Plant People Season Three Episode Seven "Cacao with Professor Pathmanathan Umaharan" Transcript

Jennifer Bernstein Narration: The impact of chocolate on culinary history is undeniable. Treasured since the height of the Olmec civilization several thousand years ago in what is now Mexico, it has since made its way around the globe to become a favorite flavor for countless cultures. And this demand for chocolate has created an enormous industry worth more than $130 billion annually.

Chocolate is of course derived from the fruit of the cacao tree, but as our climate changes and new diseases threaten domesticated cacao, the future of chocolate is uncertain. I'm Jennifer Bernstein, CEO and the William C. Steere Senior President at the New York Botanical Garden. And this is Plant People.

We're joined today by Professor Pathmanathan Umaharan. He's a professor of genetics at the University of the West Indies and a director of the Cocoa Research Center, where he studies the challenges facing the cacao tree and is developing ways to protect it for future generations.

Jennifer Bernstein: Professor, we're so glad to have you. Welcome to Plant People.

Pathmanathan Umaharan: Thank you. Thanks for having me.

Jennifer: We're very excited to talk about the cacao tree and the products that are derived from it. Chocolate. Chocolate is very important to me personally, so I've been very excited about this, about this conversation. To get us going, can you tell us a little bit about your background and the work that you do at the Cocoa Research Center and how you came to study cacao?

Path: I am a geneticist by training. And I've been working on a number of crops to overcome diseases by genetic manipulation. In 2010, I became the director of the Cocoa Research Centre, which I lead. So, the Cocoa Research Centre does research over the entire value chain. We do research in conservation. We have the International Cocoa Gene Bank, which is the largest collection of cocoa varieties in the world in Trinidad and Tobago. And then we also do a research center itself and then we have an innovation center. And recently we have a spinoff company that produces chocolates.

Jennifer: Hmm. Okay. That's wonderful. So, we're using cocoa and cacao interchangeably so far. Can you explain that distinction for us?

Path: There's not much of a difference. So usually in, in nomenclature we refer to the tree as cacao and the product that comes from it as cocoa. But I've seen in literature that people have used it interchangeably.

Jennifer: Okay. Got it. So, for the listener who I'm sure has encountered chocolate but may not have encountered a cacao tree, can you describe a cacao tree? How tall do they grow? What does the fruit look like? What do these plants look like?

Path: So, the cocoa tree is a neotropical species. It evolved in the western part of South America in Peru, Ecuador, Columbia, the Amazonian area. It evolved under the Amazon forest as an understory tree, so it likes shade. Usually in a typical forest system, it produces a lot of suckers, which we call chupons, and it produces a big clump. That's how it grows in the forest. But in a cultivated state, we try to modify it so that it fits into an orchard system. So, we grow them in a much more organized way, with less chupons or suckers, but with the main trunk that grows up to about three to five meters tall and with branches from it. And it produces the cocoa pods directly from the trunk, which is peculiar to cocoa. And there are some pods that go on the canopy as well.

Jennifer: And visitors to the Botanical Garden here can see cacao trees inside of our Conservatory. I was there just yesterday and there's a bud. So, it's very exciting when you're passing through to be able to point out to a visitor, “Oh, there begins the chocolate,” you know? So, tell us a little bit about what makes the cacao tree so unique in the plant world.

Path: The cacao tree produces the cocoa pods, and the beans from it is what is the basis of chocolates. And increasingly it's being also recognized as a nutraceutical because it provides a lot of cardiovascular protection, so to speak. The cocoa butter itself is very, very important because it is probably the most valuable part of the cocoa bean. So if you take the cocoa bean, 50% of it is the cocoa butter, and the other 50% is called the cocoa solids. And usually when we squeeze out the butter. And we grind the cocoa solids into a powder is what you normally get in the cocoa drinks that you make, right? So the cocoa powder and the cocoa butter goes into making chocolates and cosmetics and various things. So, cocoa has a wide variety of uses, that's what makes it special, I think.

Jennifer: That's interesting. You said cosmetics. I mean, I'm most familiar as a chocolate lover with the edible products that come from this plant. Tell us a little about the other kinds of products that are derived.

Path: Yeah, the cocoa butter is used in a number of different, cosmetic products basically because the cocoa butter is considered to be very good for the skin. So a lot of the skin lotions and so on, they contain cocoa butter. The cocoa pulp is used in beverages, but the cocoa beans that go into the confectionary part is the most popularly known.

Jennifer: And what is that process like?

Path: Usually you harvest the cocoa pods, you take out the beans, and it goes to a fermentation process, which lasts about six days and then you dry it. The dried beans are roasted and broken up into nibs, and then they're ground into a paste. And then you add the sugar and the milk and whatever you want into it, and then you temper it, which is a process of making it into a sort of crystalline structure. So, it gives it a little shine and texture to it, and that is molded. So that's it. Most people don't know about that pre-processing part, the fermentation and drying, which is important because it provides you the flavor profiles that you experience in a chocolate.

So, this is why the bean to bar chocolatiers are becoming very popular because how you ferment and dry it is important. But the chocolate making part of it is also important because how you roast it, you know, you do a low roast or medium roast or high roast, and then how you make it into chocolate is also important. So final product depends on both the post-harvest processing and the chocolate making both of them.

Jennifer: So, you study diseases that threaten the cacao trees, and I'm interested in learning how serious are these diseases and what progress is being made to address the threats?

Path: There are different kinds of diseases. The most important globally distributed disease is called the black pod disease caused by an organism called Phytophthora palmivora. It's a fungus-like organism that causes these pods to turn black and damage the pods, so that is why is called the black pod disease…

Jennifer: Did you say it's a fungus-like?

Path: Yeah, so it's in between, an algae, a mold, and a fungus. You know, it is in between the two, because it's classified as fungus-like. It's not a true fungus, but it invades the pods and damages the pod. So, typically if you don't manage the disease, you can lose as much as 40% of your yield and it's ubiquitous, it's all over the world. So, that is considered to be the number one disease. Then there are other diseases which are peculiar to different parts of the world, so in

South America you have in addition to black pod you have the witches' broom disease and also the frosty pod disease, which are true fungal diseases. And then in West Africa, you have the cocoa swollen shoot disease in addition to the black pod disease.

Jennifer: And are you looking for genetic traits that can make species more resilient to these threats?

Path: Exactly. We are the custodian of the International Cocoa Gene Bank, which is the largest collection of cocoa varieties. We have about 2,400 varieties of cocoa in our collection. These varieties were collected from Columbia, Ecuador, Peru, Central America, Caribbean, and brought into Trinidad to the conservatory. So, very much like your botanical garden, which is a conservatory, we have a field collection of these 2,400 plus varieties. And these are very precious because within them you contain varieties with resistance to different diseases. So, in our research we have been looking for varieties that have resistance to black pod disease, witches' broom disease and so on. Then looking at how they are controlled by genes and being able to transfer those genes into the better varieties, so the commercial varieties become resistant. So, genetic resistance is the most durable long-term strategy. But because tree crop breeding is a long-term process, it takes time because the cocoa lifecycle is about eight to 10 years you'll take to do one breeding cycle. So, there are cultural methods of managing the diseases as well. So, we work on genetic resistance as well as cultural methods to manage the disease.

Jennifer: I want to hear more about the cultural strategies, but before we get to that, it's interesting…I think there's at the kind of lay person level, a growing awareness of the importance of biodiversity and the resilience that biodiversity confers. But, I'm not sure that people have learned yet enough about the importance of genetic diversity. So, can you say a word just generally about the importance of conserving genetic diversity, particularly as we confront changing ecosystems?

Path: So, generally, you have different species, and you have species diversity. Now there are diversity of different varieties or types or breeds within the species, which is what we call the genetic diversity of the species and the genetic diversity is what gives the resilience to that species, so if your genetic diversity is lost, the species can become extinct very quickly because it cannot adapt to changing environments, so similarly, if you have a wide genetic diversity, then you can use that to mold it into different kinds of varieties with better characteristics that farmers can grow. So, the genetic diversity of in this

case cocoa species is very, very important in order to create resilient types that can withstand climate change and other diseases that affect cocoa.

Jennifer: Great. Can you talk a little bit about the cultural strategies that are also being employed? As you look at the genetic side, you're also looking at these cultural strategies, so let's hear about that.

Path: Yeah, a disease becomes an epidemic when the environment is conducive for the disease to spread. So, in cultural practices, we try to make the environment less desirable to the disease so the disease doesn't multiply and spread. So, cultural practices could be pruning the tree to open up the canopy so there's more light coming in. Light is like a disinfectant. Reduces the humidity so the diseases don't spread rapidly. It could be modifying the soil environment. It could be reducing the shade trees. If you have too much shade, you have more diseases and so on. So, cultural practices, modifications of the environment under which the cocoa tree grows so that you minimize the probability of the disease becoming an epidemic.

Jennifer: So, we've already talked a little bit about climate change and the threat that it's presenting to all different kinds of species. And certainly it's reshaping global agriculture. So, can you talk about how cacao production is being impacted, especially in regions that are already vulnerable to heat or changing rainfall patterns?

Path: Yeah, so climate change has created a lot of problems around the world, and in the last couple of years, the cocoa prices went from about $2,500 US per metric ton to as much as $12,000 US per metric ton.

Jennifer: That's a lot more.

Path: Yeah, that's because of climate change. That is causing the trees to not produce or having more diseases causing the yield to be lost. And that is what causing the price volatility that we are seeing in the market space. There are climate smart practices, which are also cultural practices that you can use to mitigate against adverse climate events. And also you can use building genetic resilience by increasing the diversity in the farm or by increasing tolerance to various abiotic stresses. Both strategies are being used at the moment.

Jennifer: So, let's talk a little bit about the conservation efforts that are underway. What does conservation look like for wild cacao?

Path: Most of the cacao we have in our collection were collected from the wild. They're not cultivated. They are collected and they're conserved in a gene bank. Our gene bank is about a hundred-acre estate, and in addition to the cocoa, we also have other species that are related to cocoa, in our collection. So, we'll primarily multiply each variety and we plant it in plots of eight or 16 trees. The reason why we conserve it as trees and not as seeds is because the cocoa seeds don't have a long viability period. So, they lose their viability within a couple of weeks.

Jennifer: Weeks!

Path: Yeah, and typically all oil seeds do not have a very long viability period. And cocoa being 50%, cocoa butter is an oil seed, so it loses viability. So, that is why we have to either keep it as tissue culture or you have to keep it as a field collection. And now the problem is that not all varieties respond well to tissue culturing. Some varieties you can culture them and others are more recalcitrant. So, that's why we have our collection as a field collection because that is the most robust way to manage it.

Jennifer: That's great. So, you're doing the ex situ conservation through the gene bank that you've developed in the field conservation that you've just described. Can you talk a little bit about any in situ conservation efforts that are underway?

Path: There are efforts for in situ conservation in the centers of diversity, so the cocoa originated as I said in the western part of South America. So, there's a lot of effort to preserve the Amazonian forest where the cocoa is evolved as an understory. We still believe that not all the cocoa varieties have been collected and conserved ex situ. So, there are lots of diversity still there in the Amazon jungles. So, it's important more and more to really maintain those diversity. But as countries develop, a lot of these jungles are really becoming cities and highways and so on. Then there's the forest fires causing considerable damage to these institute collections.

Jennifer: So, we need both…

Path: Both. You need to have a balance between the two.

Jennifer: Yeah. So, I understand that Trinidad, where you are located, is known for producing some of the finest cacao beans in the world and that the University of the West Indies, as you mentioned earlier, has recently opened a

factory producing chocolate. Can you talk about why Trinidad produces such high quality beans and also some of the challenges, maybe, of growing there?

Path: So, Trinidad, has a very long history in cultivating cocoa. So, when the Spaniards went into Central America for the first time and they encountered cocoa and they took it to Europe, it became very popular. And they needed to plant it in plantation scale because in Central America, the cocoa was really grown in the forest and harvested and used and not really cultivated. So, the Spaniards would've planted cocoa in the larger islands, Hispaniola, Jamaica, Trinidad, they established cocoa from Central America, and this was a kind of cocoa called the criollo cocoa. And this had a very delicate, fine flavor. So it was less bitter. And that's why they planted it in the Caribbean. But, these criollo types are very susceptible to diseases. So, very quickly the trees started dying in Trinidad. Now, because Trinidad is very close to South America. The planters went across and collected another type from South America called the Amenolado type and brought it in and planted it in between the surviving criollo trees. And the intermingling of these two created this new breed called the trinitario. And the trinitario was special because it had the flavor profile of the criollos from Central America and the robustness and hardiness of the types that came from South America. And that is why the trinitarios became very popular. They have much higher yielding, they were much more robust, and therefore they, they became the mainstay of Trinidad's economy. And from Trinidad, it spread around the world.

Jennifer: I see. So, cocoa is obviously a major global industry. It's worth more than $130 billion annually. What responsibilities do you think major chocolate companies have when it comes to sustainability, fair labor, long-term agricultural resilience?

Path: Yeah, I think that chocolate companies have a immense role, because, unless the farmers are economically viable they're going to leave cocoa production. So, it's important for economic sustainability, the social sustainability and environmental sustainability. Cocoa is often grown under conditions. Where they are not environmentally sustainable. So, if you want to really look at long-term value. For the cocoa industry to survive, then we need to look at sustainability as a whole.

Jennifer: What are the conditions that make it environmentally unsustainable?

Path: Because cocoa, when you grow them without adding fertility, the soil fertility declines over time. Then there is…

Jennifer: Ah, you have to put a lot of inputs.

Path: Yeah. And then if you put too much of chemical inputs, it creates soil imbalances and so on. And very often, the environment is also affected by the practices that are done in the soil. So, over time, most of the cocoa growing areas, the soil has degraded over time because lots of cocoa is cultivated in sloping lands without proper soil conservation measures. So, over time, the top soil gets eroded, and you lose fertility. So, there have been enormous environmental problems emerging in production areas. Social sustainability is important because if the children of the cocoa growers cannot really go to school and develop themselves then socially, there's no incentive to be in cocoa and they will eventually move out of the cocoa sector, and the industry as a whole would not be sustainable. So, how do you create an economically viable, socially sustainable and environmentally sustainable industry the, the people who enjoy chocolates can continue to enjoy eating the chocolates?

Jennifer: Mm-hmm. What are some of the mitigations that are responsible. manufacturers are embracing that you think make these systems more sustainable?

Path: There are certification agencies that have emerged, third-party certifications. We look at environmental sustainability of farms, looking at fair trade opportunities for farms. And these are measures to really inculcate in the final product the brand value that the consumers can see that they are consuming products of a particular sustainable type. So, there are large scale chocolate manufacturers who will buy beans in bulk and make it into chocolates and sell, you know, these are the bigger chocolate companies. But, then you have now an emerging small class of bean to bar chocolatiers who will buy beans from a particular farmer converted into chocolates and they are much more interested in the farm and the farmer, and they have a better way to manage the entire supply chain and the sustainability than the larger chocolatiers. So the bean, yeah, the bean to bar chocolatiers are becoming extremely popular because of the ability for them to really ensure that sustainability is maintained in the…

Jennifer: It's catchy, you know, farm to table, bean to bar. It's memorable. It's good. So, from a research standpoint, what do you think are some of the most promising innovations that can help to sort of future proof this type of farming?

Path: In our research center, we are working on evidence-based certification because there's also concern by the consumers that there's a lot of greenwashing going on. How do consumers understand? What actually happens on the

ground, right? So, more and more evidence-based certification systems are needed. We are setting up systems of traceability. So, you have a barcode in the final product and scan the QR code and the entire value chain is visible to the consumer and they can see where the cocoa was produced, how it was processed, what environmental certifications you have, what good agriculture practices have been maintained and so on. So, in other words, it provides visibility of the entire supply chain to the consumer. That's what we are trying to do. And only when the consumers realize that there is value in doing this.

Then there'll be more sustainability happening. So, that is one of the work we are doing, the disease management, resilience to climate change. That's another area of research we do. As I said, we look at genetics and we have a molecular breeding program that we try to improve varieties, which are much more resilient to diseases so that farmers can cultivate these varieties without the risks in farming that they encounter. And that also leads to sustainability, right? Because it reduces their cost of production, it improves their yield, and as a result, they can have a good living, and then we also do work on post-harvest processing. So, we have been doing some work on really understanding what contributes to flavor. Some of it is genetic, some of it is the way you process the beans. Some of it is the microbes that are used in processing. And how do you create a consistent flavor to the consumer. Food safety is another area we work on. There are lots of food safety problems like lead-contaminated chocolates, cadmium-contaminated chocolates, aluminum-contaminated chocolates and how do you mitigate these food safety concerns in the supply chain so the consumers don't have to be worried about the final product. Some of our work is being supported by chocolate companies because they themselves are concerned about the sustainability and the food safety and all those things. And some of the work is being funded by developmental agencies. So, much of our work is about overcoming challenges that the actors along the value chain are facing.

Jennifer: Yeah, and sort of creating some visibility and transparency into those processes for the end consumer. So, we've talked a lot about chocolate. Of course, that's always top of mind…What other sort of ecological or other benefits should we be aware of from cacao trees?

Path: Cacao is a tree crop, right? So, tree crops have a big role to play in conservation of soils, because particularly in slopey terrains, cocoa can hold the soil and be able to mitigate against soil erosion, interception of water and so on. So, many watersheds, for water security, you know, they have plantations…agroforestry systems, which contain forestry trees which provide shade and cocoa trees, which provide the revenue to the farmer. So, most of the slopey areas in Trinidad and Tobago, we advocate growing tree crops. Mostly,

it's cocoa is a major tree crop, but you know, there's breadfruit and avocado and so on. These provide strong environmental service, protecting the soil, ensuring the water supply is good so I think it has a number of environmental services in addition to providing us the chocolates that we like.

Jennifer: That's wonderful to hear. So finally, to close this out, I'm interested in tips that you have for chocolate lovers like me. What can we do to support more sustainable and environmentally responsible cocoa production?

Path: The consumers should be much more aware of the chocolates that they buy because there's a lot of greenwashing in the space so more and more there's lot more evidence-based certification systems that are coming in and they should be taking more cognizance to those new changes that are happening. And even if they pay a dollar more or something, you are contributing to the sustainability of the supply chain because making sure that things are sustainable costs money, right? And therefore the farmers should be rewarded for that. Otherwise, they will not really maintain sustainable practices and we will all lose our chocolates. It starts from the consumer so we are trying to go to trade shows in the U.S. as well as in the other places, to educate consumers about sustainability and this sort of transparent system that we are building, providing visibility of the entire supply chain to the customer. And the customer should be able to use it, to understand what they're buying.

Jennifer: Yeah. That way they can enjoy the chocolate and they can feel good about eating it. So, thank you for your good work and thank you so much for being with us today on Plant People.

Path: Thank you very much for having me.

Jennifer Narration: If you can't think of a world without chocolate, you're not alone. Thankfully, with experts like Professor Path on the case, there's still light at the end of the tunnel for this worldwide favorite. If you'd like to learn more about the work being done to strengthen the resilience of the cocoa tree, head to nybg.org for show notes and more.

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