

TPWKY	This is Exactly Right.
	(This Podcast Will Kill You intro theme)
Erin Welsh	Hi.
Erin Allmann Updyke	Hi.
Erin Welsh	I'm Erin Welsh.
Erin Allmann Updyke	And I'm Erin Allmann Updyke.
Matt Candeias	Hi, I'm Matt Candeias.
Erin Allmann Updyke	Yay!
Matt Candeias	I didn't know I was getting this one.
Erin Welsh	And this is a crossover episode with This Podcast Will Kill You and-
Matt Candeias	In Defense of Plants.
Erin Welsh	Woo-hoo!
Erin Allmann Updyke	Woo-hoo!
Erin Welsh	Yes, we're very excited. But yeah it's great because today we're gonna be talking about another poison.
Erin Allmann Updyke	Poisoncast part two.
Erin Welsh	Yeah so if you haven't listened to part one, which is called Don't Tread On Me?
Matt Candeias	Don't Tread On My Monkshood.
Erin Allmann Updyke	Don't Tread On My Monkshood.
Erin Welsh	Thanks. (laughs) Thanks guys.
Erin Allmann Updyke	That was great.
Matt Candeias	You're welcome. Felt good about that.
Erin Welsh	Go listen to it, it's great, it's super fun.
Matt Candeias	It's both canon and stand alone.
Erin Allmann Updyke	(laughs) That was super nerdy. I liked it.

Matt Candeias Well, you know.

Erin Welsh Matt's like, 'Welcome to the show'. So we have a quarantini. What are we drinking?

Erin Allmann Updyke We are drinking Throwing Deadly Nightshade. Cheers!

Erin Welsh Cheers.

Matt Candeias Cheers.

Erin Welsh What is in Throwing Deadly Nightshade?

Erin Allmann Updyke So this is made with gin, blueberry puree, lemon juice, and elderflower liqueur. And it's really quite tasty.

Matt Candeias It is, it's delicious. And I don't know if it's just the theme, I haven't seen your other quarantinis but you always make me the most beautiful looking drinks. There's so much here, yeah, yeah.

Erin Allmann Updyke We did have a really pretty one last time too, yeah. No, this is gorgeous.

Erin Welsh And we wanted to make this one look a little bit like the deadly nightshade berry color, so hence the blueberry.

Matt Candeias It worked.

Erin Allmann Updyke Yeah.

Matt Candeias I'm worried.

Erin Welsh (laughs) Maybe it is deadly nightshade.

Matt Candeias For everyone listening...

Erin Allmann Updyke Luckily I made them just like one big one so we'll all die.

Matt Candeias Okay.

Erin Welsh Unless someone has developed a tolerance. Foreshadowing.

Erin Allmann Updyke Cause what are we talking about today, Matt? As you take a sip.

Matt Candeias We are talking about deadly nightshade, Atropa belladonna.

Erin Welsh Yes.

Erin Allmann Updyke I'm really excited about this. Like I can't wait to talk about this one and learn about it.

Matt Candeias I know.

Erin Welsh: It's all she's been talking to me about, how excited she is.

Erin Allmann Updyke: It's true, the whole day.

Erin Welsh: And I'm like just hold it in, don't tell me anything, it's gotta be all fresh and new.

Matt Candeias: I'm sorry you two, I didn't see any of you leading up to this for a while so I was just safe in my own brain.

Erin Welsh: You were just brimming with excitement over on your own.

Matt Candeias: I don't know if I'm more excited for all of the cool information I learned or the detective work finding that information, I'm proud of this one.

Erin Allmann Updyke: Oh cool! Oh that makes me even more excited.

Erin Welsh: Yeah, I'm intrigued.

Erin Allmann Updyke: Yeah so we should jump right in.

Matt Candeias: Mm-hmm.

Erin Welsh: I guess so.

TPWKY: (transition theme)

Erin Welsh: In our first crossover episode on poisons we talked a lot about how there's this fine line between poisons and medicine and that these plants can be viewed as medicinal or poisonous depending on who's administering the treatment, how much they know, and most importantly what their intentions are.

Erin Allmann Updyke: Yeah what was your little spiel that you did?

Erin Welsh: Oh god I don't know.

Erin Allmann Updyke: Are you a physician or a poisoner?

Erin Welsh: A pretender or a magician or a healer. Yeah it was very contract, but...(laughs).

Matt Candeias: But I believed you.

Erin Welsh: Yeah, that's the important thing. I'm the magician here. But anyway so yeah, so today we're gonna return to this theme a little bit with *Atropa belladonna* which is, as Matt mentioned, the scientific name for a plant also known as belladonna, deadly nightshade, beautiful death, dwale, dwayberry, banewort, devil's herb-

Erin Allmann Updyke: Good lord.

Erin Welsh Devil's cherries, devil's berries, murderer's berry, sorcerer's berries-

Erin Allmann Updyke Oh my god.

Matt Candeias Huh.

Erin Welsh Witch's berry, poison black cherry, death cherries, and my absolute favorite: naughty man's cherries.

Matt Candeias That makes two of us.

Erin Allmann Updyke Almost the name of our quarantini, guys.

Matt Candeias I didn't wanna drink that, though.

Erin Allmann Updyke Wow that is a very long list of names.

Matt Candeias I don't find common names to be terribly useful but when you see that many for one plant, it's done some stuff over the years.

Erin Welsh Yeah! Yeah, exactly.

Erin Allmann Updyke Yeah that's a really good point actually.

Matt Candeias It's kind of like how the only ants with common names are the ones that get into your house, right.

Erin Welsh Ah, yeah.

Erin Allmann Updyke God. So smart.

Erin Welsh (laughs) But that is a really good point because yeah, this is a serious plant we're talking about and so it makes sense that it has all of these different names and it was really important to designate this plant as being distinct from other plants that looked like it or were in the same family of poisonous plants. So okay, just listing these names for belladonna, we can see that there might not be as much of a divide between good and evil in public opinion of this plant as there were for monkshood or wolfsbane. But it's kind of funny actually to me that the name that seems to have stuck with this plant for the longest is belladonna which describes one of the more innocuous uses of the plant.

Erin Allmann Updyke Yeah.

Erin Welsh And I know that you might know this already but in case you don't, everyone might be dying to know so I'm just gonna jump right to it.

Erin Allmann Updyke I'm sure they're dying cause I didn't know this until very recently.

Matt Candeias I didn't know.

Erin Welsh: Oh I love it, okay. So basically some writer in the 1500s described how Venetian women would put drops of belladonna tincture or juice or something into their eyes to make them appear deeper and darker and sexier by dilating the pupil.

Erin Allmann Updyke: Which we'll talk a lot more about.

Erin Welsh: Yes.

Erin Allmann Updyke: But like what the heck?

Erin Welsh: Yeah!

Erin Allmann Updyke: People were like, 'You gotta have that big old pupil, it's beautiful.'

Erin Welsh: Oh yeah.

Matt Candeias: Yeah I didn't know I was missing something until you told me that and that just solves so many...

Erin Allmann Updyke: It's why you haven't yet won America's Next Top Model, your pupils aren't dilated enough.

Matt Candeias: No.

Erin Welsh: Yeah and well also women would apply it directly to their cheeks to give it a rosy glow, like the juice in the berries.

Matt Candeias: But that's the bad kind of rosy.

Erin Allmann Updyke: Yeah, we'll talk about it.

Matt Candeias: All right.

Erin Welsh: But so anyway, so because it was used for these reasons it earned the name 'belladonna' which is Italian for 'beautiful woman'. But before it was used as a beauty enhancer it had much more sinister associations. Let's start back at the beginning. Atropa belladonna, and I'm just gonna call it belladonna-

Erin Allmann Updyke: Great.

Erin Welsh: Okay. Was definitely known to the Ancient Greeks, Romans, Scots, and probably many other cultures since it is pretty widely distributed. It's genus name, Atropa, actually comes from Atropos which is one of the three Fates with a capital 'F'. So you may remember these Fates from Disney's Hercules.

Erin Allmann Updyke: That's the only way I know them.

Erin Welsh: Yeah I know, right? They all shared an eyeball and one of them had scissors and would go clink-clink.

Erin Allmann Updyke: And then you're dead.

Erin Welsh: And then you're dead.

Erin Allmann Updyke: Yeah.

Erin Welsh: So in Greek mythology, these three goddesses determined the fate of every mortal and god, so even Zeus feared-

Erin Allmann Updyke: Oh!

Matt Candeias: That's a powerful entity.

Erin Welsh: Yeah, yeah. One of these goddesses would spin the thread of life, another would measure it out and shape it, and the third would decide when it would be cut.

Erin Allmann Updyke: Wow.

Erin Welsh: And this third goddess was known as Atropos, the inflexible or immutable or she who may not be turned aside.

Erin Allmann Updyke: Wow!

Matt Candeias: I love it.

Erin Welsh: And yeah, it's pretty appropriate for these plants who are in the genus because a lot of them can cause you to not return to life again.

Erin Allmann Updyke: What a nice way of saying they'll kill ya.

Matt Candeias: The very least it'll be a bad couple of days.

Erin Allmann Updyke: Yeah.

Erin Welsh: Yeah. Borrowing from the ancient name of this plant Atropa and it's more recent, more innocent name belladonna, Linnaeus decided to name the plant Atropa belladonna. So it kind of has it's both sides to it.

Erin Allmann Updyke: Yeah.

Erin Welsh: Which is amazing. You know you look at synonyms and the amount of revisions plants have gone through, to have Linnaeus give it one and have it stick this whole time, either people are really into that idea, like why would you wanna earn such a name or just... Good job, Linnaeus with your taxonomic prowess.

Erin Allmann Updyke: Yeah it is a good name, though.

Erin Welsh: It's a great name cause it's like, okay, it tells you everything, not everything but it tells you a lot about what you need to know about this plant.

Erin Allmann Updyke: Right. Right up front.

Matt Candeias: It'll kill you, it'll make you pretty.

Erin Allmann Updyke: It'll make you pretty!

Matt Candeias: I'm conflicted.

Erin Welsh: (laughs) Beauty is pain, pain is beauty. While belladonna was used in ancient times as a poison such as for poison-tipped arrows or by King Duncan of Scotland who poisoned an invading army of Danes so Macbeth and company could slaughter them in their sleep, it was also used in rituals. One of the more infamous of these rituals was the celebrations held by the followers of the cult of Dionysus who is the Greek god of wine, fertility, yes, cheers to that, ritual madness, etc. The followers would apparently mix belladonna into wine, so they would have these crazy wild trips and lose some or all of their sexual inhibitions.

Erin Allmann Updyke: Wow.

Erin Welsh: So it was like all of these orgies, these Ancient Greek orgies is what sort of helped-

Matt Candeias: Brought to you by-

Erin Welsh: By belladonna. Side note on that, plant identification through ancient texts is a little difficult, right.

Erin Allmann Updyke: (laughs) They were actually just eating blueberries and they were like, 'No, no I swear, I feel totally different, let's do it.'

Erin Welsh: Well okay.

Matt Candeias: This is just who you are, David.

Erin Welsh: Just blame it on the blueberries.

Erin Allmann Updyke: Yeah.

Erin Welsh: There are a lot of different plants that can cause symptoms that are similar to this or like this or whatever and so yes it may have been attributed to this plant but it's could've been henbane, it could've been mandrake, it could've been something else. So we don't know exactly but definitely belladonna was used and identified and known about in ancient times.

Erin Allmann Updyke: Right.

Erin Welsh: It's a strong candidate. Just wanted to say that. But regardless of whether belladonna was used in orgies or to poison your enemies or husband, all ancient writings about the plant are full of dire warnings about its extremely dangerous nature.

Erin Allmann Updyke: Yeah.

Erin Welsh: It always came with this warning: don't grow it, don't eat it, don't plant it, just get rid of it. And so there doesn't really seem to be a lot of healing done by the plant during this time.

Erin Allmann Updyke

Okay.

Erin Welsh

In the Middle Ages, belladonna started to be called deadly nightshade and its reputation for occult rituals grew. Stories from this time say that the devil himself was responsible for cultivating and tending to the plant and the only day he forgot to do this was Walpurgisnacht, which is also known as-

Matt Candeias

It's my favorite holiday.

Erin Welsh

(laughs) It's also known as St. Walpurgis Night. So St. Walpurgis Night, I'm probably pronouncing this wrong by the way-

Erin Allmann Updyke

I was like are you saying this as if we're supposed to know what it is?

Erin Welsh

I'm about to tell you!

Matt Candeias

Of course.

Erin Allmann Updyke

You know, Walpurgis Night. What was your costume? (laughs)

Erin Welsh

It takes place on April 30th every year to commemorate St. Walpurgis whom you all know, right?

Erin Allmann Updyke

Yeah, good old...

Erin Welsh

Well she was an 8th century abbess who battled pest, rabies, whooping cough, and witchcraft.

Erin Allmann Updyke

Ooh, I love her!

Matt Candeias

Yo!

Erin Welsh

Well she did it all.

Matt Candeias

Timely.

Erin Allmann Updyke

Except the witchcraft thing, just like let that be.

Erin Welsh

I know.

Erin Allmann Updyke

Right?

Matt Candeias

Well everyone dabbled back then, right?

Erin Welsh

(laughs) Both for and against. On this night which is also witches night, all the wretched would gather to wait for the arrival of spring. And some of them would go to this mountain where they would await to meet or lay with the devil. So this is according to stories from the time.

Matt Candeias

I wanna go to this party.



Erin Allmann Updyke Yeah.

Matt Candeias Not the Greek orgy one, this one.

Erin Welsh (laughs) Well-

Erin Allmann Updyke It might end the same.

Erin Welsh I was going to say let me just finish this part here. So according to these stories, the plant that the devil had forgotten to tend would turn into a beautiful but dangerous woman who would enchant you against your will.

Erin Allmann Updyke Why is it always a woman?

Erin Welsh Yeah.

Matt Candeias They're just so darn enchanting, come on.

Erin Welsh Atropa belladonna was also allegedly used by witches and wizards who would - so Matt, if you're going to go to this party, this is what you're going to have to do.

Matt Candeias That happens when you jump the gun.

Erin Allmann Updyke Also Erin just tensed her hands in a very serious way. It looks great.

Matt Candeias This has turned into a lecture.

Erin Allmann Updyke Yes. (laughs) Matt, listen closely.

Erin Welsh Matt, Matthew.

Matt Candeias My young Matt.

Erin Welsh Witches and wizards would rub a mix of this plant along with a few others like hemlock and crazy other ones onto their thighs and genitals before setting off on their broomsticks.

Matt Candeias I'm out. I'm out. I'm out. When the sticks come out.

Erin Welsh (laughs) Seriously.

Matt Candeias Your thighs?

Erin Welsh Your thighs and genitals.

Erin Allmann Updyke Wait your thighs as well?

Erin Welsh Yeah that's what holds you up.

Matt Candeias: I get the genitals actually, cause if you're going all in... The thighs.

Erin Allmann Updyke: Maybe it'll just like continually renew, it's like an extra, you know.

Matt Candeias: Yeah like sensitive skin just absorbs.

Erin Welsh: Or maybe it's like splinters in the wood, they were like 'No, we don't want...' Maybe it protects you. Cause it was an ointment.

Matt Candeias: Oh, right, right, right. Okay.

Erin Welsh: I don't know.

Matt Candeias: Perhaps it tingles.

Erin Welsh: So the topical application of the plant might cause hallucinations with the sensation of flying being one of these potential hallucinations, so that kind of makes sense about broomsticks and flying and so on. But the witches' ointment was also supposed to be sexually stimulating and that is what I wanna say a little bit about. So let's take a minute to just take stock of where and when we are. We're in the - not right now, but I mean in history. In the history section.

Matt Candeias: (laughs) In your bedroom.

Erin Allmann Updyke: Yeah we're in my back bedroom of my house right now. Anyways.

Erin Welsh: Okay. But if we are celebrating St. Walpurgis Night in let's say the 14th-17th centuries, we're in western Europe, Christianity is the prevailing religion in most areas and so you were either a Christian on the side of good or you were evil, considered evil.

Erin Allmann Updyke: Right, yeah.

Erin Welsh: Or you practiced your religion in secret under the cover of night. So witchcraft became this sort of scapegoat term that was used as an explanation for why something bad and unexplainable happened and as a 'other', like this is not like us. And so it also was used to put blame on whoever was viewed as deserving of blame, often an outsider or someone who simply did not conform. This was often women hence witch, especially women who were outspoken or fierce, didn't act subservient, that type.

Erin Allmann Updyke: The troublesome ones.

Erin Welsh: The troublesome.

Matt Candeias: The kinda ones you wanna poison, right?

Erin Welsh: Yeah exactly, right? But and so those women were to be feared and cast out and so they were said to have sex with the devil or with demons and the use of plants like belladonna represented this aggressive female sexuality which was the scariest thing of all to men during this time.

Erin Allmann Updyke: Of course, still is. Still is.

Erin Welsh: So of course it became this like-

Matt Candeias: How dare you.

Erin Welsh: It was like, 'Oh, she's... I'm sorry, you're not acting like a woman should.'

Matt Candeias: Witch.

Erin Welsh: Witch! She must be a witch. But that makes it one of my favorite plants too that it was this-

Erin Allmann Updyke: Yeah it makes me really have love for it.

Matt Candeias: Yeah. This is gonna be the centerpiece to my Satan garden.

Erin Welsh: (laughs) Yes!

Erin Allmann Updyke: I love it. Satan garden.

Matt Candeias: We'll have a bonfire to commemorate it or something.

Erin Allmann Updyke: That sounds great.

Erin Welsh: Oh perfect. Well anyway, so whether *Atropa belladonna* was actually used during witchcraft or pagan rituals isn't really clear but what is clear is that the plant is largely viewed as being on the side of evil during this time. But during the next couple of centuries, the superstition surrounding the plant receded. So you've already heard about a non-witchcraft or non-poisoning example of the plant's use as a beauty enhancer in Italy during the 1500s and in the 18th century during the Age of Enlightenment, doctors began performing thoughtful or at least systematic studies on the possible medicinal applications of plants such as belladonna. And they found one and then another and then another until it seemed like they were kind of just pulling these applications out of thin air. One of the first and actually effective uses of belladonna was to dilate the pupils which was helpful in eye surgeries. But atropine, which is one of the active compounds, was also a common ingredient in suppositories, enemas, plasters, injections-

Erin Allmann Updyke: That's actually, I mean, that's a terrible idea just in terms of its mechanism of action, it's not gonna do what you... Okay.

Erin Welsh: So it was used on its own as a topical painkiller and was also combined with other poisonous plants including the star of our first crossover with *In Defense of Plants*, aconite.

Erin Allmann Updyke: Ooh!

Matt Candeias: Nice.

Erin Welsh: Together belladonna and aconite were supposed to be excellent for a severe sore throat or tonsillitis, I don't know it I'd go that route.

Erin Allmann Updyke: I would say no, it would actually make it worse. We'll talk about it.

Erin Welsh: It's supposed to be, it was hailed as a great cure.

Erin Allmann Updyke: Great.

Erin Welsh: And another thing that I have listed under my questionable uses bullet point is cigarettes with belladonna leaves soaked in opium tincture which were prescribed up through the 1930s.

Matt Candeias: I think the opium just worked so good it didn't matter what you were slathering it on.

Erin Welsh: Just like, why would you be prescribed that? Would you just carry those around like on a smoke break?

Erin Allmann Updyke: Actually those two effects would kind of counter each other a little bit.

Matt Candeias: Really?

Erin Allmann Updyke: Yeah I think cause opium is gonna slow your metabolism down and atropine is gonna kind of do the opposite of that so it would kind of just like counter the effects of opium a little bit, so you would be at less risk for stopping breathing and things like that, I guess. But it seems like a terrible idea, not advocating it.

Erin Welsh: Well it's funny though cause its cousin is nicotine, nicotiana, so tobacco, you know, they're in the same family and we smoke plenty of alkaloids when we're... We'll get to that obviously, but yeah. I mean it's like do you want the stuff that'll kill you slowly or stuff that might kill you a little bit faster?

Matt Candeias: Interesting.

Erin Allmann Updyke: Yeah.

Erin Welsh: Okay so maybe not as crazy as I initially thought when I read it.

Erin Allmann Updyke: I mean it still seems pretty crazy to me.

Matt Candeias: Yeah.

Erin Allmann Updyke: Like bad idea for sure. (laughs)

Erin Welsh: Seems like it.

Matt Candeias: Stick to tobacco, children.

Erin Welsh: So another of belladonna's compounds, scopolamine, was used alongside morphine to induce twilight sleep for surgeries. And revisiting the dark side of the plant, it was also used as a truth serum on occasion.

Matt Candeias: Still is.

Erin Allmann Updyke: Really?

Erin Welsh: Still is?

Matt Candeias: Yeah there's a really interesting documentary about scopolamine in Mexico. Yeah it can make you very open to coercion without showing any outward symptoms that you're on things.

Erin Allmann Updyke: Fascinating.

Matt Candeias: Yeah.

Erin Welsh: Is that VICE?

Matt Candeias: I think VICE did it, yeah.

Erin Welsh: Okay I did watch that a while ago, yeah.

Erin Allmann Updyke: Interesting.

Erin Welsh: Yeah it's really-

Matt Candeias: It's intense, it's terrifying actually.

Erin Welsh: It is terrifying.

Erin Allmann Updyke: Wow.

Matt Candeias: Yeah.

Erin Allmann Updyke: I'm gonna check that out.

Matt Candeias: For sure.

Erin Welsh: Yeah we should watch that again. Also before anyone gets any ideas about this plant being an awesome new hallucinogen that grows all over the world, Timothy Leary who is the god of psychedelics basically, who's this famous, everyone knows the name.

Erin Allmann Updyke: No. Go. Tell me who he is. I nodded cause I was like yeah tell me about it.

Erin Welsh: Okay. Well Timothy Leary, he was a Harvard researcher who studied the effects of psychedelics on people and he tested them himself, like all kinds. He was the 'turn on, tune in, drop out' was like his thing. It was the time of the cultural revolution in the U.S. in the 1960s and 70s, he was a big part of that.

Matt Candeias: Yeah.

Erin Allmann Updyke: Okay.

Erin Welsh: So anyway, he knew psychedelics for sure.

Erin Allmann Updyke: Yeah.

Erin Welsh: And he allegedly said about belladonna that he had never heard of a good belladonna trip, that it was all terrifying and horrible and just left you feeling awful.

Erin Allmann Updyke: Not surprised.

Erin Welsh: Not recommended.

Erin Allmann Updyke: Yeah.

Erin Welsh: The active components of belladonna, so mainly atropine and scopolamine, were discovered in the early 1800s which meant that the compounds could be isolated to include in the many medications that I mentioned and also that it could be detected in cases of suspected murder. That's right. So it turns out that belladonna was not an uncommon way to off your spouse or neighbor or patient.

Erin Allmann Updyke: Ooh.

Erin Welsh: Some did it with the plant itself such as a woman who tossed in 20 or so belladonna berries into her husband's blueberry bowl in an attempt to sedate him as he was raging out against the entire family. In any case he was more than sedated, he was-

Erin Allmann Updyke: He died?

Erin Welsh: He died.

Erin Allmann Updyke: Okay.

Erin Welsh: Others used the isolated compound atropine, which was pretty much only accessible at a certain point to physicians and nurses. And have either of you ever heard of the serial killer named Marie Jeanneret?

Matt Candeias: No.

Erin Allmann Updyke: Maybe?

Erin Welsh: She was a Swiss nurse who in 1868 was convicted of murdering six of her patients and attempting to poison two more with atropine. Turns out she had been taking atropine for years and had developed a tolerance for it so she had to fake an eye condition to get more, which reminds me of The Princess Bride when he developed a resistance to iocane powder. I didn't know that you could actually do that to different poisons and somebody actually did that, so. Kind of funny.

Matt Candeias: Huh.

Erin Welsh

But with that fresh prescription she began giving it to her patients but she was eventually caught red-handed. And then there's the more recent case of the scientist and lecturer, biologist I think, in Scotland who in 1994 attempted to poison his wife by serving her a gin and tonic with a little something extra. After taking a few sips, she started to feel really sick so he called the general practitioner who had gone home for the evening and he left a message, he didn't bother calling emergency services even though she was feeling deathly ill. The message got sent to emergency services anyway and they showed up where they diagnosed her as having symptoms of atropine poisoning. It turned out that this dude had put atropine in a bunch of bottles of tonic at a grocery store and then returned home with one. So he put them in bottles of tonic water at the grocery store.

Matt Candeias

What?

Erin Allmann Updyke

Why?

Erin Welsh

Yeah, well.

Erin Allmann Updyke

That's a terrible plan.

Erin Welsh

7 other people around the area had also come down with a strange case of atropine poisoning after drinking tonic water from this same grocery store.

Matt Candeias

Huh.

Erin Welsh

So on first glance it seemed like his wife was just another victim.

Matt Candeias

Oh.

Erin Allmann Updyke

Oh.

Matt Candeias

Kinda smart.

Erin Welsh

Yeah.

Erin Allmann Updyke

He's like, 'I don't care if multiple people die, I just don't wanna get caught for...'

Erin Welsh

Well the thing is in the other bottles it was a lower concentration of atropine but in his wife's tonic bottle or his wife's drink, it was much higher. So he was definitely making an effort.

Matt Candeias

It's interesting that people can show up though and see it and go, 'This looks like atropine poisoning.' It's enough of a thing...

Erin Allmann Updyke

Yeah, we'll talk about it.

Matt Candeias

Cool.

Erin Allmann Updyke

Yeah.

Matt Candeias

I keep rolling on yours just a little bit.

Erin Allmann Updyke

I'm like ooh, this is why I can't wait.

Erin Welsh

(laughs) I'm almost done, don't worry. Yeah so this was his plan all along, just be oh this is a random poisoning. And he also was having an affair with this younger woman that he was trying to run off with. Anyway, so he was convicted, sent to jail, served 12 years, he's out obviously. And after his release he was hired as a professor of philosophy and medical ethics.

Matt Candeias

What?

Erin Allmann Updyke

I'm sorry.

Matt Candeias

Why did they let him out?

Erin Welsh

Attempted murder doesn't get you very far I guess in the court system. So on that note, Erin, will you tell us what it would be like to be poisoned by belladonna?

Erin Allmann Updyke

Yes!

Erin Welsh

Okay, good.

Matt Candeias

Enthusiasm.

TPWKY

(transition theme)

Erin Allmann Updyke

Okay, are we ready?

Erin Welsh

Yes.

Matt Candeias

Yes.

Erin Allmann Updyke

Okay. So to tell you about the effects of belladonna, we're gonna take a step back so I can tell you about the nervous system.

Erin Welsh

Oh, okay.

Erin Allmann Updyke

I'm like giddy. Okay.

Matt Candeias

(laughs) She's not joking. Physically giddy.

Erin Allmann Updyke

(laughs) Okay so your nervous system, if you're unaware, has two major parts to it. The first is your somatic nervous system which is like your muscles in your arms, in your legs, like what you might think of as your nervous system, it's like your sensory nerves and your bending your arm, all that stuff. But then there's your autonomic nervous system and that's the part that you might not think about because it mostly controls stuff that your unaware of, like your digestion and sweating. Maybe you're aware of sweating, I don't know.

Erin Welsh

I'm always aware of sweating.

Matt Candeias

I'm aware after the fact. Never enough to control it.



Erin Allmann Updyke So the autonomic nervous system, it controls all of that kind of stuff in your body. Digestion, salivation, blah, blah, blah, okay? And the autonomic nervous system has two major divisions, the sympathetic and the parasympathetic. So don't fade on me guys, it's gonna get really fun, like we're gonna talk about crazy things happening.

Matt Candeias I'm with you.

Erin Welsh We're in the autonomic nervous system.

Erin Allmann Updyke We're in the autonomic nervous system.

Erin Welsh We've got some sympathetic and unsympathetic, wink. Just kidding.

Erin Allmann Updyke Exactly. So the sympathetic nervous system, basically think of it as fight or flight, okay? So everybody know fight or flight, right?

Matt Candeias Sure.

Erin Allmann Updyke So if you think about what happens in your body physiologically if you were to get into a situation where you would need that fight or flight response.

Erin Welsh Murderer outside my window.

Erin Allmann Updyke Exactly, a clown in a maze. All of those things. Okay. So think about and tell me, you guys, what kinds of things are gonna be happening in your body in that situation. Go.

Erin Welsh Sweat, heart rate increase.

Matt Candeias Blood vessel dilation.

Erin Allmann Updyke All of these things are great.

Erin Welsh Pee my pants.

Erin Allmann Updyke Okay, no. You're actually not gonna pee your pants, I'll tell you why.

Erin Welsh Maybe that's my fight!

Matt Candeias Oh no. (laughs) Or just you.

Erin Allmann Updyke Okay so absolutely our heart rate is gonna increase, right, your heart rate is gonna increase, it's gonna beat harder, and it's gonna beat faster and that's because you need to get that blood to your body, right, to your arms and your legs so that you can run away. You said your blood vessels are gonna dilate. Absolutely, all of the blood vessels that go to your skeletal muscles are gonna dilate and all the ones that go to your internal organs are gonna constrict.

Matt Candeias Is that why I get nauseous if I eat and run?

Erin Allmann Updyke Yeah, probably. Yeah.

Matt Candeias I don't do that a lot, by the way.

Erin Allmann Updyke Cause your stomach is like, 'We don't need this right now.' Right, you don't need to digest the sandwich that you just ate cause you need to focus on running away from a murderer. So awesome. Sweating is probably gonna happen after the fact, right, so it'll actually probably be... I mean sweating is a complicated one so let's ignore it.

Erin Welsh What about hearing the blood in my ears?

Erin Allmann Updyke Yeah so that's just because your heart is pumping so hard and so fast, right. So your heart is like going crazy and so you can hear the blood rushing to your ears. You're not gonna pee your pants until after the threat is gone. Here's why.

Erin Welsh Challenge accepted.

Erin Allmann Updyke (laughs) All of the smooth muscles around your GI tract and your bladder are actually going to relax because you don't need digestion right now, right.

Erin Welsh No peristalsis.

Erin Allmann Updyke No peristalsis.

Matt Candeias Oh.

Erin Allmann Updyke But all of your sphincters are gonna contract.

Matt Candeias So that's why you poop yourself?

Erin Allmann Updyke You're not gonna poop yourself, all of your poop is gonna be held right in, all of your pee is gonna be held in real tight because the last thing that you need when you're confronted with something is to pee. It could be that immediately upon seeing something things could void before they contract or what happens often-

Matt Candeias It's toothpaste in the tube. Ew, I'm sorry I said that.

Erin Allmann Updyke What happens often and what my high school biology teacher actually told us about, he was not a great human but he was a great biology teacher, he said that what he used to do-

Matt Candeias Same!

Erin Allmann Updyke -was like at Knott's Berry Farm or whatever when you have those haunted scary houses, he worked at one of those in high school or something like that and he said that he would scare people right in front of the restroom cause then they like need to pee really bad. And so then it would stimulate their sympathetic response really fast but then they would quickly realize that they don't need it and then the parasympathetics would take over and then it would release everything and they'd pee themselves right in front of the restroom.

Matt Candeias (laughs) Oh my god.

Erin Welsh Oh my...

Matt Candeias: Oh wow. That is power that we probably should not have just given to the world.

Erin Allmann Updyke: I know.

Erin Welsh: But if I were a high school student working at a corn scary maze or whatever, absolutely I would do that!

Erin Allmann Updyke: Right?

Matt Candeias: If I just wanted to make my friends pee...

Erin Allmann Updyke: I mean hearing that story is part of what made me interested in biology, you know? It's like whoa.

Erin Welsh: Oh man, see I just did it for the fun sheer of the scare.

Matt Candeias: I like you all the more because of that.

Erin Allmann Updyke: (laughs) Okay so anyways, all of that, all of those reactions, that's your sympathetic response. So fight or flight, sympathetic. That's what's happening when you're under serious duress, okay. Fight or flight, anxiety attack, etc. What about the rest of the time? The rest of the time, your parasympathetic nervous system is your friend. This system is your rest and digest, okay?

Erin Welsh: Feed and breed.

Erin Allmann Updyke: That one's grosser cause like...breed. (laughs) But yes, you could say that too. So you can think of the actions of the parasympathetic nervous system as basically almost exactly the opposite of the actions of the sympathetic nervous system.

Erin Welsh: You're peeing all the time.

Erin Allmann Updyke: Exactly. So if your sympathetic nervous system is increasing your heart rate, your parasympathetic is slowing it down. If your sympathetic is blocking peristalsis and digestion, then your parasympathetic is promoting it. If the sympathetic is constricting your sphincters, then the parasympathetic is letting them fly. Right? Okay.

Matt Candeias: Floodgates.

Erin Allmann Updyke: Exactly. Okay so the parasympathetic nervous system's actions are mediated by two things basically. A neurotransmitter that's called acetylcholine which is like a little molecule that's released at the end of a nerve, and the receptor where acetylcholine binds. Okay? And that receptor is called a muscarinic receptor.

Erin Welsh: Whoa, okay.

Erin Allmann Updyke: Muscarinic like a muscle, think of it that way.

Erin Welsh: Muscle receptor.

Erin Allmann Updyke

Sure. Even though it's not on muscles.

Matt Candeias

These are the little jumps inbetween the nerves?

Erin Allmann Updyke

Exactly.

Matt Candeias

Okay.

Erin Allmann Updyke

Right, yeah. Okay. These two divisions of your autonomic nervous system, parasympathetic rests and digests, sympathetic fight or flight, they work together and most of the time in most organ systems, it's your parasympathetic that's kind of in control, right. Cause you're not most of the time under serious fight or flight stimulation.

Matt Candeias

I hope not.

Erin Allmann Updyke

But if you were to block the sympathetic nervous system, then the parasympathetic would be even more pronounced, so your heart rate would go down even more etc. right if you were to block the sympathetic response.

Erin Welsh

Okay.

Erin Allmann Updyke

And if you were to block the parasympathetic, then your sympathetic would take over. So both of these things are acting kind of all the time, it's just a matter of which one is in control and taking over. Makes sense?

Erin Welsh

Yeah.

Matt Candeias

Yeah.

Erin Allmann Updyke

Cool, now you're an expert on the nervous system. Congratulations everyone.

Matt Candeias

Sweet. Just call me.

Erin Allmann Updyke

So why did I spend so much time talking you through how the nervous system works?

Erin Welsh

I have a feeling it has to do with belladonna?

Erin Allmann Updyke

You're just so smart. Erin, do you have a doctorate or something? Cause you're so smart.

Matt Candeias

Why am I even here?

Erin Welsh

So glad you mentioned it.

Erin Allmann Updyke

(laughs) Okay.

Matt Candeias

Doctor, doctor, doctor.

Erin Allmann Updyke

You're right. So it turns out that the compounds in belladonna that make it so dangerous directly affect your parasympathetic nervous system.

Matt Candeias: Oh no.

Erin Allmann Updyke: Specifically they are what's called a muscarinic receptor antagonist, which is a fancy mouthful of a word that basically means it blocks the effects of the parasympathetic system. So it's blocking rest and digest which means what system takes over?

Erin Welsh: Sympathetic.

Erin Allmann Updyke: Right, exactly.

Matt Candeias: Fight or flight.

Erin Welsh: Uh oh.

Erin Allmann Updyke: Right?

Matt Candeias: That's terrifying.

Erin Allmann Updyke: Yeah. And so those compounds which you mentioned already are atropine, scopolamine, and there's another one called hyoscyamine or daturine, whatever. Atropine and scopolamine are the most important.

Erin Welsh: Who cares about those other ones?

Erin Allmann Updyke: Not me. So having atropine or scopolamine in your system basically means that your sympathetic nervous system, the one that makes you freak out, have anxiety, fight or flight is now unopposed and can take over the workings of your body. So you guys tell me what kind of symptoms are we gonna see?

Erin Welsh: Dilated pupils.

Erin Allmann Updyke: Yeah.

Matt Candeias: Lots of heavy breathing.

Erin Allmann Updyke: Yeah.

Erin Welsh: Heart rate really going fast.

Erin Allmann Updyke: Exactly. So your heart rate's gonna increase like crazy.

Erin Welsh: No more peeing.

Erin Allmann Updyke: No more peeing, right. All your sphincters are gonna be shut up real tight so it can cause constipation and it can cause urinary incontinence. Your pupils are gonna dilate and that's because if you think about in a fight or flight situation, you need to be able to get as much light into your eyes as possible to see what's going on.

Matt Candeias: Oh snap.

Erin Allmann Updyke

Yeah. But if you're in rest and digest, your eyes are like, 'It's cool, we'll just be here, chill.'

Matt Candeias

Yeah, yeah.

Erin Allmann Updyke

Right? What it also affects is that your parasympathetic nervous system is what controls the near/far focus of your eyes which is called accommodation.

Matt Candeias

Whoa.

Erin Allmann Updyke

And so blocking the parasympathetic effect doesn't allow you to accommodate, so it can actually cause blurry vision in addition to this pupillary dilation.

Erin Welsh

Oh, oh! So that was another thing that women who used it too much in their eyes would go blind or lose the ability to see very well.

Erin Allmann Updyke

Yep, absolutely. Yeah cause you lose the ability to accommodate.

Matt Candeias

Dang.

Erin Allmann Updyke

Yeah, right? It's fun. So yeah that's sort of the main effects of atropine. There also are central nervous system effects which we didn't necessarily talk about the central nervous system effects of your parasympathetic or sympathetic nervous system but because atropine can cross your blood-brain barrier, it can also affect your brain which is why it can cause hallucinations, confusion, all kinds of crazy things. There's actually a really funny little poem, I don't know, saying-

Erin Welsh

Can I guess what it is?

Erin Allmann Updyke

Yeah, do it.

Erin Welsh

Is it 'Hot as a hare, blind as a bat, dry as a bone, red as a beet, and mad as a hen'?

Erin Allmann Updyke

Mad as a hatter, actually.

Matt Candeias

Oh.

Erin Welsh

I wrote 'mad as a hen'.

Erin Allmann Updyke

Mad as a hatter because hens are not really that crazy but hatters, people who made hats-

Matt Candeias

Have you played Zelda? Those hens are crazy.

Erin Welsh

Hens are crazy. But also the hatter is really crazy.

Matt Candeias

True.

Erin Welsh

I guess the mask-maker, yeah.

Erin Allmann Updyke

Yes that's exactly the saying, yes. Yeah. And what's cool is that we kind of went through already all of those specific things, right?

Matt Candeias

Oh yeah.

Erin Allmann Updyke

You're blind as a bat because your pupils are dilated and you've lost accommodation. You're red as a beet because all of your blood vessels to your skin and your muscles are now dilated so you've got tons of blood rushing to your skin which makes you red and also hot as a hare. And you're dry as a bone because your parasympathetic nervous system is what causes salivary secretion so now you have no saliva which is also why I don't think it would be a good treatment for sore throat cause it actually can cause a very sore throat, atropine, because you have no saliva.

Matt Candeias

Do you want to be drier?

Erin Allmann Updyke

(laughs) And mad as a hatter because it crosses the blood-brain barrier and can cause hallucinations and confusion.

Matt Candeias

Wow. So that just opened up a whole... That's why I love coming here cause it takes all these cool things about the plants and just puts it into context.

Erin Allmann Updyke

It's so... Ugh, it's so cool.

Matt Candeias

That is so cool.

Erin Allmann Updyke

So atropine is the most potent of these compounds but it actually still today is used sometimes medically. So we use it in emergency situations to treat bradycardia or a very, very low heart rate cause it's gonna end up stimulating your heart rate. I don't know how often it's actually used for real but I do know that it's like if you look at a crash cart at a hospital, they do have atropine on hand. So there you go.

Matt Candeias

Wow.

Erin Allmann Updyke

It also can be used in the case of organophosphate insecticide poisoning because - this is really cool and I get into it because entomology but organophosphates act kind of on the same receptors and they cause them to be constitutively active and so this can kind of help reverse those effects but only on the muscarinic receptors. This is probably too much. Anyways. It can be used to treat organophosphate insecticide poisoning, I think it's cool.

Matt Candeias

Yeah. So I mean we're here in a very rural area.

Erin Allmann Updyke

Right, it's a very real thing that somebody could be poisoned by that.

Matt Candeias

Yeah.

Erin Allmann Updyke

It's not gonna help, it's just symptomatic relief for that.

Matt Candeias

Sure, just getting you to the hospital to get you detoxed proper.

Erin Allmann Updyke Right, exactly. Scopolamine is actually still used as a treatment for seasickness or motion sickness, they give it as a transdermal patch because it also can cross the blood-brain barrier so can help with nausea and things like that. And treatment of atropine overdose is with a drug called physostigmine which basically just helps... So the neurotransmitter acetylcholine that I mentioned, the drugs that you treat atropine with just increase the amount of that available so that you can kind of overcome the effects of atropine.

Erin Welsh Okay.

Erin Allmann Updyke So it doesn't reverse atropine necessarily is just helps you sort of overcome the effects so that you can then get better faster.

Matt Candeias Sure. Healing people is a bizarre sport.

Erin Allmann Updyke Yeah dude, tell me about it. (laughs) So yeah. I have some info on how much it might take to kill you. You guys wanna know?

Matt Candeias Yeah.

Erin Welsh Yeah.

Erin Allmann Updyke Not much.

Matt Candeias Just for a friend.

Erin Allmann Updyke Just for a friend? Just for fun? So atropine specifically was the one that I found the most information about. Atropine can basically start incapacitating people at about 10-120 milligrams dosage. And I wanted to ask you, Matt, and maybe you'll talk about this cause I couldn't find, probably could've if I looked harder, how many milligrams of atropine are in like a berry or a plant.

Matt Candeias Shouldn't ask me that cause I do not know.

Erin Allmann Updyke I don't know either. I saw a number of-

Erin Welsh I read anecdotally that like some children could die after eating a handful, like a few berries.

Matt Candeias Yeah.

Erin Allmann Updyke Right. I saw that it could be between like 0.5% and 1.2% but I don't know how many milligrams that equates to.

Matt Candeias Actually let's rewind, I do know an answer to that which is the safe bet but it varies from plant to plant honestly depending on where it's growing too. So to give a standard would be rough but there is...yeah.

Erin Allmann Updyke So anyways, 10-20 milligrams can incapacitate you, it could probably kill a child but the lethal dose for an adult human is usually between 90-130 milligrams of pure atropine. So again, not sure exactly how many berries but we're not advocating that you kill anybody with atropine so let's not even get into it.



Matt Candeias: Yeah. Just don't.

Erin Welsh: Just don't. Don't.

Erin Allmann Updyke: Don't do it.

Erin Welsh: Just don't touch the plant.

Erin Allmann Updyke: Yeah. If you survive, so if your dose is not lethal which it's obviously not always lethal, symptoms generally... Like the onset is pretty quick within like an hour or couple of hours but they do get better within like 3-4 days.

Matt Candeias: Oh that's interesting.

Erin Allmann Updyke: And then there really isn't any permanent loss of function.

Erin Welsh: Okay.

Matt Candeias: Provided you're not dropping it in your eyes, yeah.

Erin Allmann Updyke: Doing it all the time. Exactly, yeah. But yeah there's also huge individual variation in your susceptibility to atropine so it totally makes sense that people could become used to it because it basically is just blocking this specific receptor so what your body will do is just make more receptors.

Erin Welsh: Okay.

Erin Allmann Updyke: So if you use it all the time, it's the same thing with opiate, right?

Matt Candeias: Oh so, yeah.

Erin Allmann Updyke: That's why you go from a low dose to like straight up heroin, right, is because your body makes more receptors and then it becomes less effective and then you need a stronger dose.

Erin Welsh: Yeah.

Erin Allmann Updyke: So yeah.

Matt Candeias: Amazing! That puts a lot of things into context here. It's really cool.

Erin Allmann Updyke: Good! I'm so glad.

TPWKY: (transition theme)

Erin Allmann Updyke: But now like we need to know, Matt.

Erin Welsh: Yeah.

Erin Allmann Updyke: Why on earth do plants make this stuff?

Erin Welsh: Yes!

Matt Candeias: I'm gonna have the same darn answer for ya I think every time we do one of these but it's to not get eaten.

Erin Welsh: (laughs) Seems reasonable.

Matt Candeias: No but this one actually took me down a really fun rabbit hole which I always appreciate because it forces me to take a different perspective on things to ask different questions and just the kinds of questions that I had to ask to get to the answer of this, it was fun. And I didn't... I hope my advisor doesn't listen to this. Let's put it that way.

Erin Allmann Updyke: (laughs) It was only a few days.

Matt Candeias: No it's fine, I know how to balance my time, darn it. All right so many names for this plant include the word 'nightshade' and did you know there's a whole nightshade family?

Erin Allmann Updyke: I did. From my mom.

Matt Candeias: You did? Awesome. Anyone who gardens to any sort of degree probably comes across that word at some point or another because a lot of our favorite fruits and tubers, or I guess we call them vegetables, they're fruits and tubers-

Erin Allmann Updyke: (laughs) Fruits and tubers! That's a really cute name.

Matt Candeias: Fruits and tubers come from this family so deadly nightshade is a cousin of tomatoes, potatoes, aubergines and/or eggplant.

Erin Allmann Updyke: Aubergines, you're so fancy.

Matt Candeias: Tomatillos, yeah. It's a big family, a lot is going on. But a lot of the same toxic compounds are shared by this family which is why you don't eat raw potatoes, you do not eat unripe ro literally any other part of the tomato plant.

Erin Allmann Updyke: Yeah.

Matt Candeias: They're well defended to a large degree.

Erin Allmann Updyke: It really make sense that you don't eat raw potatoes cause that's the root and the root generally has the most of the compounds.

Matt Candeias: Yeah. They're well defended because that's the thing that's getting them through to next year.

Erin Welsh: Is this family Solanaceae?

Matt Candeias

Solanaceae, yes. So it's native to Europe and parts of North Africa as well as Western Asia so this is like a nice Eurasian, it shares that with a lot of other plants that have been found useful just because history of human settlement and cultivation. But it has been naturalized and introduced throughout the world. I don't think it's terribly weedy, in fact most of what I read said it's actually kind of hard to cultivate, it can be picky which is interesting but it is a plant of disturbance. It likes edges, nothing too sunny, nothing too shaded, little bit more nutrients in the soil. So this makes sense that it would be involved in human history, you think humans leave a mark on the landscape, even paleolithic humans were disturbing the landscape, right, and certain plants probably followed them around whenever they did that.

Erin Allmann Updyke

Yeah.

Matt Candeias

Inevitably you see a plant enough, you're gonna experiment with it a little bit you'd expect, right.

Erin Welsh

Yeah.

Matt Candeias

So this probably came into play way earlier than people were even keeping records of it.

Erin Allmann Updyke

Wow, yeah.

Erin Welsh

Yeah.

Matt Candeias

Which is fascinating because I always think about all of the work that must go into playing with and experimenting with plants through the ages, right. But if certain ones are kinda just sticking around human settlements, yeah of course we're gonna come into contact with them.

Erin Allmann Updyke

Right.

Matt Candeias

It's not a very long-lived plant which I think is pretty interesting, it can live up to 48 years in the wild which really tells you it's at home in these transitional environments, it gets done what it needs to get done in a short amount of time, makes the best use of its time. And what better way to optimize your short life on this planet than to protect yourself with some nasty, nasty chemicals.

Erin Allmann Updyke

Yeah.

Erin Welsh

Makes sense, yeah.

Matt Candeias

Plants have two options really, chemical and physical. And physical is very costly, right, it takes lots of energy and carbon to produce spines, thorns, needles, those sorts of things.

Erin Allmann Updyke

Yeah.

Matt Candeias

Chemicals, if you grow in a nutrient-rich area especially one high in nitrogen, you can make alkaloids really easily and so that is probably one of the main selective pressures that drove this plant to be just horrendous for you. Right?

Erin Welsh

Wow.

Matt Candeias And so it's also very fleshy, it's not something that guards itself with woody tissues, again that's costly, they don't live very long, they're perennial, they die back every year. Again more emphasis for that selection pressure for toxic compounds.

Erin Allmann Updyke Cool!

Matt Candeias Yeah. It's fun to think about this because they can't get up and run away so poison, whatever's chewing on you, you wanna make sure it either doesn't do that again or has no opportunity to do that again.

Erin Allmann Updyke Right.

Matt Candeias So I've heard botanists call this one of the most toxic plants in the western hemisphere.

Erin Allmann Updyke Wow.

Matt Candeias I've also heard botanists say it's one of the most toxic plants in the eastern hemisphere, so go figure.

Erin Welsh (laughs) So one plus one equals...

Matt Candeias Whatever hemisphere you find yourself on, avoid it. But again thinking about all of the plants in the nightshade family, a lot of these chemicals are not unique to deadly nightshade, it's just really good at it and happens to hang around people very often. It likes sort of these calcareous rocks so it does really well in Europe which might explain some of the more Mediterranean, European-themed anecdotes being kind of predominant there, right.

Erin Welsh Yeah, yeah.

Matt Candeias It just does well. And like I said it's kind of fleshy which is kinda cool. It's a beautiful plant, I didn't have a picture, all the ones in my book... They don't recommend growing it very often so it doesn't show up in a lot of the beautiful gardening illustrations but it is a beautiful plant. So the issue with common names is sometimes they can apply to a lot of different plants and you wanna make sure if someone serves you a nightshade, if it happens to share one with a less toxic one... The good news is that most of them that are called nightshade don't mess with them but people confuse it with another one, bittersweet nightshade which is a vine, has tiny little purple flowers and it looks like a yellow traffic cone coming down from the bottom, very reminiscent of a tomato flower, right.

Erin Allmann Updyke Oh, okay.

Matt Candeias Belladonna looks nothing like that, it's actually very different for this family. It's not buzz pollinated which is what tomatoes and aubergines are.

Erin Allmann Updyke Does buzz mean bee?

Matt Candeias Yes.

Erin Allmann Updyke Oh that's so cute.

Matt Candeias: So buzz pollination is really cool where the bees come in and they land on the cone and they have to vibrate at a specific frequency to release the pollen, they're in these little chambers.

Erin Allmann Updyke: Oh that's so cute.

Matt Candeias: And so there's plants that are at like a C sharp, there's plants that are usually like an E minor, that sort of thing.

Erin Welsh: Oh my god. (laughs)

Matt Candeias: I don't know what tomatoes are, they might be like in a C. But it's really fun to watch because if you sit and watch and (high-pitched noise). And you'll see it like spray down onto them. Belladonna does not do that.

Erin Welsh: That's crazy.

Matt Candeias: It's got these beautiful sort of burgundy/maroon bell-shaped flowers that come down freely pollinated by a variety of larger insects. Very pretty plant though, I mean if it's something that you're aware of, cautious around, respectful of, it would make an actual very interesting addition to any garden.

Erin Allmann Updyke: Like a beautiful centerpiece to your Satan garden, for example. (laughs)

Matt Candeias: Yeah, Satan garden. (laughs) They can get pretty impressive in height, 6.6 feet is the tallest one.

Erin Allmann Updyke: Whoa.

Erin Welsh: Whoa!

Matt Candeias: Yeah which is really impressive for an herbaceous plant and that probably packs some potency.

Erin Allmann Updyke: Yeah! Oh my god, yeah.

Erin Welsh: Can you imagine?

Erin Allmann Updyke: No. Yes.

Matt Candeias: And the fruits themselves, the ones that probably get the most attention despite the whole plant being pretty awful for you, is a berry. It's an actual berry just like tomatoes, tomatoes are berries, eggplants are berries, right. It's a fleshy, pulpy fruit with lots and lots of seeds in there. So the berries start green and ripen to black and they are said to have a sweet taste to them, so a lot of children make very bad mistakes because they don't, it's not like you're eating something bitter, they eat a few and they're dead.

Erin Welsh: Right, right. And would it numb your tongue or anything even to give you an indication of like-

Erin Allmann Updyke: No, so because it doesn't... So the muscarinic receptors are only in the parasympathetic nervous system not the somatic nervous system which is your sensory and muscles.

Erin Welsh: So it would have to be once you ingest it and it would start to digest before it took effect.

Erin Allmann Updyke Well yeah and it wouldn't affect any sensory nerves or anything like that, so you wouldn't have any numbness, you wouldn't have any tingling, you wouldn't have any muscle spasms cause it's not affecting any of that stuff. So the first symptoms that you probably have would be things like dry mouth. Yeah, stuff like that.

Erin Welsh Okay.

Erin Allmann Updyke Flushing, fever, that's one of the first ones.

Matt Candeias So as we discussed, not all parts of the plant are equally toxic. Plants are gonna prioritize certain organs over others, mainly their roots and their reproductive structures. And there's kind of a descending level of toxicity accordingly. The roots have the most, upwards of 1.3% of them is made up of toxic compounds.

Erin Allmann Updyke Shoot.

Matt Candeias There's a whole suite which I'll get to. Leaves is 1.2%, stalks or stems 0.65%, flowers 0.6%, and berries oddly enough 0.7% and the seeds are only 0.4%. That also makes sense. So berries, you don't want anything that shouldn't be eating them to eat them but you also need to eventually get your seeds out into the environment right, so don't load them with toxic things.

Erin Welsh Right.

Matt Candeias I also found out interestingly enough that these toxins are expressed in everything from the nectar to the pollen as well and they're not alone in that, a lot of plants have toxic nectar.

Erin Welsh I have heard about people becoming sick or maybe dying after eating honey.

Matt Candeias Mad honey.

Erin Welsh Yeah!

Matt Candeias You are from Appalachia.

Erin Welsh I am.

Matt Candeias You would deal with that actually. So anytime they say don't honey your honeybees next to rhododendrons because rhododendrons have a pretty nasty toxin that builds up in honey. And you mentioned feeding it to soldiers to knock them out, I think it was the Romans, don't quote me on this, would leave hives with mad honey, they would feed these bees on rhododendron and leave them on the routes for other soldiers, wait til they gorged themselves on it and then just come in and slay them as they were on the ground all nerved out.

Erin Welsh Oh my god.

Erin Allmann Updyke We're gonna quote you on that, it's going on a podcast.

Matt Candeias Yeah, that's true. I don't know if it was the Greeks or the Romans. One of those two were doing it, probably both.

Erin Allmann Updyke

Yeah, I believe it.

Matt Candeias

Right but the interesting thing is that a lot of organisms can get away with eating these plants, right.

Erin Allmann Updyke

Yeah.

Matt Candeias

It's very confusing to have something so terribly toxic to something like you and I but seeing a little bird go up and go, 'No problem'. Right? Yeah so that really sent me down this rabbit hole because I know nothing about any sort of metabolic process that would be able to cope with this. You brought it up last time we talked, I think it was on my podcast, about how insects kind of overcome this with some channelization and stuff but it's fascinating because these are small, brightly-colored berries. Birds. Birds are number one the seed disperser of this plant so I went, 'Huh, what's going on there?'

And it's not just atropine that they're producing, right, they're also producing compounds like hyoscyamine, scopolamine, and solanine. So there's a lot of stuff to deal with there which tells me there's a lot of things that it doesn't want eating it but whatever has to deal with it has to cope with that. So I went about trying to figure out what it is about birds that lets them deal with this on any great degree and there's a lot of really fascinating ecology here. Interest in how animals cope with toxic plants actually comes up way more than I realized and it comes up from the food industry, right. Because if an animal can eat a lot of something or eat something and doesn't immediately die from it, can it build up in that animal and then when we consume the byproducts of that animal, can that hurt us?

Erin Allmann Updyke

Wow.

Erin Welsh

Mercury in fish.

Matt Candeias

Yeah, mercury in fish.

Erin Allmann Updyke

Right.

Matt Candeias

Lincoln's mother was said to be killed by milk sickness which is actually from drinking the milk of cows that had been feeding on a certain type of plant that grows like crazy around here.

Erin Welsh

Oh!

Matt Candeias

White snakeroot.

Erin Welsh

Yes, I've heard of that! Okay.

Matt Candeias

So this is a big concern that we've known about for a very long time and it comes up quite a bit. So there's a lot of unfortunate experiments where they just feed toxic things to animals and see what happens.

Erin Allmann Updyke

Wow.

Matt Candeias

So in searching for how birds are able to cope with eating these berries I found a thing about tropane alkaloids and birds which that's the suite of compounds that nightshades are producing, they're called tropane alkaloids and alkaloids are across the board very bioactive molecules, very rich in nitrogen. And so they wanted to know what was going to happen because obviously again they've observed that a lot of animals can eat this stuff, larger animals of course just because it takes a lot to bring down a cow vs a medium-sized human. But birds are pretty small even if it's a hen. And so they noticed birds were eating these, they're dispersed by birds, what's going on here?

Well they took a bunch of different kinds of hens, which I realized that there are mostly hens that are like egg producers and ones that are meat producers and they just fed them varying levels of plant materials containing that class of compounds. Which I think they used datura, which daturamine was one of the ones you mentioned, they're named after these plants which is great. But they fed them, regardless it's the same compound, they're just trying to see at what concentrations does it affect. And it turns out that poultry specifically, so chickens, these galliformes, appear to possess an atropine hydroxylase-like enzyme that inactivates tropane alkaloids.

Erin Allmann Updyke

What?

Erin Welsh

What?

Matt Candeias

Yeah.

Erin Allmann Updyke

That's so cool!

Matt Candeias

Blew my mind. So yes, they're bringing them in, they affect them at increasing doses but they can eat a lot more than you would expect for an animal that size.

Erin Welsh

(laughs) Erin's mind is blown.

Erin Allmann Updyke

My mind is fully blown. Because I mean that has to mean that birds, at least poultry, that they have evolved with exposure to these compounds like from the beginning.

Matt Candeias

Right. So I'm gonna test you. What are chickens, as like a type of class of birds?

Erin Allmann Updyke

I don't know.

Matt Candeias

What do chickens fall under?

Erin Welsh

They're not passeriformes.

Matt Candeias

No.

Erin Welsh

They're-

Erin Allmann Updyke

Good job.

Matt Candeias

Which is the small little perchy birds.



Erin Welsh: That's like the only one I can think of right now. They're galliformes?

Matt Candeias: Right, which is pheasants.

Erin Allmann Updyke: Nice job! I'm really impressed.

Erin Welsh: I don't know where that came from.

Matt Candeias: Air fives! I'm across the room. Just double that noise up, we're good. So they are in the same group as pheasants and in the wild pheasants are said to be the most numerous birds seen feeding on this plant. So at some point in the lineage of the pheasants they realized that there's a group of delicious berries out there, evolutionarily speaking they have a history dealing with this.

Erin Allmann Updyke: Yeah.

Matt Candeias: Right?

Erin Allmann Updyke: Oh my god that is cool.

Matt Candeias: I never expected to track down that kind of connection out of a medical-agro journal.

Erin Allmann Updyke: Yeah!

Matt Candeias: That was really cool to find that.

Erin Allmann Updyke: Oh my god.

Matt Candeias: But it gets even better.

Erin Welsh: Oh my god.

Erin Allmann Updyke: What, how?

Matt Candeias: Right? So again it still affects them, it's not going to kill them outright.

Erin Allmann Updyke: Right.

Matt Candeias: The more they're eating the worse it's gonna get.

Erin Allmann Updyke: They're just able to basically break down the atropine or the alkaloid in their body.

Matt Candeias: Inactivate it to some extent, right. So feeding on higher amounts or feeding for longer increased the chances of mild diarrhea which is interesting going back to what you said about it actually shutting it down.

Erin Allmann Updyke: Yeah.

Matt Candeias: But it may not be atropine, it may be one of the other classes of compounds.

Erin Allmann Updyke: Something else, yeah.

Matt Candeias: But it actually gave the birds mild diarrhea.

Erin Allmann Updyke: Just a little bit, little poops.

Matt Candeias: From a plant's perspective, do you want seeds sitting in a gut for a very long time or do you want them to get removed from their thing, moved a distance and pooped out?

Erin Allmann Updyke: Oh my god.

Erin Welsh: Oh my-

Erin Allmann Updyke: Stop it right now, Matt. Stop it right now.

Matt Candeias: Amazing, right?

Erin Welsh: That's the coolest thing.

Matt Candeias: So not only do you have birds that can eat your berries, you give them the poops and you pretty much ensure that they get just far enough away to make your seeds find a new spot full of nitrogen-rich poop to grow in.

Erin Allmann Updyke: You guys are you hearing this? Because-

Erin Welsh: I wanna do another PhD. (laughs)

Matt Candeias: Don't do it.

Erin Allmann Updyke: But like what the heck?

Erin Welsh: That's really cool.

Matt Candeias: Plants are fascinating.

Erin Allmann Updyke: Plants are fascinating. I feel so sad for my life that i lived with plant blindness for so long.

Matt Candeias: We're curing it.

Erin Allmann Updyke: Thank god for you, Matt.

Matt Candeias: (laughs) That warms my heart.

Erin Welsh: Curing it with belladonna which is kind of ironic.

Matt Candeias: Yeah.

Erin Allmann Updyke: But it's so interesting.

Erin Welsh

We're dilating our eyes.

Matt Candeias

And our minds!

Erin Allmann Updyke

(laughs) And our minds!

Matt Candeias

So long term exposure, elevated exposure gives the birds the case of the diarrheas but breeding frequency was not affected and the effects tended to be transient only for the duration of the study and did not appear to affect their health in the long run whatsoever. And to be honest with you, this plant is not numerous enough on the landscape to ever become an issue for any wild bird to begin with. So being relatively uncommon is actually beneficial.

Erin Allmann Updyke

Wow.

Matt Candeias

They find some food, it's a quick easy meal, they eat it, gives them a little diarrhea, they poop the seeds out, the plant's happy and the bird's happy, no one's worse for the wear. If this plant were to become common and birds were to gorge themselves on it, you might be hearing a different evolutionary story.

Erin Allmann Updyke

Wow.

Matt Candeias

So Atropa, like I mentioned, also has the toxic pollen and the toxic nectar which brings up a lot of questions about pollination. So what they found was that the alkaloid content in both the nectar and the pollen is significantly higher than it is in other species investigated, which is interesting. So Atropa is really expressing a lot of these in weird tissues. But the selective selection hypothesis is only part of that alkaloid spectrum being produced. So they don't think it's getting the full complement of that chemical cocktail but on some level the plant just can't help produce it. But it could also help protect from potential pollen thieves, nectar thieves, things that want to eat their pollen.

Erin Allmann Updyke

Yeah.

Matt Candeias

So it's this trade-off, right. There's no one size fits all solution, you can't be the most beneficial thing across the board.

Erin Welsh

Right.

Matt Candeias

So you know, okay you hurt a few pollinators here and there, you hurt your seed dispersers temporarily but it's working.

Erin Allmann Updyke

But overall you come out positive.

Matt Candeias

Yeah, it's working. It's this idea that not everything in evolution should be thought of as hierarchical or being better than the other, it's just if it works, it works, right. It just can't be less beneficial than it is beneficial.

Erin Allmann Updyke

Exactly. (laughs)

Erin Welsh

Right.

Matt Candeias

I think the most important thing to remember here is at the end of the day it's a matter of variation within a species when it comes to toxicity and you had mentioned someone had said there has been no case of a good trip on belladonna but plenty of other members of this family are toyed around with and used to one degree or another for recreational purposes. And plants are very plastic organisms, again because they can't get up and move, so keep in mind that across the board, the dose is gonna depend on where it's growing, how it's growing, what conditions the soil or how much light it was getting, all of those things. And to pick up one berry and give it to someone and say, 'Oh, that was fine' you could pick up the next berry and that would be the last berry anyone ever ate. So in recreating with any of these in any way-

Erin Allmann Updyke

Don't.

Matt Candeias

Yeah, don't eat it. But it is an interesting dimension that even if you're trying to grow these plants, there's nothing saying you can't try to grow these in your garden. Because cautious, right.

Erin Welsh

Right.

Matt Candeias

And there's a reason you don't see it being sold very often. (laughs)

Erin Welsh

Right, grow at your own risk.

Erin Allmann Updyke

Yeah.

Matt Candeias

It's a fascinating plant though and I'm really happy this was the one we jumped on.

Erin Allmann Updyke

Oh my gosh, me too. I feel like we picked for our first two poisoncasts like two of the coolest.

Erin Welsh

I mean that's the thing though, every time I feel like you go digging it becomes this amazing fun story.

Erin Allmann Updyke

I know. Yeah.

Matt Candeias

Yeah. So thank you.

Erin Allmann Updyke

Ugh, this world is so cool!

Erin Welsh

It is.

Erin Allmann Updyke

Oh my gosh that was the most fun.

Erin Welsh

That was really great.

Erin Allmann Updyke

Matt, thank you so much.

Erin Welsh

Yes.

Matt Candeias

Thank you both so much for having me.

Erin Allmann Updyke

And thanks everybody for listening, hopefully you guys enjoyed it as much as we did.

Erin Welsh	Please follow us on all the social medias.
Erin Allmann Updyke	Yep we're @thispodcastwillkillyou on Facebook and Instagram and @TPWKY on Twitter.
Erin Welsh	And check us out on our website <a href="http://thispodcastwillkillyou.com">thispodcastwillkillyou.com</a> .
Erin Allmann Updyke	On our website you'll find all of the sources that we use for each episode, the books and the articles that we used for research if you'd like to read.
Matt Candeias	And what about them drink mixes?
Erin Allmann Updyke	Also those.
Matt Candeias	There you go.
Erin Welsh	Quarantinis.
Erin Allmann Updyke	Those will be on our Instagram, our Facebook, our Twitter, etc. Like if you follow us you'll see our recipes.
Erin Welsh	And thank you to Bloodmobile who provided the music for this episode and all of our episodes.
Erin Allmann Updyke	Yep, love ya!
Erin Welsh	And finally, wash your hands.
Erin Allmann Updyke	And don't eat strange berries.
Matt Candeias	Yeah. This is just a plug for plant ID, it can help save your life.