

Geography of Crop Plants
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Lecture Notes
Part 2

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Cacao

Cacao belongs to the genus *Theobroma*, which means Food of the Gods, (thus named by the famous Swedish taxonomist Linnaeus).

The scientific name of the cacao tree is *Theobroma cacao*.

Cacao has about nine near relatives (i.e. nine other species in the genus *Theobroma*).

Chocolate is made from beans (technically seeds) of cacao fruits.

The term chocolate is derived from the Aztec word *chocolatl*.

The Aztecs and other indigenous cultures of Mexico, Guatemala, and Honduras processed cacao beans to make a chocolate drink (not candy bars).

Specialized ceramic bowls are still made for serving the chocolate drink; archaeological remains of such bowls in the Ulua River valley of Honduras have been dated at 1,600 B.C.

So people have drunk chocolate in parts of Central America for at least 4,600 years.

But it was not like the hot chocolate familiar to most of us.

The chocolate beverage prepared by Central Americans in ancient times was flavored with hot capsicum pepper.

Sometimes maize meal (“grits” to southerners) was added to form a thickened drink. Such a concoction would taste pretty bitter to most of us because it did not have any sugar.

The Aztecs collected tribute from conquered tribes in the form of cacao beans, among other valuable commodities.

Spain had the first chocolate factories in the Old World and they sweetened their chocolate drinks with cane sugar produced in their territories in Central and South America.

Pharmaceutically-active ingredients in chocolate: Sex, addiction, and longevity

Chocolate is often associated with, and marketed as, an aide in courtship.

A common gift on St. Valentine’s Day, for example, is a box of chocolates or cookies with chocolate chips.

One upscale Colorado-based chocolate company, for example, is called Chocolive.

Chocolate eating is perceived as sensual pleasure, an allegory for sex; this dimension is explored in a popular film that was released in the early 1990s

entitled *Like Water for Chocolate* (1993), a Mexican film that became a hit in the U.S. The film is “a passionate tale of forbidden love”, and features *mole* sauce and the use of cocoa butter as a lip balm.

More recently, *Chocolat* (2000) is a humorous film depicting life and passions surrounding the opening of a chocolate shop in a French town in the 1960s.

There is a physiological basis for this "passion" for chocolate; it contains phenylethylamine, a stimulant chemically similar to the human body's dopamine (which acts on the brain's mood center) as well as adrenaline.

Cocoa butter may contain lipids that are related to anandamide, which is a brain lipid that binds to cannabinoid receptors and mimics the psychoactive effects of plant-derived cannabinoid drugs (*Nature*, vol. 382, 22 August 1996, p. 677). Chocolate contains 3 unsaturated N-acyl ethanolamines that could act as cannabinoid mimics.

Chocolate also contains theobromine and methylxanthines, two mildly active substances similar to caffeine.

Chocolate contains polyphenols and flavonoids which act as antioxidants and reduce the build-up of fatty deposits in veins. Some studies suggest that eating chocolate can reduce the chances of developing hardening of the arteries. Chocolate has higher levels of these beneficial chemicals than vegetables and fruits. Chocolate contains catechins, a particular class of flavonoids, are strong antioxidants, thus reducing the harmful effects of free radicals, which can damage cell membranes and DNA. The catechin content of chocolate is 4 times higher than black tea.

Description of Cacao and its Fruit

Cacao is a small tree that is adapted to the lowland, humid tropics, where it produces fruits all year, although production may peak at certain times of the year. It is indigenous to the rainforests of western Amazonia where it is an understory tree. How and when it reached Central America is a mystery, but it spread thousands of years ago.

Cacao produces pods that grow on tree trunk and branches (cauliflory). Each pod contains 20-60 beans that are surrounded by a white, delicious tasting pulp.

The pulp (technically mesocarp) is “designed” to attract seed dispersal agents, mainly monkeys.

Monkeys break off the pods, scamper away to loftier trees, and crack open the pods on branches and tree trunks. After sucking the pulp off, the seeds are dropped to the ground where they can germinate.

The seed coat is impregnated with bitter-tasting alkaloids to discourage biting down on the seeds.

In this manner, cacao progeny are dispersed safely away from the parent tree where they are less susceptible to disease and pest pressure.

PowerPoint #8: *Cacao*

Cacao in Farming Systems

Cacao is grown both on large estates or plantations, as well as by individual farmers in small groves near their home. Most of the world's cacao, however, is grown on small farms, often with other crops or in partially cleared forest. Thus cacao farms can be biodiversity-friendly.

Harvesting and Processing

The cacao pods are torn off the trunks and branches by hand or with the aid of a pole equipped with a blade and are cut open with a machete to scoop out the beans and pulp.

The beans and pulp are then transported to the farm or estate, usually in sacks carried by mules, or if near water, by canoes.

Chocolate cannot be made directly from the recently-harvested beans.

The following steps are necessary to make chocolate:

1. The beans and attached pulp are fermented for 3-7 days, usually in a wooden bin or vat (called *cuxo* in Bahia, Brazil). Small producers often ferment cacao beans in baskets or in heaps covered with banana leaves. Fermentation releases the precursors of chocolate flavor
2. After a few days, the fermentation is stopped by drying the beans. This is accomplished either by spreading the beans on mats in the sun (which can be quickly gathered up or covered with plastic or tarpaulin in case of rain), or in large movable drawers that can be pushed into a shed when it rains. Cacao grows in the hot, humid lowland tropics where rain showers can be frequent and powerful. In particularly rainy areas, such as Bahia, Brazil, the movable drawers are heated from below, sometimes by wood fires that impart a smoky flavor, thereby impairing its quality. Drying takes about a week and the flaky pulp is dislodged from the beans by periodically turning over the beans with paddles and by workers stomping on the beans.
3. The dried beans are then stored in sacks or baskets until a merchant picks them up, or the grower takes them to a dealer.
4. At the factory, beans are first put on a shaking sieve to remove debris, while a magnet removes metal items that may have been slipped in sacks to increase their weight (thereby deceiving the buyer).

5. The clean beans are then roasted to bring out chocolate flavor: over 500 components are involved in the flavor of chocolate. That is why no artificial chocolate has been created (the closest equivalent is carob made from a leguminous plant).
6. After roasting, the beans are ground up into a sticky paste, called liquor in the trade (although it does not contain any alcohol).
7. The liquor is then pressed to bring out the oil, called cocoa butter. Cocoa butter is an important byproduct from chocolate making and is used in a wide variety of sun tan lotions, moisturizing creams and hair conditioners, and other cosmetics.
8. The pressed liquor is called cake.

Cacao producing countries export cacao beans, liquor, cake, and cocoa butter to countries that manufacture chocolate.

PowerPoint #9: *Chocolate*

Basic Kinds of Chocolate: Milk, Dark, Semi-Sweet, and White

In 1824, C.J. van Houten, a Dutchman, discovered a process for removing cocoa butter, thereby making drinking chocolate more palatable because the amount of cocoa butter can be controlled.

Some, but not all, of the cocoa butter is added back to the mix.

If no cocoa butter is removed, the chocolate is a bit greasy, and an unattractive oily film appears on the surface of hot chocolate beverages.

In 1876, M.D. Peter in Switzerland conceived of idea of adding dried milk to make "milk chocolate".

Milk chocolate contains the following main ingredients:

- Cocoa powder
- Some of the cocoa butter which has been added back
- Sugar
- Milk powder

Dark chocolate is used for baked products and is composed of:

- Cocoa powder
- Some of the cocoa butter which is added back

Semi-sweet chocolate is used for baking and also for direct eating. Semi-sweet chocolate is more popular in Europe, where it is sometimes called bittersweet chocolate, than in the U.S. Semi-sweet chocolate is composed of:

- Cocoa powder

- Some of the cocoa butter which is added back
- Sugar (just a little)

White chocolate

White chocolate is more popular in Europe than in the U.S.

In the early 1990s, Nestlé marketed a white chocolate bar in the U.S. called *Alpine* (it contained almonds). Although this product line seems to have been discontinued, Hershey began marketing a white chocolate bar called *Cookies and Cream* in 1995, and that product is still on the market.

White chocolate is an ingredient in some “upscale” desserts, such as strawberries dipped in white chocolate, and in some yogurts such as Yoplait's "Raspberries with White Chocolate".

The main ingredients in white chocolate are:

- Milk powder
- Sugar (a lot, thus increasing the calorie "load")
- Cocoa butter

Consumption and Manufacturing

Globally, the chocolate industry generates \$60 billion in sales annually

Main consumers of chocolate are in the industrial world, not in areas where cacao is grown.

No cacao producing country is anywhere near the top in per capita consumption of chocolate for two main reasons:

1. Refrigeration facilities are often limited in developing countries
2. Purchasing power is often limited for discretionary items such as candy

The main chocolate-consuming countries on a per capita basis are:

Ranking	Country	Kg chocolate/person/year
1	Switzerland	9.3
2	Norway	6.7
3=	United Kingdom	6.6
	Germany	6.6
5	Belgium	6.5

The United States is in 14th place with about 5.4 kg chocolate/person/year.

Chocolate was drunk as a luxury item in parts of Europe during the 16th century. Chocolate houses sprung up alongside coffee houses in the 17th century in Western Europe, but were only patronized by the wealthy.

Famous Chocolatiers

Netherlands

The Netherlands became famous early for chocolate because it had a tropical Empire where cacao could be grown, such as in Surinam in northern South America and in the various islands of Indonesia.

Also, the Netherlands has a large, and highly productive dairy herd supplying a major ingredient for milk chocolate. A lot of consolidation has occurred in the chocolate industry worldwide, and several independent chocolate makers in Holland have either gone out of business through stiff competition or have been bought out, including *Verkade* and *Van Houten*.

The best known remaining Dutch chocolate company is:

- ◆ *Droste*: Very high quality, expensive, individual chocolates are round, tablet-shapes and are packaged in either an hexagonal box or tube. Both milk chocolate and semi-sweet chocolates are made by this company based in Haarlem. Exported to many countries, including the U.S.A.

Switzerland

Switzerland has become renowned for its chocolate because milk chocolate was first made there, and because Switzerland has a lot of milk production.

- ◆ *Nestlé*: Now a multinational corporation with interests in a wide range of food products, including baby formula, Nestlé focuses its business on the mass-market for chocolate. Nestlé is the largest chocolate company in the world. It has grown in part by acquiring other companies, such as Rowntree in the U.K., which developed Kit-Kat among other products. Nestlé has also bought Baby Ruth and Butterfinger from RJR Nabisco.
- ◆ *Lindt*: Founded by Rodolphe Lindt in Zurich in 1845. Expensive, high quality chocolates exported to many countries, including the U.S.A.
- ◆ *Suchard*: Established in Neuchâtel in 1826. Expensive, high quality chocolates. One of Suchard's products, Toblerone, is exported to many countries. Suchard is now a subsidiary of Kraft, a U.S.-based multinational food corporation, which in turn is owned by Philip Morris, a tobacco company.

Belgium

Belgium was part of the Holy Roman Empire in the 17th century, and this explains why the tradition of chocolate-making is so well entrenched there.

Belgium has always imported cacao from other colonial powers, since cacao was not grown to any significant extent in its few colonial possessions in Africa, such as the Congo (now Zaire), Burundi, and Rwanda.

- ◆ *Godiva*: Expensive chocolates, exported to many countries. Packaged in distinctive gold boxes. The main store is located at the Grand Place in Brussels. In Gainesville, Godiva chocolates can sometimes be found in such up-market stores as Burdines in the Oaks Mall. Godiva is now owned by Campbell Soup.
- ◆ *Neuhaus*: Founded in 1857; the main store is off the Grand Place in Brussels. The hand-crafted chocolates are flown to some U.S. markets where they sell for about \$32/lb. Neuhaus chocolates are packaged in distinctive silver boxes.
- ◆ *D'Orsay*: Established in 1659. Found in expensive boutiques.
- ◆ *Schoofs*: Expensive, up-market chocolate, exported to the U.S. and other markets.
- ◆ *Café Tasse*: Marketed as a chocolate for coffee drinkers. The company is headquartered in Brussels. Dark, white, and milk chocolate sold at specialty food and candy stores, such as Upper Crust Bakery in the Millhopper shopping center of Gainesville, Florida. Expensive, at about \$3.60 for a medium-sized bar.

Britain

The British are heavy consumers of chocolate and this tradition can be traced to a colonial empire in the tropics where cacao has been produced, particularly in Ghana and Nigeria in West Africa, and because the British Isles support a large dairy herd.

Britain is not known for upmarket chocolates, and only one chocolate company is well-known outside of the U.K:

- *Cadbury*: Started as a family firm. The Cadbury family members are Quakers, a Christian church that believes in pacifism and emphasizes treating people with kindness. This religious attitude explains why the Cadbury family insisted on humane treatment for workers on cacao plantations in West Africa. Also, the Cadbury family promoted smallholders for cacao production, rather than large estates. Cadbury chocolates are now manufactured under license in the U.S. by the Hershey corporation. Cadbury cream eggs are a seasonal item during the Easter season in the U.S. market.

U.S.A.:

- *Hershey*: Milton Hershey started the company in 1894, and Hershey Kisses were first produced in 1907. Headquartered in Hershey, Pennsylvania, where tourists can visit the factory and patronize the adjacent amusement park. The Hershey chocolate bar has become an icon or symbol of American culture. Hershey is a strong company in the U.S., but is weak internationally. It has grown by acquiring other small chocolate companies.
- *Mars*: Frank Mars started this company in Chicago in 1927, but it was his son, Forrest, who transformed the company into an international force in the candy

business. The first Snickers bar came off the production line in 1930. Mars markets a large array of products and is roughly neck-a-neck with Hershey in U.S. chocolate sales. However, internationally, Mars is much stronger. Mars has grown by investing products in developing new products, rather than by acquiring small competitors. The only exception is the *Dove* line of chocolates and chocolate-coated ice cream bars, purchased from a Chicago-based company.

- *Baker's* is the oldest chocolate company in the U.S., founded in 1779 at Lower Mills, Dorchester County in Massachusetts.

The Growing Market for Premium Chocolate

Premium chocolates usually use no artificial ingredients or preservatives (although check the labels!), and are typically hand-made. Below are some premium as well as mass-marketing chocolate companies by country. Higher quality chocolates are typically have a higher content of cacao. In the U.S., a candy product can be called chocolate if it contains only 10 % cacao (the rest is typically milk and sugar). The most expensive chocolates are typically dark chocolate with 70% cacao. Some of the high end chocolate bars point out the variety of cacao beans used, their source called “terroir” (a single plantation or area), and the year harvested “vintage” (*Wall Street Journal*, 13 February 2003, p. D1). Most of the cheaper chocolate bars are a blend.

Small, high quality chocolate producers in the U.S. include:

Ghiradelli at Fisherman’s Wharf in San Francisco.

Scharffen Berger, founded in Berkeley, California, in 1996, this company specializes in dark chocolate.

The Emergence of Chocolate Lounges

Following the success of Starbucks with coffee, the Mars corporation opened Ethel’s Chocolate Lounge in 2005 in Chicago. Mars intends to open a chain of Ethel’s Chocolate Lounges throughout the U.S. The lounges sell Mocha coffee with premium chocolate squares, as well as hot chocolate. The café Mocha sells for \$4.50 a cup, and the chocolate squares varying from 90 cents to \$1.50 a piece (*Wall Street Journal*, 15 July 2005, p. B1).

Hershey Corporation has also started selling chocolate beverages at its retail stores in Chicago, New York, and Hershey, Pennsylvania.

Godiva chocolate boutiques (owned by Campbell Soup) have started selling a frozen chocolate beverage called Chocolixer in a variety of flavors for \$4.50 in a 12 ounce cup.

Starbucks is also getting into the market for chocolate beverages in a café setting with chocolate drinks including Chantico which contains cocoa butter and milk. Starbucks is also selling its own brand of chocolate and chocolates made by other manufacturers.

Chocolate in Cuisine

In Mexico, chocolate still occupies a special place in cuisine.

Mole is a thick chocolate sauce used in various dishes, such as to cover roast chicken. The use of chocolate in dishes is especially pronounced in the vicinity of Puebla, Mexico.

In Amazonia, beans apparently not used in prehistoric times, but the pulp was eaten as a snack food.

Juice made from cacao pulp is popular in Bahia, Brazil, the major cacao producing area of the state, and is growing in popularity in the Amazon region as well.

Chocolate is a major ingredient in many desserts served in restaurants and entire cookbooks are devoted to chocolate desserts including:

- *Death by Chocolate: The Last Word on a Consuming Passion*. From the book jacket: This book is about obsession, cravings, and licit indulgences. It is about deliriously delicious, silkily sensuous, soul-stirring chocolate desserts, about Rabelaisian pleasures, and fantasies come true. These seductive cakes, elegant ice creams, lustrous sauces, mouthwatering truffles, divine wafers, and unbelievably satisfying brownies are all from the kitchen of Marcel Desaulniers, a truly inspired chef. At the Trellis Restaurant, in Colonial Williamsburg, Marcel Desaulniers has created a unique and innovative cuisine.
- *Sin-Free Chocolate Smoothies: A Chocolate Lover's Guide to 70 Nutritious Blended Drinks*

Diffusion of Cacao

Not clear exactly when or how cacao arrived in Central America.

It was either carried there by people, such as up the Negro and down the Orinoco the coast and then along northern South America to Central America.

Cacao beans may have been carried across the Andes in Peru, Ecuador, or Colombia, and along the Pacific Coast of South America up into Central America. Or, the tree may have dispersed naturally.

Either truly wild or naturalized cacao is found in the humid, lowland parts of Central America.

In 1525, Spaniards planted cacao on Trinidad and later Venezuela. Spaniards tried to control the planting to gain a monopoly, but eventually the Dutch, British, French broke this down as they established possessions in the Caribbean and northern South America.

Brazil became the world's largest exporter of cacao in the New World by the late 1800s.

Cacao was introduced to West Africa, via São Thomé in the Gulf of Guinea, in 1878 or 1879.

By 1951, West Africa produced more than 60% of world's cacao. But in the 1970s and 1980s, cacao production in Nigeria and Ghana, the main producers in that region, dropped precipitously due to civil strife, poor management of the national economies, and disease problems.

While West Africa has lost ground in the global cacao market, Malaysia is emerging as a significant producer.

Genetic Resources

An old traditional cultivated type of cacao, called *criollo*, has largely fallen into disuse even though it produces a better quality chocolate. The problem is that it does not have high yielding as modern forms.

Wild populations of cacao are found in the rainforests of western Amazonia. As those forests are increasingly cut down, genetic resources for the crop are lost.

Breeding Challenges

Cacao is pollinated by certain small flies called midges; insecticides can disrupt pollination. If insecticides are sprayed to control pests, they can kill the pollinators. If that happens, fruit set is minimal.

Genetic resistance to insect pests is an important strategy for overcoming pest problems, and underscores the importance of conserving genetic resources of cacao.

Both in Malaysia and in Rondônia, Brazil, certain beetles attack cacao pods on plantations. The small beetles tunnel through the pod to lay their eggs in the pulp. The larvae then damage the fruits, and the tunnels allow bacteria and fungi to enter the fruit.

A hard-shelled cacao that might be useful in breeding for resistance to the tunneling beetles was discovered in a home garden in Benevides, Pará, Brazil. This discovery underscores the importance of traditional varieties for modern cacao breeding.

Several diseases attack cacao, the most important being:

Witches' Broom

Witches' broom disease is caused by a fungal pathogen (*Crinipellis perniciosa*), which is native to Amazonian forests.

In the Amazon rainforest, witches' broom does not cause catastrophic damage because the individual cacao trees are more spread out than on plantations.

Witches broom has been spreading out of the Amazon; it was reported in Surinam in 1895, Trinidad in 1928, Grenada in 1948.

Since the 1930s, several field missions have been mounted to collect wild cacao in the Amazon and screen it for resistance to witches' broom.

Although genetic resistance has been located, the problem is that there is more than one strain of the pathogen, and it continues to evolve new races. Thus single gene resistance may not work for long.

Farmers can control witches' broom by pruning the diseased branches. But this adds to labor costs. When cacao prices are high, it is worthwhile for farmers to do this. When cacao prices are low, many farmers suspend both harvesting and tending to their orchards until prices improve.

In Brazil, the main producing area is Bahia, a state in the eastern part of the country. Cacao has been produced there on a commercial scale for over 100 years and has been historically protected from diseases of cacao found in the Amazon by a dry corridor of scrub savanna. But in 1989, witches' broom was introduced by accident to Bahia, and within a decade has resulted in a 75% drop in production. This has not only hurt the owners of cacao farms, but has led to a flooded of cacao workers without jobs now heading into towns and cities with already overburdened social services.

A three-pronged strategy has been drawn up by the private sector, universities, and the Brazilian cacao research program to combat the disease in Bahia:

1. Develop biocontrol methods using a fungus from the Amazon rainforest to attach the Witches broom fungus. As of 2000, the biocontrol fungus was being tested in field trials; it can already be cultured on a large scale.
2. Graft resistant clones to old cacao trees.
3. Develop agroforestry systems that reduce the density of cacao by interplanting with other economic trees, thereby reducing disease and pest pressure.

Prospects

The market for specialty chocolates using premium quality beans is growing. For this reason, a few growers are "rediscovering" the virtues of *criollo* cacao. This trend is particularly noticeable in parts of Jamaica.

Jamaican growers have learned to specialize with high value varieties of other crops, such as Blue Mountain coffee.

Cupuaçu

Cupuaçu (*Theobroma grandiflorum*), one of the cultivated relatives of cacao, is highly prized in the Amazon and Upper Orinoco for its creamy pulp which surrounds beans encased in a large, rust-colored pod.

Although the pulp, which occupies about a third of the fruit, has little nutritional value, its flavor is unique and immediately appealing to most people who try it. Cupuaçu pulp is used to make fresh juice, ice cream, jam, and tarts.

Cupuaçu is native to the understory forest of eastern Amazonia (Pará State and western Maranhão in Brazil).

PowerPoint #10: *Cupuaçu*

Dispersal Agents and Artificial Enrichment

As in the case of cacao, cupuaçu is dispersed in the wild by monkeys, such as the capuchin monkey (the common organ grinder monkey), which break open the pods on a branch to access the pulp.

Also like cacao, indigenous people may have enriched some areas with cupuaçu to provide refreshing snacks near villages and temporary camps.

Cupuaçu beans germinate readily, particularly if they land in partial shade and on relatively fertile kitchen middens.

Diffusion

In pre-contact times, cupuaçu was taken up the Amazon and some of its tributaries. Cupuaçu is planted as far west as the lower Ucayali in Peru and the Caquetá River in the Colombian Amazon.

In remote times, cupuaçu seeds were evidently also taken up the Rio Negro, through the Casiquiare canal, and into the Upper Orinoco and its tributaries.

Cultivation

For a long time, cupuaçu lingered as a backyard tree.

Then in the 1980s, began to be grown in orchards on a commercial scale, both in monocrop orchards and in agroforestry systems.

In some areas of eastern Amazonia farmers obtain cacao from:

- The nearby forest (if it is still standing)
- Their home gardens
- Agroforestry fields

Cupuaçu thus spans the spectrum from a wild harvest product, to minor backyard plant, to commercial crop.

Markets

Demand for cupuaçu is growing within Amazonia and in some extra-regional markets, such as central and southern Brazil.

Cupuaçu has begun to penetrate a few international markets where it is known as “cupuassu”, but the fruit has not really taken off, due perhaps to supply problems, and some of the companies are now longer selling products with cupuaçu.

The marketing of “cupuassu” juice in the United States has apparently not been very successful. In 1995, several health food stores in Gainesville, such as Mother Earth and SunFoods, sold *cupuassu* juice made by R.W. Knudsen, a company based in Chico, California. The cupuaçu pulp in that drink was mixed with a lot of other juices, and did not have a very appealing taste. Knudsen eventually dropped that product.

Snapple made a drink called Samoan Splash that contained juice from orange, strawberry, and cupuassu. However, the company dropped that drink after a year or two in the mid-1990s because of disappointing sales.

Jungle Ade (www.stargate.co.nz) once sold a fruit punch mix in powder form that contained several tropical fruits including camu-camu, passionfruit, cashew fruit, guava, and cupuassu. The company is still in business, but does not sell any products with cupuassu.

Ben and Jerry’s tested cupuaçu ice cream on a panel of tasters, but they did not like it, so the company decided not to market it. However, cupuaçu ice cream is very popular in Brazil and many eventually make significant inroads in the U.S. market.

A few companies with web sites are offering cupuassu powder for mixing with ice cream or smoothies:

KCJ Vanilla Company (www.icdc.com/~vanilla/product2.htm#panfae)

Eventually, however, a significant market may develop for cupuaçu juice based on frozen pulp. This would preserve its true flavor better. Several web sites are offering frozen cupuaçu pulp for making juice or ice cream, cupuaçu jam and jelly, and cupuaçu extract as a “health food supplement”, but the dollar volume of business appears to be small at the moment:

Prospects for Cupulate (cupuaçu chocolate)

In the 1970s, several chocolate manufacturers, such as Nestlé in Switzerland, expressed interest in cupuaçu for a novel type of chocolate. Small amounts have been made in research laboratories of the Brazilian agricultural research service in the Brazilian Amazon where it is called *cupulate*.

A major stumbling block in the past has been obtaining sufficient quantities of cupuaçu beans for further testing. Now that cupuaçu is grown on a larger scale in the Amazon in agroforestry plots, the problem of obtaining sufficient beans is likely to ease.

However, another problem needs to be confronted: cupuaçu butter has a lower melting point than cocoa butter. That means that *cupulate* melts at room temperature.

A market may eventually develop for *cupulate* if they can find a profitable way to remove some or all of the butter and replace it with some acceptable substitute with a higher melting point. Pure frozen or chilled *cupulate* could be used in certain deserts, such as ice cream.

Agenda for Improvement

Witches' broom, the same disease that afflicts cacao, is the main reason that cupuaçu is not grown on a wider scale in Amazonia.

However, the strain or strains of the fungus that causes witches' broom apparently differ from those that attack cacao.

In the forest, cupuaçu trees are more dispersed and therefore less prone to infection with witches' broom.

Resistance to witches' broom is thus high on the agenda of the few scientists working on the commercial aspects of cupuaçu.

Seedless forms of cupuaçu, a deleterious mutation in nature, have been found on rare occasions in the Brazilian Amazon and have elicited some excitement because they do not require labor to snip away the pulp from the seeds.

Unfortunately the few seedless cupuaçu trees have proven highly susceptible to witches' broom and are low yielding.

SPICES AND WORLD HISTORY

Spices are used today in cuisine to impart flavor nuances, but historically they were developed as crops as a "cover up" for food that was spoiling (refrigeration only became widely available in the 20th century) and to preserve foods, especially meats and fruits in the form of preserves.

Vanilla

Vanilla was domesticated in pre-contact times in Veracruz, along the Gulf Coast of Mexico, and is still cultivated in that warm, humid region by the Totonoco Indians.

In the 16th century, Spain became first country to imported vanilla because of its conquest of much of Central America in the early 1500s. By the second half of the 16th century, Spain had factories processing it for mixing with chocolate (remember that Spain had the first chocolate houses in Europe).

PowerPoint #11: *Vanilla*

Description of Vanilla

The vanilla plant is a climbing orchid and is native to the tropical forests of Central America.

Vanilla is tincture of the cured pods (technically capsules).

The pods are usually referred to as beans.

Pods are fermented and cured.

Pods are about 2-4 " long, and are black when cured

Vanilla Uses

Vanilla extract obtained by macerating cured beans in alcohol.

Another way is to cut off some of the cured beans and mix them with sugar.

Artificial vanilla has not replaced natural vanilla because real vanilla has so many flavor nuances.

The fragrance and flavor of true vanilla are not only due to vanillin but numerous aromatic compounds, including resins, which produced during the curing operation. Artificial vanilla contains only vanillin as the "active ingredient".

For example, some 170 volatile constituents have been identified in the Bourbon variety of vanilla.

Demand for real vanilla is increasing due in part to consumers who increasingly insist on "natural" products and organically-grown foods.

The position of the natural vanilla industry strengthened in 1965 when the U.S. Food and Drug Administration required the labeling of natural or artificial vanilla for frozen desserts.

In France, a law passed in 1966 requires that the nature of vanilla in any flavoring should be labeled as natural or artificial.

Demand for natural vanilla thus remains high, in spite of its high cost compared to synthetic vanillin.

For example, premium ice creams advertise their "all natural ingredients"; in the case of vanilla ice cream, tell-tale black flecks are a sign that real vanilla beans have been used.

Natural vanilla also in demand for premium chocolates, beverages, custards, and puddings.

Vanilla is also used to scent a variety of cosmetics, such as:

Botanical Therapy Body Lotion: Very Vanilla in the Rainforest Products line of Rachel Perry Inc., Chatsworth, California.

Formerly used in medicine as a nerve stimulant, also thought to be an aphrodisiac.

Vanilla is also used to scent some pipe tobacco.

Artificial Vanilla

Artificial vanilla was first produced in 1874 from the glucoside coniferin, which occurs in sapwood of certain conifers.

Synthetic vanilla now produced from the waste liquor of paper mills, from coal-tar extracts, and to a lesser extent from eugenol obtained from clove oil.

Artificial vanilla has accounted for most of the vanilla consumption in the 20th century. By 1970, about 95% of vanilla flavor used worldwide came from artificial vanilla, but demand for true vanilla has been rising since the early 1970s after half a century of stagnation.

Main Producers of Natural Vanilla and Markets

The main producers of natural vanilla are:

- Madagascar (a poor country, thus vanilla an important source of foreign exchange)
- Seychelles (Indian Ocean)
- Réunion (formerly Bourbon, in the Mascarene islands, Indian Ocean)
- Comoro Islands (off east Africa)

Mexico, where vanilla domesticated, is a minor exporter.

U.S. accounts for 60% of the market for natural vanilla.

Western Europe and Japan are also important markets for real vanilla.

Some Routes followed in Moving Vanilla Plants to Colonial Possessions

Several vanilla plants were taken to England first in 1733, but they were lost. Vanilla plants were re-introduced to England by the Marquis of Blandford around 1800. Some of these flowered in Charles Greville's collection in the Paddington area of London in 1807.

Greville supplied vanilla cuttings to botanic gardens in Paris, France and Antwerp, Netherlands (rival colonial powers).

Two vanilla plants were sent from Antwerp to Bogor (then Buitenzorg) on Java in 1819, but only 1 plant survived.

Vanilla cuttings from the Jardin des Plantes, Paris, were taken to Réunion, and from there to Mauritius in 1827, Madagascar in 1840, and Seychelles in 1866.

Genetic Resources and Breeding of Vanilla

Vanilla still grows wild in lowland and mid-elevation forests of Central America from Mexico to Panama. Wild populations are diminishing because the forests of Central America are rapidly being cut down.

Very limited breeding work with vanilla.

Superior material cloned by stem cuttings.

Commercial groves worldwide are based on a few genotypes.

The vanilla plantations of Réunion, Mauritius, Seychelles, and Madagascar all derive from a single cutting introduced to Réunion from the Jardin des Plantes in Paris.

The global vanilla industry thus rests on a narrow genetic base. More breeding work would be justified, especially for disease resistance.

Annatto

Annatto is an ancient crop of the tropical lowlands of Latin America where it is extensively grown for the seeds that produce bixin, a bright orange-red dye.

Known also as *achiote* in Spanish, and *urucú* in Portuguese.

Urucú in the lingua franca of the Brazilian Amazon means red.

Annatto is a bush that produces oval capsules.

The oval capsules are easily split open by hand to extract the pellet-sized seeds, normally around 40-60 per capsule.

After drying the pulpy exterior of the seeds, either with solar dryers or on the ground, the resulting cake is exported if the bixin content is at least 2.5 percent, or they are ground up into powder for local consumption. Bixin is found in various parts of the plant, but is concentrated in the fleshy mesocarp. Bixin was first identified in 1825, but its complex chemical structure has not been synthesized.

Early Uses

Annatto was domesticated in Amazonia for supernatural reasons. Indigenous people use annatto for body paint. Annatto body paint is thought to ward off evil, and to help protect warriors in battle. Among some tribes, annatto paint is also smeared on the body to repel insects and for decorative purposes during ceremonies.

Annatto is also employed in wide range of folk remedies.

Annatto may have been among the earliest plants domesticated in tropical America.

The use of annatto for dyeing cloth and coloring food came later.

Colorant for Food and Cosmetics

After the Second World War, artificial dyes largely replaced annatto as a colorant for food and cosmetics.

However, one of the artificial dyes, Red Dye No. 3, has been implicated as a carcinogen since 1970 (thyroid cancer in rat experiments).

In early 1990, the U.S. Food and Drug Administration finally decided to ban its use. Red Dye No. 3 has long been defended by the food and pharmaceutical industry because of its low cost and steadfastness in fluids.

It is the only known red dye that does not bleed in citrus juice, and has thus been preferred for coloring the cherries in canned fruit cocktails.

The food industry also liked Red Dye No. 3 to color the wax around certain cheeses.

The ban on Red Dye No. 3 sparked renewed interest in annatto among growers, food processors, and cosmetic companies because the natural red dye is safe for consumption and for skin applications, including lipstick.

But the boost for annatto growers was short-lived. Within a few years, annatto prices nose-dived on world markets because when annatto is heated it turns a yellowish color and therefore must compete with artificial yellow dyes and natural yellow food colorants such as saffron, turmeric, and marigold.

In developed countries, annatto has managed to retain a small market for coloring some foods, such as rice mixes, several sodas, ice cream, and cosmetics.

Annatto in cosmetic products:

The Aveda corporation of Minneapolis markets three lines of *urukú* lipstick (various shades of deep orange/red) made from annatto obtained from indigenous groups in the Amazon.

The lines of *urukú* lipstick include: Annatto and Orellana.

Aveda is one of several companies marketing lipsticks and skin care products that contain only “natural” ingredients based on plants.

Product	Company	Place Manufactured	Placed and Date Purchased
<i>Urukú</i> lipstick	Aveda	Minneapolis	Gainesville, FL, 1995
Amazon Rainflowers Herbal Shampoo	Tropical Botanicals	U.S.A.	Natural History Museum, Smithsonian Institution, D.C., 1996

Aubrey Organics also uses annatto in some of its skin care products.

Annatto in food and beverage products:

Industrialized countries use bixin extensively to color butter, cheese, yogurt, chocolate, and various ointments.

Examples of manufactured products with annatto:

Product	Company	Place Manufactured	Placed and Date Purchased
Ginger Crisp Biscuits	Peek Freans	Canada	Gainesville, FL, 1996
Rhubarb Custard Style Yogurt	Safeway	England	England, 1993
All Natural Citrus Punch	Minute Made	Houston, Texas	Gainesville, FL, 1995
Orange Crush	Sunkist	England	England, 1993
Harvest Peach Yogurt	Yoplait	U.S.A.(France HQ)	Gainesville, FL, 1996

Another benefit of increased annatto production is nutritional, since the seeds are an excellent source of vitamin A.

Vitamin A is often deficient in diet of poor people living in the humid tropics.

Agronomy

Annatto is a common dooryard shrub in many lowland areas of tropical America, where housewives periodically pluck off seed capsules as needed.

A cottage industry of drying annatto for local merchants has sprung up in many regions of Latin America.

Annatto is a good intercrop with pasture because livestock do not eat the leaves. Annatto leaves contain calcium oxalate crystals, which apparently irritate the mouths of livestock.

An Ocean of Genes

Annatto (*Bixa orellana*) is probably native to Acre in southwestern Amazonia where it may have arisen from *Bixa excelsa*, a forest tree. Most of the genetic resources of annatto are thus found wild in Amazonia and in home gardens.

After domestication, probably during the Paleolithic, annatto was adopted widely and diffused to Central America and the Caribbean, where it has become naturalized. Annatto persists around old homesites and in old secondary forests.

Colonial powers have taken annatto to Africa, Asia, and Polynesia, where it is also cultivated, mainly as a dooryard shrub.

Genetic variants of potential value for breeding are thus likely to have arisen outside of the region where annatto arose.

Little breeding is currently underway with annatto.

Desirable genotypes can be propagated vegetatively, thereby helping to achieve higher yields with consistent quality. Currently, most annatto plantings are from seedlings, however.

Prospects

Commercial annatto growers, as is the case with many other commodity growers, are vulnerable to fluctuating prices for their product. As prices for annatto rose, especially in the late 1980s and early 1990s, many growers planted annatto, leading to overproduction by the mid-1990s. Prices then fell, and some growers in the Brazilian Amazon have cut their annatto groves down and switched to other crops.

Annatto growers are also vulnerable to the possibility that a “safe” synthetic orange-red dye will be synthesized for the food processing industry.

This is already happening.

Red Dye #40 is now commonly used in the U.S. as a colorant for food, beverages, and pharmaceutical products.

A sample of products for sale in the U.S. that contain Red Dye #40 includes:

- Tylenol Geltabs
- Good Neighbor Pharmacy Children’s Pain Reliever Acetaminophen Suspension Liquid
- Doritos Cooler Ranch Tortilla Chips
- Betty Crocker Gel Food Colors
- Gatorade Fruit Punch Thirst Quencher
- Jell-O Cranberry-Raspberry Gelatin Dessert

Red Dye #33 is used in various cosmetics and shampoos, including:

- White Rain Exotics: Orchid Petals Shampoo, manufactured by the Gillette company. This product contains a number of botanical products, including orchid extract, hibiscus extract, lotus extract, chamomile extract, clover blossom extract, rosemary extract. Annatto might have been used to add color, but a synthetic dye is used instead.
- Dewberry Shampoo, by the Body Shop. Dewberry is the English name for yerba de la negrita, a Mexican plant.

Checklist of place names for map quiz on 2nd test:

Islands

Bora Bora
Madagascar
Mauritius
Reunion
Seychelles

Countries

Belgium
Brazil
Britain
Ghana
Guatemala
Malaysia
Mexico
Netherlands
Nigeria
Switzerland
Venezuela

Rivers

Amazon