ready to be shipped to the distributors. The boxes are loaded onto a truck that will arrive at the distributor's headquarters.¹⁶ When the truck arrives at the destination, workers will unload the merchandise from the manufacturer's truck, much like the wholesaler to retailer phase. Once unloaded, the chocolate is stored in a cool place to prevent melting and later shipped using the Matson Navigation Company out to one of the wholesalers on Guam.

Manufacturing Plant

Hershey's does not make every single ingredient they need in order to make a milk chocolate bar. According to its website—www.hersheys.com—Hershey's purchases sugar, cocoa, sweeteners, and even packaging materials from other companies.¹⁷ With the combination of all these elements, Hershey's is able to produce its world renowned milk chocolate bar.

Hershey's receives its cacao beans from the countries near the equator, such as the Ivory Coast, Ghana, and Ecuador.¹⁸ Once they receive the precious beans, the manufacturing plant starts off by grinding the beans. The nibs (what is left of the bean after winnowing) are

¹⁶ REF NUMBER: 007000448B, Hershey's Company, March 16, 2010
Email from Hershey's company.

¹⁷ "What We Buy", The Hershey Company, February 26, 2010
< http://www.thehersheycompany.com/business/suppliers_what.asp>.

¹⁸ About the Cacao Tree, Cacao Web, February 10, 2010
< <http://www.cacaoweb.net/cacao-tree.html>>.

made of 53 percent cocoa butter and the rest is of cocoa solids.¹⁹ The nibs are crushed and milled by heavy steel discs in order to separate the two parts which liquefies the nibs into chocolate liquor (Appendix F).²⁰ The liquor is placed into a 25-ton hydraulic press that squeezes the cocoa butter out.

Pressure is employed to the cocoa liquor to remove the cocoa butter.²¹ The cocoa butter is then drained through metallic screens (Appendix G). After, they can be used for all types of chocolates, or even cosmetics and medicine.²²

Cocoa butter is very important in the production of all chocolates. It is made up of 16-18 carbon triglycerol (Appendix H) which crystallizes in very exact ways, producing up to 6 different crystalline structures, each with its own melting point.²³ These melting points vary from 17.3° C (form I) to 36.6° C (form VI). The most desirable form is V, with a melting point between room temperature and body temperature, 33.8° C.²⁴ Form V melts on the tongue to release the coated cocoa solids and provides the smooth and creamy sensory experience associated with quality chocolate.²⁵

¹⁹ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
< <http://www.fieldmuseum.org/chocolate/making.html>>.

²⁰ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
< <http://www.fieldmuseum.org/chocolate/making.html>>.

²¹ About the Cacao Tree, Cacao Web, February 10, 2010
< <http://www.cacaoweb.net/cacao-tree.html>>.

²² All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
< <http://www.fieldmuseum.org/chocolate/making.html>>.

²³ Manufacturing Chocolate, Chocolate Affairs, February 2, 2010
< http://www.chocolate-affairs.com/manufacturing_chocolate.shtml>.

²⁴ Manufacturing Chocolate, Chocolate Affairs, February 2, 2010
< http://www.chocolate-affairs.com/manufacturing_chocolate.shtml>.

²⁵ Manufacturing Chocolate, Chocolate Affairs, February 2, 2010
< http://www.chocolate-affairs.com/manufacturing_chocolate.shtml>.

The cocoa solid left still contains between 10-25 percent cocoa butter, depending on the brand.²⁶ The remaining solid is pulverized into cocoa powder, which is then used in beverages, cooking, and baking.²⁷ Another form made from the solids is dutched cocoa, which is cocoa-made alkaline treated by potassium carbonate.²⁸

Chocolate is made by blending non-pressed liquor with condensed milk, sugar, and extra cocoa butter which keeps the chocolate solids at room temperature.²⁹ This raw mixture is churned until it becomes a coarse, brown powder called crumb.³⁰ This stage depends on the quality and kind of chocolate being made. Sometimes, many beans are combined to bring out different tastes. Hershey's actually uses up to 12 different beans from near the equator to achieve its flavors.³¹ The beans are blended in different proportions to achieve the secret formula.

Refining makes chocolate crumb into a silky chocolate. The smaller the particle size, the silkier the finished chocolate feels in the mouth.³² The crumb goes through a series of five heavy steel refining rollers set at different intervals and different speeds.³³ The gaps between the rollers are so small they produce the crumbs into 25 to 30 microns in size, both

²⁶ About the Cacao Tree, Cacao Web, February 10, 2010
<<http://www.cacaoweb.net/cacao-tree.html>>.

²⁷ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
<<http://www.fieldmuseum.org/chocolate/making.html>>.

²⁸ About the Cacao Tree, Cacao Web, February 10, 2010
<<http://www.cacaoweb.net/cacao-tree.html>>.

²⁹ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
<<http://www.fieldmuseum.org/chocolate/making.html>>.

³⁰ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
<<http://www.fieldmuseum.org/chocolate/making.html>>.

³¹ From Pod to Palate Part II: The Birth of The Bar, The Nibble, February 12, 2010
<<http://www.thenibble.com/REVIEWS/MAIN/CHOCOLATE/from-pod2.asp>>.

³² Madell, Samantha, How Chocolate is Manufactured, February 7, 2010
<http://www.chocolatereview.com.au/chocolate_manufacturing>.

³³ From Pod to Palate Part II: The Birth of The Bar, The Nibble, February 12, 2010
<<http://www.thenibble.com/REVIEWS/MAIN/CHOCOLATE/from-pod2.asp>>.

in the liquor and sugar.³⁴ The chocolate becomes smoother with more cocoa butter and more rolling. Traditionally, roll refiners (Appendix I) were used, but these days, factories use ballmills (Appendix J).³⁵

After refining takes place, the chocolate is made even smoother by a process called conching. Conching helps to eliminate undesirable odors.³⁶ During conching, the chocolate paste created before is put through heavy machinery.³⁷ When poured into a vat, the chocolate paste is kneaded, blended, and grinded by heavy rollers. This process smoothes out the sugar grains to give the chocolate its silky texture.³⁸

Aerating the paste allows the acids and moistures in it to evaporate.³⁹ During the aeration process, chocolate's bitter taste gradually disappears and the sweet, rich flavor is fully developed.⁴⁰ The chocolate no longer seems sandy, but dissolves meltingly on the tongue. It has attained the outstanding purity which gives it its reputation.

The machines used in conching are called conches (Appendix K) which can heat 100 to 1000 kilograms of chocolate paste at a time, and can be heated up to 80 ° C.⁴¹ Cocoa butter can be added here at this stage to make the texture smoother. Conching makes the

³⁴ From Pod to Palate Part II: The Birth of The Bar, The Nibble, February 12, 2010
<<http://www.thenibble.com/REVIEWS/MAIN/CHOCOLATE/from-pod2.asp>>.

³⁵ Madell, Samantha, How Chocolate is Manufactured, February 7, 2010
<http://www.chocolatereview.com.au/chocolate_manufacturing>.

³⁶ From Pod to Palate Part II: The Birth of The Bar, The Nibble, February 12, 2010
<<http://www.thenibble.com/REVIEWS/MAIN/CHOCOLATE/from-pod2.asp>>.

³⁷ How Chocolate is Made, Amelie Chocolat[sic], February 10, 2010
<http://www.ameliechocolat.co.uk/info_chocolate_made.html>.

³⁸ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
<<http://www.fieldmuseum.org/chocolate/making.html>>.

³⁹ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
<<http://www.fieldmuseum.org/chocolate/making.html>>.

⁴⁰ Chocolate Production, Cadbury India, January 23, 2010
<<http://www.cadburyindia.com/media/chocoproducton.asp>>.

⁴¹ Chocolate Production, Cadbury India, January 23, 2010
<<http://www.cadburyindia.com/media/chocoproducton.asp>>.

particles in the paste smaller so it rids of any grittiness.⁴² Tempering-the repeated cooling and heating of the chocolate-ensures the chocolate will melt properly.⁴³

The next step at the chocolate factory is to pour the chocolate paste into molds in order to shape the chocolate. After pouring the paste into the mold, the mold is vibrated to eliminate any bubbles and to help the chocolate to form evenly.⁴⁴ All this happens in an assembly line fashion (Appendix L); several hundred molds are produced in a single minute.⁴⁵ The formed molds are then passed through cooling tubes to speed up the hardening process.⁴⁶

The final step the chocolate would undergo is the wrapping phase. During the wrapping phase, the chocolate is wrapped in its designated wrapper. The wrappers are actually not manufactured by Hershey's, but a different unnamed company.⁴⁷ When asked, Hershey's refused to reveal who manufactured the items.⁴⁸ The wrappers arrive in large rolls that are later cut into individual wrappers. The milk chocolate is wrapped, sealed and organized into boxes that are ready to be shipped to their designated destinations.⁴⁹

⁴² How Chocolate is Made, Amelie Chocolat[sic], February 10, 2010
< http://www.ameliechocolat.co.uk/info_chocolate_made.html>.

⁴³ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
< <http://www.fieldmuseum.org/chocolate/making.html>>.

⁴⁴ Inside a Modern Chocolate Factory, Essortment, February 26, 2010
< http://www.essortment.com/hobbies/insidemodernch_ttfc.htm>.

⁴⁵ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
< <http://www.fieldmuseum.org/chocolate/making.html>>.

⁴⁶ Inside a Modern Chocolate Factory, Essortment, February 26, 2010
< http://www.essortment.com/hobbies/insidemodernch_ttfc.htm>.

⁴⁷ REF NUMBER: 007000448A, Hershey's Company, March 3, 2010
Email from Hershey's company.

⁴⁸ REF NUMBER: 007000448B, Hershey's Company, March 16, 2010
Email from Hershey's company.

⁴⁹ REF NUMBER: 007000448A, Hershey's Company, March 3, 2010
Email from Hershey's company.

Selling Cacao Beans

Cacao beans are the centerpiece of chocolate. Without it, chocolate would not exist. These beans, though, are sold even before they are harvested. Buyers, such as The Hershey Company, negotiate with the farmers early in the year to predict how many cacao beans will be harvested. After the harvest is in, the buyers inspect the harvest by slicing open a few seeds to make sure that the seeds have fermented properly. If the seeds are deemed good, the farmers receive the full amount of pay agreed on at the beginning of the year.⁵⁰ Now the harvesting begins to try and fulfill the order amount. (The process involving the harvesting of cacao will be discussed in the Ingredients section of the paper.)

Fermentation, Drying, and Cleaning of Cacao Beans

Once the beans have been harvested, the cacao harvesters collect pods (Appendix M) in baskets and transport them to the edge of the fields where they are opened one by one with a machete (Appendix N), and the cacao seeds or beans are taken out.⁵¹ This labor is intense and can take many hours of time. These areas are generally called the de-husking areas.⁵² The seeds are then put into boxes and covered with banana leaves.⁵³ During fermentation, the

⁵⁰ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
< <http://www.fieldmuseum.org/chocolate/making.html>>.

⁵¹ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
< <http://www.fieldmuseum.org/chocolate/making.html>>.

⁵² Madell, Samantha, Theobroma Cacao: From Bud to Bean, Tava, February, 10, 2010
< http://www.tava.com.au/article_processing.html>.

⁵³ About the Cacao Tree, Cacao Web, February 10, 2010
< <http://www.cacaoweb.net/cacao-tree.html>>.

pulp around the seeds turns into acetic acid and evaporates leaving behind only the bean.⁵⁴

Fermentation techniques vary based on the growing region.⁵⁵ Large heaps of cacao beans are turned over many times to ensure even fermentation within the beans.⁵⁶

The seeds take between three to nine days to ferment, much like wine does. Fermenting occurs when the pulp around the seed heats up and activates the enzymes surrounding the seeds to create the chocolate-like flavor.⁵⁷ Once the seed is a rich deep brown, fermentation is complete. Fermenting is a yeasting process and can generate temperatures up to 125°F.⁵⁸ The longer the fermentation process, the stronger the aroma of the beans is.⁵⁹

After fermentation has taken place, the seeds are dried before they are packed and shipped. The drying process usually takes about a week and there are many different methods of drying: sun and hot air pipes to name but a couple (Appendix O).⁶⁰ Often, force-drying methods are executed poorly and may cause smoke-stains in the beans, which makes the beans smell and taste a bit smoke-like.⁶¹ After the beans have been thoroughly dried, they turn from a reddish brown color to a more dark brown color. While drying, the fresh smell of

⁵⁴ How Chocolate is Made, Amelie Chocolat[sic], February 10, 2010

< http://www.ameliechocolat.co.uk/info_chocolate_made.html>.

⁵⁵ Chocolate Production, Cadbury India, January 23, 2010

< <http://www.cadburyindia.com/media/chocoproducton.asp>>.

⁵⁶ From Bean to Chocolate, Info Galaxy, February 1, 2010

< http://www.info-galaxy.com/Chocolate/From_Bean_to_Chocolate/from_bean_to_chocolate.html>.

⁵⁷ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010

< <http://www.fieldmuseum.org/chocolate/making.html>>.

⁵⁸ How Chocolate is Made, This and That, January 23, 2010

< <http://www.waynesthisandthat.com/howtomakechocolate2.htm>>.

⁵⁹ About the Cacao Tree, Cacao Web, February 10, 2010

< <http://www.cacaoweb.net/cacao-tree.html>>.

⁶⁰ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010

< <http://www.fieldmuseum.org/chocolate/making.html>>.

⁶¹ Madell, Samantha, How Chocolate is Manufactured, February 7, 2010

< http://www.chocolatereview.com.au/chocolate_manufacturing>.

cacao fills the air,⁶² giving delight to anyone nearby to be able to smell it. The drying of cacao beans helps to reduce the moisture content of the beans.⁶³

After drying, the weight of the seeds is reduced to about half their original weight.⁶⁴ The smaller beans are then cleaned thoroughly by being placed through sieves and by being brushed. They are checked for remnants of jute fibers, sand, and are cleaned by a powerful vacuum.⁶⁵ The next step the cacao beans go through is inspection by the quality control experts (Appendix P). After passing the inspection, the beans are then sorted into country origin and bean type in order to be roasted.⁶⁶

Sorting and Roasting

Chocolate manufacturers organize the cacao seeds according to type and country when they are received. The chocolate flavor is based on roasting.⁶⁷ Cocoa beans are roasted in a similar way coffee beans are roasted.⁶⁸ The beans are roasted after cleaning to develop the chocolate flavor in large rotary cylinders.⁶⁹ The beans are roasted from 30 minutes to two

⁶² About the Cacao Tree, Cacao Web, February 10, 2010

< <http://www.cacaoweb.net/cacao-tree.html> >.

⁶³ Manufacturing Chocolate, Chocolate Affairs, February 2, 2010

< http://www.chocolate-affairs.com/manufacturing_chocolate.shtml >.

⁶⁴ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010

< <http://www.fieldmuseum.org/chocolate/making.html> >.

⁶⁵ Chocolate Production, Cadbury India, January 23, 2010

< <http://www.cadburyindia.com/media/chocoproductio.asp> >.

⁶⁶ From Pod to Palate Part II: The Birth of The Bar, The Nibble, February 12, 2010

< <http://www.thenibble.com/REVIEWS/MAIN/CHOCOLATE/from-pod2.asp> >.

⁶⁷ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010

< <http://www.fieldmuseum.org/chocolate/making.html> >.

⁶⁸ Manufacturing Chocolate, Chocolate Affairs, February 2, 2010

< http://www.chocolate-affairs.com/manufacturing_chocolate.shtml >.

⁶⁹ Harvesting of Cocoa Pods, The Chocolate Wrapper Museum, February 2, 2010

< <http://www.chocolatewrappers.info/production.htm> >.

hours at a very high temperature. Time and temperature are the most important factors when roasting the beans.⁷⁰

After the roasting is done, the beans are a rich deep brown color. They are then winnowed to reveal only the cocoa nibs.⁷¹ Winnowing is the process by which air is blown through cracked beans to remove the crispy and papery shells from the nibs.⁷² The farmers then scoop the seeds into burlap sacks that can weigh up to 200 pounds when full. Cacao spoils quickly, so it is transported swiftly to the shipping ports in the country.⁷³ The beans are then shipped to different chocolate outposts of the world.⁷⁴ This marks the end of processing of cacao before it reaches the factory to be developed even further into actual milk chocolate.

Ingredients of HERSHEY'S Milk Chocolate

Hershey's milk chocolate bars contain many diverse ingredients. The main ones include milk, cacao beans, and sugar.⁷⁵ A few other minor ingredients called additives, such as soy lecithin (Appendix Q), polyglycerol polyricinoleate (PGPR, Appendix R), and vanillin

⁷⁰ How Chocolate is Made, Amelie Chocolat[sic], February 10, 2010
<http://www.ameliechocolat.co.uk/info_chocolate_made.html>.

⁷¹ Manufacturing Chocolate, Chocolate Affairs, February 2, 2010
<http://www.chocolate-affairs.com/manufacturing_chocolate.shtml>.

⁷² Madell, Samantha, How Chocolate is Manufactured, February 7, 2010
<http://www.chocolatereview.com.au/chocolate_manufacturing>.

⁷³ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
<<http://www.fieldmuseum.org/chocolate/making.html>>.

⁷⁴ How Chocolate is Made, Amelie Chocolat[sic], February 10, 2010
<http://www.ameliechocolat.co.uk/info_chocolate_made.html>.

⁷⁵ Common Ingredients Found in HERSHEY'S Products, Hershey's, February 25, 2010
<<http://www.hersheys.com/nutrition/ingredients.asp>>.

(Appendix S), are also included in Hershey products.⁷⁶ These additives and ingredients are combined in precise proportions to make the essentially perfect Hershey's milk chocolate. These special ingredients are supplied to Hershey's by its partners (the partner companies were refused to be named by The Hershey Company in an interview via email) that have agreed to supply Hershey's with the requested supplies.

The most important part of the chocolate, the cacao bean, comes from different countries around the world. About 20 percent of the world's cacao, though, comes from Central and South America while the majority comes from West Africa.⁷⁷ The leading suppliers in cacao today are Ivory Coast, Ghana, Nigeria, Cameroon, Indonesia, Brazil, Ecuador, Dominican Republic and Papua New Guinea, mostly countries on the equator.⁷⁸

Cacao is an agricultural plant that must be tended to often by farmers. They check up on their cacao fields in intervals and eliminate pests, molds, and diseases that may wipe out their whole crop.⁷⁹ Cacao is also one of the rare crops that are still required to be harvested by hand.⁸⁰ The cacao tree grows in warm and humid climates between 10-20° North and South of the equator which is sometimes called the Cocoa Belt (Appendix T). The trees themselves may grow up to 40 feet tall, and the cacao pod can grow over a foot long. The pods also come in different colors depending on the tree.⁸¹ These huge trees, though, do not

⁷⁶ Depken, Kristen L., What Are the Ingredients in Hershey's Chocolate?, February 25, 2010
<http://www.ehow.com/about_5427870_ingredients-hersheys-chocolate.html>.

⁷⁷ How Chocolate is Made, Amelie Chocolat[sic], February 10, 2010
<http://www.ameliechocolat.co.uk/info_chocolate_made.html>.

⁷⁸ About the Cacao Tree, Cacao Web, February 10, 2010
<<http://www.cacaoweb.net/cacao-tree.html>>.

⁷⁹ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
<<http://www.fieldmuseum.org/chocolate/making.html>>.

⁸⁰ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
<<http://www.fieldmuseum.org/chocolate/making.html>>.

give as many beans as harvesters expect them to give. One tree only produces about 75 pods a year with each pod containing around 20-60 beans.⁸² One pod approximately produces 3 kilograms of dried cacao beans.⁸³

There are many different kinds of cacao beans. The four most common types of beans are the Criollo, Forastero, Trinitario, and the Nacional (Appendix U). The Criollo originated in Mexico and gives very high quality cacao, but the harvest though is fairly low.⁸⁴ The Forastero, which originated in the Amazon, flourishes in western Africa and Brazil and is manufactured for mass production throughout the world.⁸⁵ The Trinitario is a cross between the Criollo and the Forastero, and countries producing cacao are usually part of the developing world.⁸⁶ Last, but not least, the Nacional is mostly grown in South America west of the Andes, mostly Chile. It is the hardest to grow out of all the other trees, but it produces an excellent aroma, which makes up for the hard harvest⁸⁷.

A cacao tree grows fruits all year long, but the harvesting season starts either in October or March, both which are at the beginning of the rainy seasons.⁸⁸ When ready, these pods, as stated above, must be harvested by hand or a machete. Most pods turn deep red or

⁸¹ About the Cacao Tree, Cacao Web, February 10, 2010
< <http://www.cacaoweb.net/cacao-tree.html>>.

⁸² Madell, Samantha, How Chocolate is Manufactured, February 7, 2010
< http://www.chocolatereview.com.au/chocolate_manufacturing>.

⁸³ Madell, Samantha, How Chocolate is Manufactured, February 7, 2010
< http://www.chocolatereview.com.au/chocolate_manufacturing>.

⁸⁴ Manufacturing Chocolate, Chocolate Drops, February 3, 2010
< <http://www.chocolatedrops.com.au/manufacturing-chocolate.aspx>>.

⁸⁵ Manufacturing Chocolate, Chocolate Drops, February 3, 2010
< <http://www.chocolatedrops.com.au/manufacturing-chocolate.aspx>>.

⁸⁶ Manufacturing Chocolate, Chocolate Drops, February 3, 2010
< <http://www.chocolatedrops.com.au/manufacturing-chocolate.aspx>>.

⁸⁷ About the Cacao Tree, Cacao Web, February 10, 2010.
< <http://www.cacaoweb.net/cacao-tree.html>>.

⁸⁸ Harvesting of Cocoa Pods, The Chocolate Wrapper Museum, February 2, 2010
< <http://www.chocolatewrappers.info/production.htm>>.

yellow when they ripen.⁸⁹ The cacao beans may only be harvested by hands or with machetes because the usage of machines may potentially harm the Cacao trees.⁹⁰ Once the beans are harvested, they are then taken to be dried and, ultimately, exported to Hershey's.

In order to bring out the taste of the chocolate even more, Hershey's uses nutritive sweeteners. The company uses sucrose (Appendix V), or high grade sugar, in the production of chocolate.⁹¹ Sucrose is most likely the most abundant pure organic chemical in the world.⁹² Sucrose is a disaccharide that contains one equivalent of glucose and one equivalent of fructose.⁹³ Sucrose is what most people think of as sugar. Hershey's uses this sugar to enhance their products. The manufactured sugar is then shipped to Hershey's by truck or by train.

Milk is a vital ingredient in milk chocolate. Milk is obtained through dairy farms, where cows are fed up to eight times a day. The milk obtained is incorporated into the chocolate during the refining process.⁹⁴ Milk is actually an emulsion of butterfat globules and a water based fluid.⁹⁵ Many vitamins, such as A, D, K, and E are found in milk along with calcium.⁹⁶ Milk's sweet taste comes from carbohydrate lactose (Appendix W) which is about

⁸⁹ How Chocolate is Made, Amelie Chocolat[sic], February 10, 2010
< http://www.ameliechocolat.co.uk/info_chocolate_made.html>.

⁹⁰ From Pod to Palate Part II: The Birth of The Bar, The Nibble, February 12, 2010
<<http://www.thenibble.com/REVIEWS/MAIN/CHOCOLATE/from-pod2.asp>>.

⁹¹ Ingredients, Hershey Center for Health and Nutrition, February 10, 2010
< <http://www.hersheys.com/nutrition-professionals/chocolate/composition/definitions/ingredients.aspx>>.

⁹² Sucrose, 3D Chem, January 28, 2010
<<http://www.3dchem.com/molecules.asp?ID=59>>.

⁹³ Sucrose, 3D Chem, January 28, 2010
<<http://www.3dchem.com/molecules.asp?ID=59>>.

⁹⁴ All About Chocolate: Making Chocolate, The Field Museum, February 12, 2010
< <http://www.fieldmuseum.org/chocolate/making.html>>.

⁹⁵ McGee, Harold, "Milk and Dairy Products", *On Food and Cooking: The Science and Lore of the Kitchen*, pp. 3-53.

⁹⁶ McGee, Harold, "Milk and Dairy Products", *On Food and Cooking: The Science and Lore of the Kitchen*, pp. 3-53.

40 percent of the milk's calories.⁹⁷ The milk is transported from the farm to Hershey's either by truck or railcar.

A type of derivative of milk used is milk crumb. Milk crumb is made by evaporating and condensing liquid milk using heat and a vacuum in the presence of a small amount of chocolate liquor to form a dry crumb that can be stored and used as an ingredient to make milk chocolate.⁹⁸ Milk crumb is actually just a combination of cocoa liquor, sugar, milk solids and sometimes added cocoa butter. The process used to make it is a Maillard Reaction, which produces a toasted or caramel flavor using milk protein and sugar.⁹⁹

Soy lecithin is a byproduct of soybean oil and is produced naturally.¹⁰⁰ It is removed from the plant either mechanically or chemically, and it is used in the manufacturing of chocolate. Soy lecithin is used because of its emulsification properties, which are able to keep the chocolate bar together before eaten.¹⁰¹ It makes sure the cocoa and the cocoa butter do not separate. Since it is derived from soybean oil, people allergic to soybeans do not need to worry about products containing soy lecithin.¹⁰²

Polyglycerol polyricinoleate is formed by the esterification of polyricinoleic acid and has a natural condensation rate of 2 to 10.¹⁰³ This polyglycerine mixture comprises of 5-35

⁹⁷ McGee, Harold, "Milk and Dairy Products", *On Food and Cooking: The Science and Lore of the Kitchen*, pp. 3-53.

⁹⁸ Ingredients, Hershey Center for Health and Nutrition, February 10, 2010

< <http://www.hersheys.com/nutrition-professionals/chocolate/composition/definitions/ingredients.aspx>>.

⁹⁹ What is Milk Crumb? Dairy Management, February 26, 2010

< <http://www.innovatewithdairy.com/Pages/Whatismilkcrumb.aspx>>.

¹⁰⁰ What is Soy Lecithin and Why is it Found in so Many Products, Fooducate, February 26, 2010

<<http://www.fooducate.com/blog/2009/07/07/what-is-soy-lecithin-and-why-is-it-found-in-so-many-products>>.

¹⁰¹ What is Soy Lecithin and Why is it Found in so Many Products, Fooducate, February 26, 2010

<<http://www.fooducate.com/blog/2009/07/07/what-is-soy-lecithin-and-why-is-it-found-in-so-many-products>>.

¹⁰² What is Soy Lecithin and Why is it Found in so Many Products, Fooducate, February 26, 2010

<<http://www.fooducate.com/blog/2009/07/07/what-is-soy-lecithin-and-why-is-it-found-in-so-many-products>>.

¹⁰³ Polyglycerol Polyricinoleate, Free Patents Online, February 12, 2010

< <http://www.freepatentsonline.com/5736581.html>>.

percentage of weight glycerine, 15-40 percentage of weight diglycerines, 10-30 percentage of weight triglycerines, 8-20 percentage of weight tetraglycerines, and 3-10 percentage of weight pentaglycerines, and the remainder being oligoglycerines.¹⁰⁴ This material is used to improve emulsifying capacity of chocolate along with soy lecithin.

Another vital ingredient which is sometimes mistaken for vanilla, vanillin has a strong milky odor that makes it a useful ingredient in chocolate. Vanillin is extracted from the pods of *Vanilla planifolia*.¹⁰⁵ The Aztecs were actually the first ones to use it as a flavoring in chocolate.¹⁰⁶ Its pleasant smell and flavoring make vanillin a much sought after product.¹⁰⁷

Conclusion

As I finished my research while munching on a chocolate bar, it made me really appreciate what I was holding in my hand. The chocolate was a product of not one huge chocolate factory process as many people believe, but many different subsidiaries and the big companies around the world. Something as simple and as taken for granted as a chocolate bar takes a myriad of steps (Appendix X) and people to develop into the final product.

¹⁰⁴ Polyglycerol Polyricinoleate, Free Patents Online, February 12, 2010
< <http://www.freepatentsonline.com/5736581.html>>.

¹⁰⁵ Vanillin, Be-Long Group, January 20, 2010
< <http://www.be-longgroup.com/Human-Nutrition/Vanillin.html>>.

¹⁰⁶ Vanillin, 3D Chemistry, February 20, 2010
< <http://www.3dchem.com/molecules.asp?ID=307>>.

¹⁰⁷ Vanillin, 3D Chemistry, February 20, 2010
< <http://www.3dchem.com/molecules.asp?ID=307>>.

Thankfully, inventions, such as Henry Ford's assembly line,¹⁰⁸ have aided in the speed of development of the products. Without the assembly line, chocolates and many other items would be significantly more expensive than now.

After this project, I started to realize that nothing in our world is easy. Even the simple chocolate bar takes innumerable steps to be manufactured correctly. As I live out my day, I ask myself how everything else got there and wonder if those other items took as long as the chocolate bar did to be made. From this project, I gleaned the mindset of appreciating the many fortunes we have and the hard work that goes into the making of these daily goods.

¹⁰⁸ Henry Ford (1863-1947), About.com, February 9, 2010
<<http://inventors.about.com/od/fstartinventors/a/HenryFord.htm>>.

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Appendix

Appendix A



http://candyaddict.com/blog/candy_pictures/hersheys-candydirect.jpg

Appendix B



<http://z.about.com/d/travelwithkids/1/0/z/C/CHOCOLAT.JPG>

Appendix C



<http://www.hiloliving.com/Shopping/CostULess.JPG>

Appendix D



<http://www.grubgrade.com/wp-content/uploads/2009/07/Chocolate-World-at-Hershey-Park14-1024x614.jpg>

Appendix E



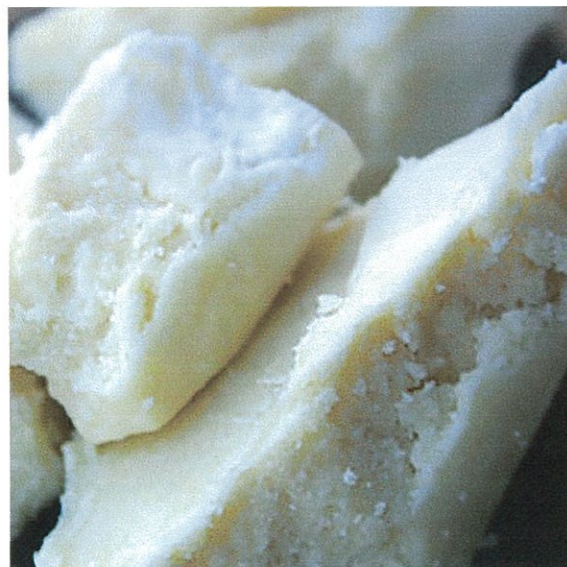
<http://www.treesfullofmoney.com/wp-content/uploads/2009/03/checkout1.jpg>

Appendix F



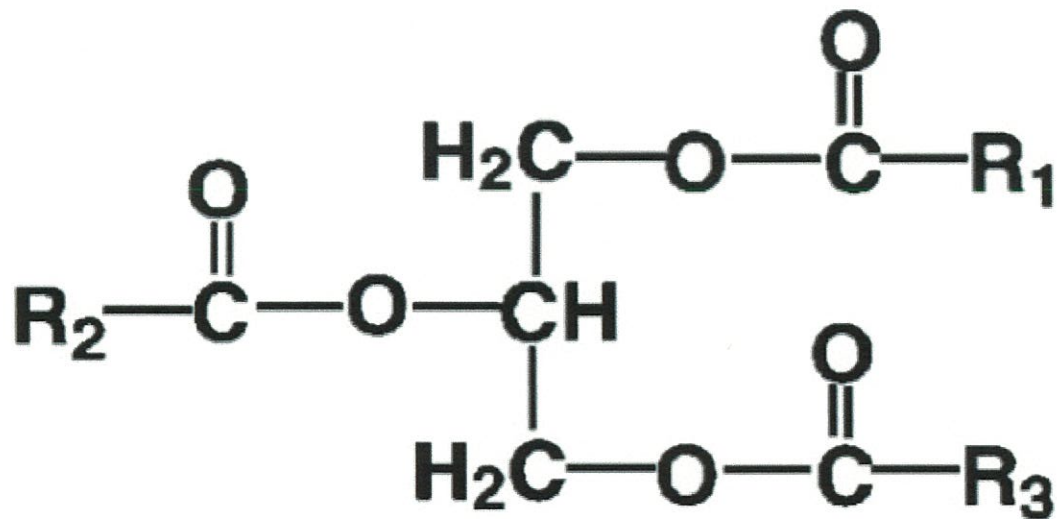
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Appendix G



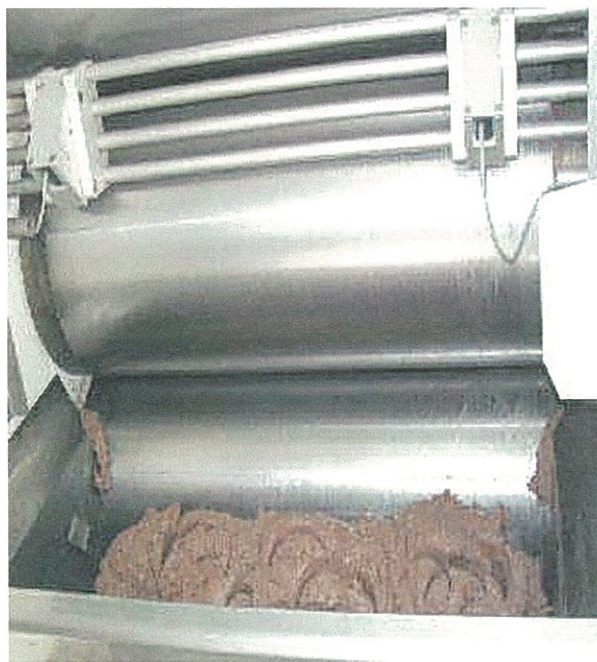
<http://organicsoapbygrace.com/images/ButterCocoa.jpg>

Appendix H



http://msr.dom.wustl.edu/Research/images/Lipodomics_Figure_1.jpg

Appendix I



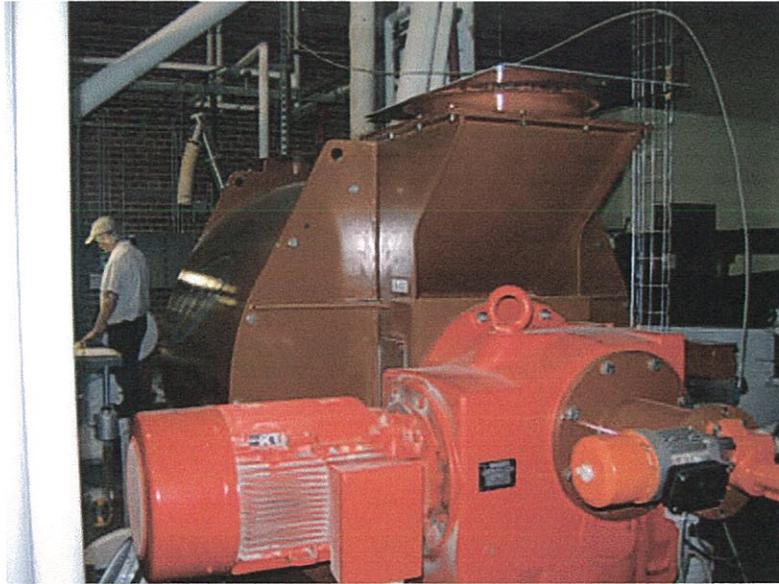
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Appendix J



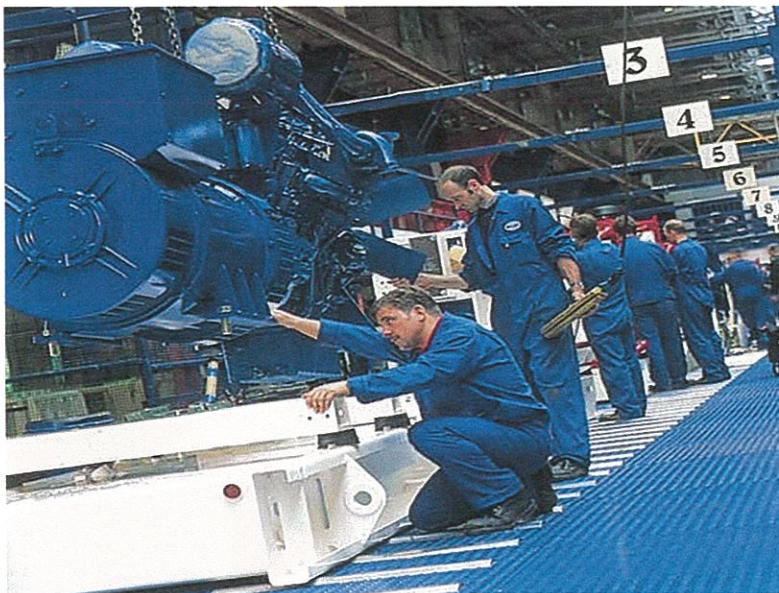
<http://img.tradeindia.com/fp/0/256/818.jpg>

Appendix K



<http://z.about.com/d/candy/1/5/9/4/-/-/conch.jpg>

Appendix L



<http://espin086.files.wordpress.com/2009/05/assembly-line.jpg>

Appendix M



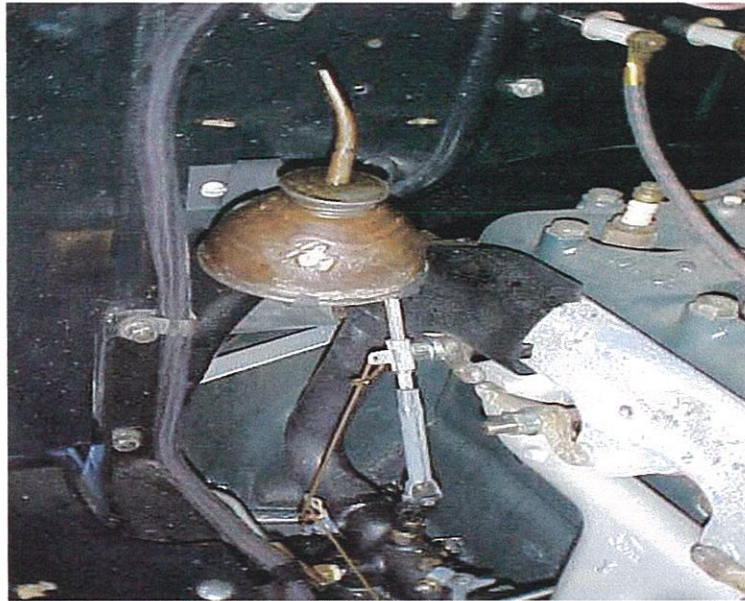
<http://cbertel.files.wordpress.com/2008/09/cacao-pods-on-tree.jpg>

Appendix N



<http://www.freewebs.com/panthr/machete.jpg>

Appendix O



[http://www.tontruckclub.org/carburetor hot air pipe and oil can installed.JPG](http://www.tontruckclub.org/carburetor_hot_air_pipe_and_oil_can_installed.JPG)

Appendix P

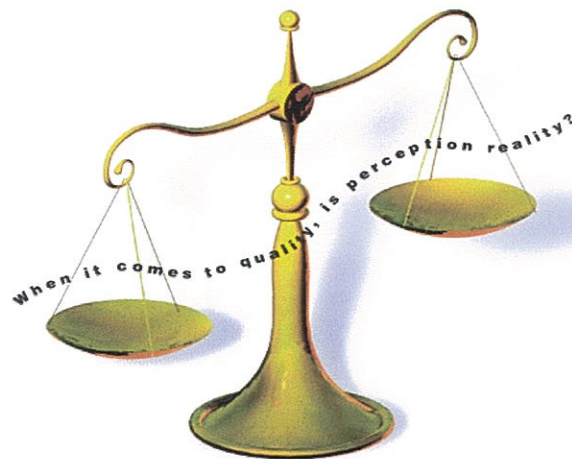
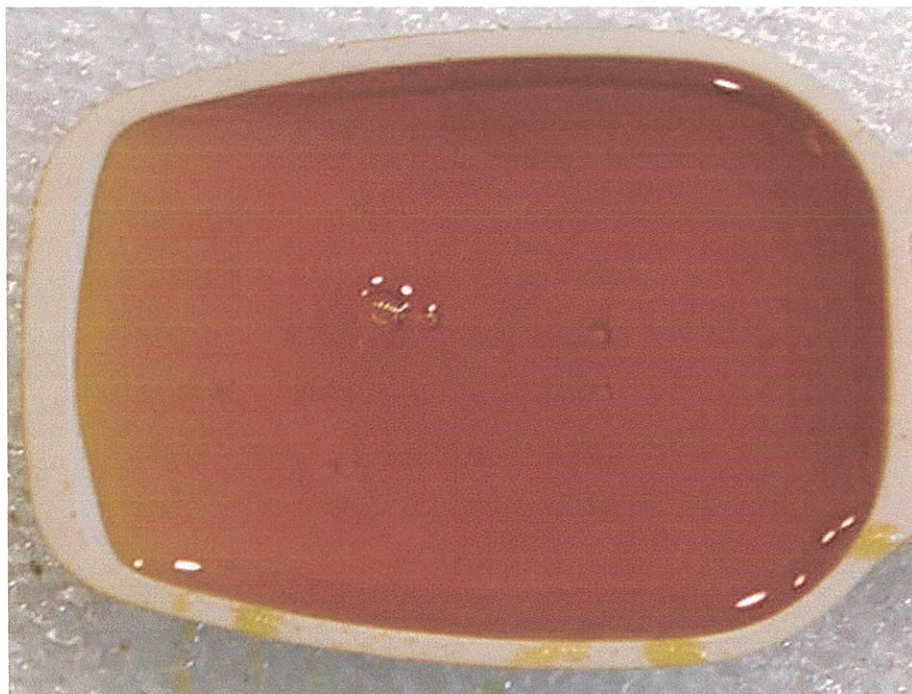


ILLUSTRATION BY BRYAN LESTER

QUALITY CONTROL

http://www.cmcltd.com/sbu/images/cet_quality_control.gif

Appendix Q



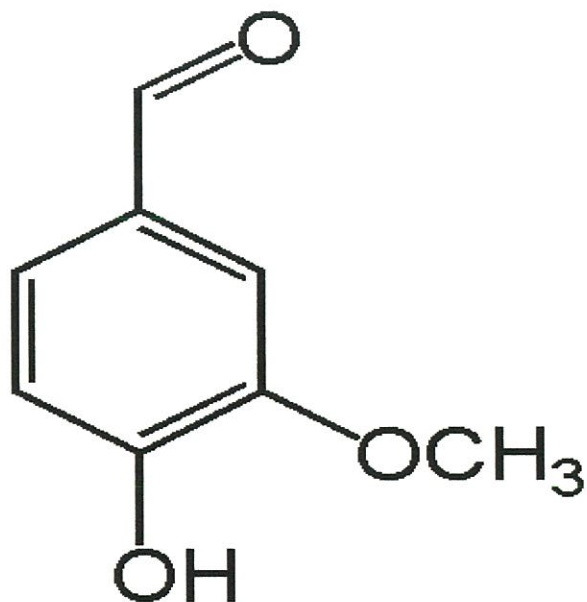
<http://www.treehugger.com/Soy-Lecithin.jpg>

Appendix R



<http://img.tradeindia.com/tradeleads/1/2053911.jpg>

Appendix S



<http://colinsbeautypages.co.uk/wp-content/uploads/2008/06/vanillin.jpg>

Appendix T



[http://www.teachnet-lab.org/miami/2005/linero2/images/unit pictures/ripefruitmarink12caus.jpg](http://www.teachnet-lab.org/miami/2005/linero2/images/unit%20pictures/ripefruitmarink12caus.jpg)

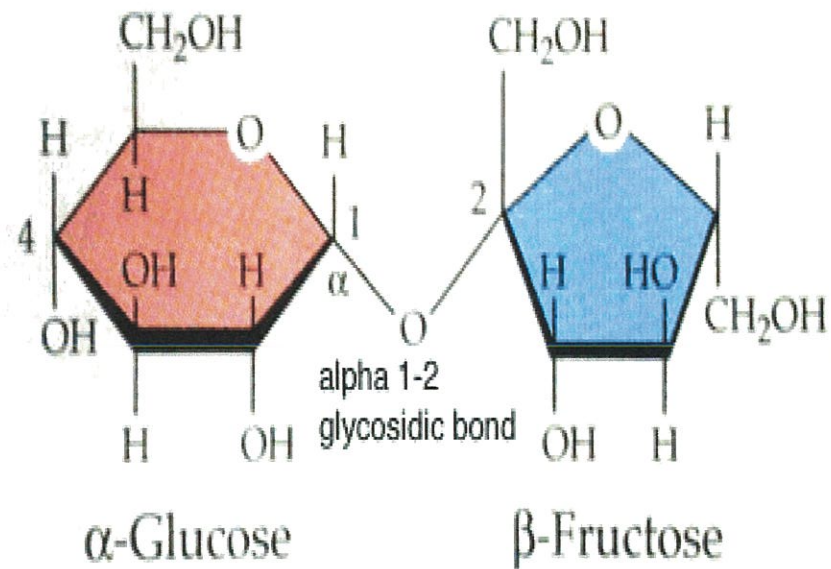
Appendix U



<http://www.detoxtrading.co.uk/images/cacao2.gif>

Appendix V

Sucrose has the molecular formula $C_{12}H_{22}O_{11}$

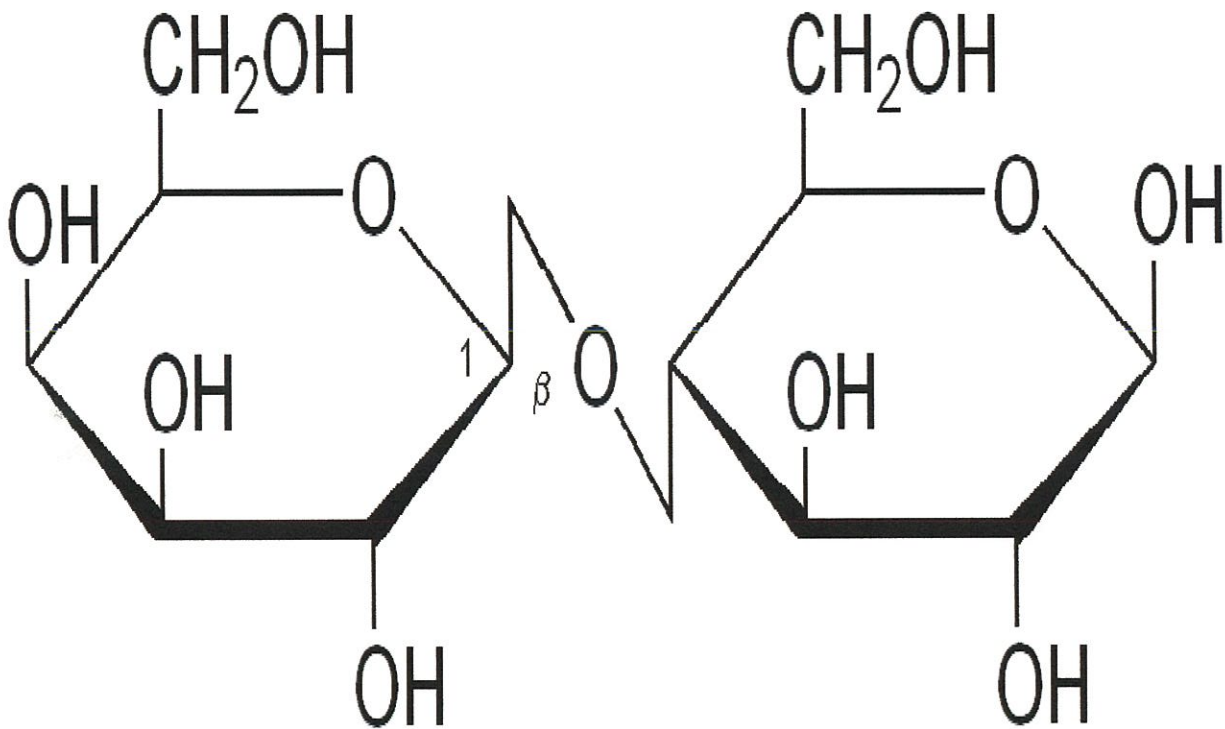


Sucrose

<http://www.chm.bris.ac.uk/motm/glucose/sucrose.gif>

Appendix W

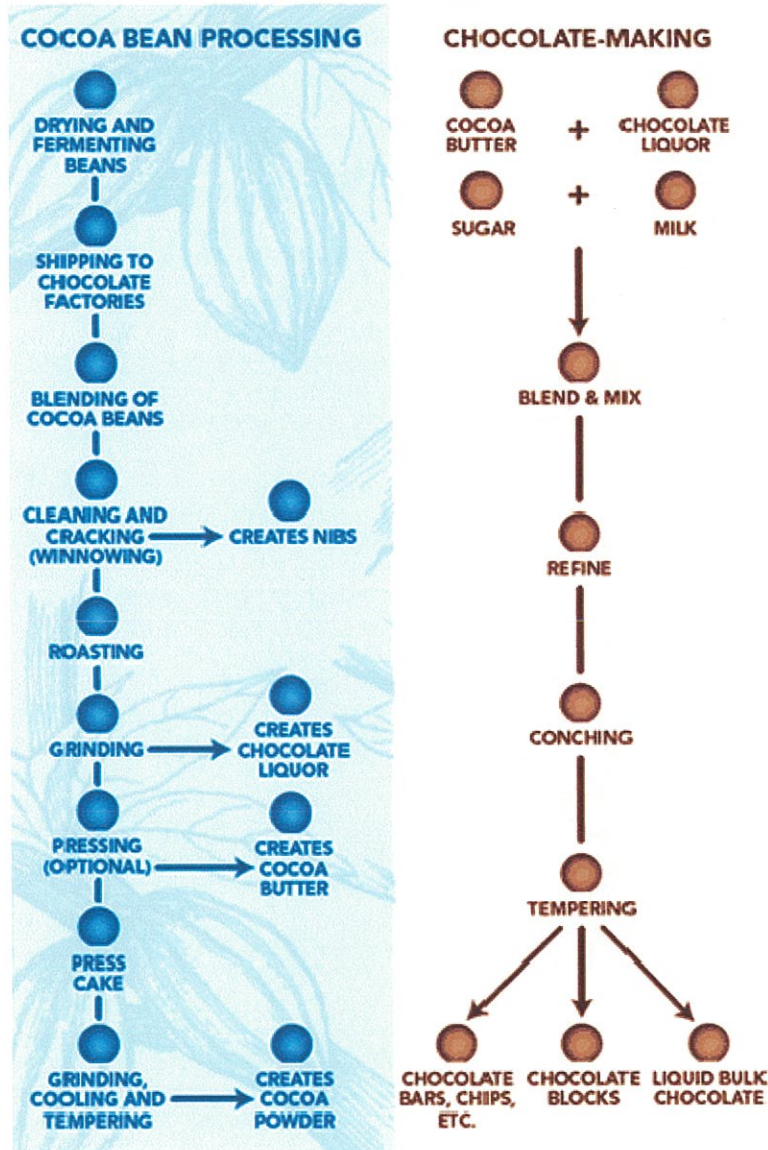
Lactose



[http://upload.wikimedia.org/wikipedia/commons/1/17/Lactose\(lac\).png](http://upload.wikimedia.org/wikipedia/commons/1/17/Lactose(lac).png)

Appendix X

Chocolate Manufacturing



http://www.thenibble.com/REVIEWS/MAIN/draft/images/choc_manu_chart.gif