

[00:00:00] **Dr Mike T Nelson:** Welcome back to the Flex Diet Podcast. I'm your host, Dr. Mike T. Nelson. On this podcast, we talk about all things to increase muscle performance and improve your body composition all without destroying your health in a flexible framework. Today on the podcast, we've got Dr. Karen Hecht, and we're talking all about astaxanthin.

[00:00:23] You've asked who? It is a red colored pigment and a very interesting supplement. If you have not listened to the show with Dr. Hunter Waldman yet we'll link to that. You can go back and listen to that. We covered some astaxanthin there, also ketones and metabolic flexibility. And I wanted to have Dr.

[00:00:43] Karen on here. I've had the chance to meet her a couple times at the ISSN program, and she is a wealth of knowledge and a world expert on the supplement astaxanthin. Which is a non stimulant, kind of sort of an antioxidant, but it has a whole bunch of very interesting properties. And we go really deep on that, and I think you will enjoy that.

[00:01:08] Right now, the Physiologic Flexibility Certification is open for a few more days, depending upon when you're listening to this. Is open from now until midnight. September 25th, 2023. Go to PhysiologicFlexibility.com for all the information. Once you have your training and exercise and sleep pretty dialed in, then this is going to be the level 2 to the FlexDiet certification.

[00:01:38] So what are the things you would need to do then to increase your body's ability to recover, be more resilient, and just generally much harder to kill. We cover everything from temperature regulation, from cold water immersion to sauna, to pH changes. These are going to be everything from zone 2 cardio to actual true high intensity stuff.

[00:02:01] No, you can't just go do a bunch of Tabata workouts you pulled off the internet because they're probably incorrect anyway. Three, we expand the fuels area into ketones and lactate. Why that is going to be beneficial. And the pillar four is going to be breathing. So how your body regulates CO2 and oxygen.

[00:02:22] If you're pretty good on training and nutrition, this is going to be the next level, in my biased opinion, is the most efficacious things to focus your time on. The good part is it doesn't take you a huge amount of time. Some of them, like the Zone 2 stuff, do take more time. But most of the interventions here are usually not super time consuming.

[00:02:43] Because people don't have a lot of exposure to them. So we go through the big picture of the concept, physiologic flexibility, the specifics, and then we also make it extremely actionable for you or your clients, so that you know exactly what to do and when to do it. All based on actual published research that, shocker, I actually read the full studies.

[00:03:06] So this isn't just some abstracts thrown together. I started thinking of this concept literally over a decade ago. So it's taken quite a while to put it all together, but I'm super happy with how it turned out. So if you're interested in that, go to [physiologicflexibility.com](https://www.physiologicflexibility.com) and that will be open through September 25th, 2023 at midnight.

[00:03:29] If you're listening to this after that time, you can still go to that link. I'll put you on to the daily newsletter list with all the great info there. And you'll be added to the wait list for the next time that it is open. So right now, this is the only plan. It will probably not open again until sometime next year.

[00:03:48] I don't know what time yet. So go to [PhysiologicFlexibility.com](https://www.physiologicflexibility.com) and enjoy this interview with Dr. Karen Heck all about the fascinating supplement Astaxanthine.

[00:03:59] Thank you so much for being on the podcast here. I really appreciate it.

[00:04:02] **Dr Karen Hecht:** My pleasure. Thanks for having me on.

[00:04:05] **Dr Mike T Nelson:** Yeah, we got to connect at I S S N this past year, and then I pastored you at your booth the year before too, so, and you're, now you're here.

[00:04:15] I'm so glad you

[00:04:16] **Dr Karen Hecht:** did. I love I S S N. It's such a great conference for learning and meeting people. Very convivial environment for,

[00:04:23] **Dr Mike T Nelson:** yeah. How did you find out about I S Ss N? Obviously working in the supplement field, I would've assumed that's how you found out about it. Yeah, I

[00:04:31] **Dr Karen Hecht:** would say so. We were, you know, looking to find the, the right people to talk to more about sports nutrition.

[00:04:38] What are the, you know, the, the bleeding edge studies, who's working on it? Where are we gonna be able to fit in as science nerds ourselves? And maybe, I don't think I'm speaking just for myself when I say that. I think the whole team is you have to have a certain level of nerdy to, to be you know, into astaxanthin at asil.

[00:04:56] So, we just found our people, I would say at I S SS N, you know, they're really passionate very intelligent and very communicative. That's the great thing, is that they're actually looking for a place to build bridges, you know, between academia and industry and all these different type of we, we can't work in silos and I feel like everybody at is n recognizes that, and that's how we learn and grow.

[00:05:21] So it was a good place.

[00:05:22] **Dr Mike T Nelson:** Yeah. It's, it's been been very fun. Well, a buddy of mine from the fitness field came and he, he, I said, Hey, what did you think of the conference? He's like, it was good, but it's like really nerdy. I'm like, yeah. Like, what did you think? What did you think? Because I think sometimes people hear like, oh, supplements, and they think, oh, there's no real science involved in that, and they're unregulated and all this other stuff.

[00:05:47] But it's actually very fun. All the people are great, but it's, it's legitimate, like actual hardcore science at the same time too, which I think is still unfortunately surprising to some people who are not in the industry.

[00:05:59] **Dr Karen Hecht:** Right. I think one of the things that's really interesting is not only do they study, you know, the importance of nutrition and supplementation, but they also implement these practices into their own lives.

[00:06:11] So it's, it's quite unique. There are not many places where you can actually, you know, so, so-called practice what you preach. And th this is definitely a group that, that does that. And they apply everything that they learn to their own lifestyles, which is very motivating and inspiring and very cool.

[00:06:29] And I agree with you that, you know, this whole. Notion or misconception that supplements are unregulated is very frustrating because, you know, on the industry side, I gotta tell you, we have whole teams and we spend a lot of time and resources on meeting those regulations and just the amount of, you know, the audits, the, the paperwork, the supplier and material qualification questionnaires, we, we don't do that stuff for fun.

[00:06:55] We do it because it's required and important for ensuring the safety and efficacy of the products that go out on the market. So, yeah, I think it's hard to, to hear that and see that people maybe don't, don't see fully or understand fully what the role of industry is and what, what it is that we do, because it's kind of behind the scenes.

[00:07:17] But that's why I love these opportunities, you know, to go and meet people at these conferences or we get to talk a little bit more about how do they perceive it and what are we actually doing and how do we fill in that knowledge

[00:07:30] **Dr Mike T Nelson:** gap. Yeah, because unfortunately in, I mean, any field or even in supplements, there's still some fly-by-night companies that show up who are not following all those things.

[00:07:41] Even though there are regulations for 'em, they just ignore 'em. And so I've told, you know, people who are not sure, like if you're not sure, like just call a company like any of the companies I've ever talked to, like yourself who are working to do it, you know, buy the book and are spending the time and the effort to do all the regulations, like 99 out of a hundred times, they're more than happy to talk to you and then show you what they're actually doing.

[00:08:06] Because one, they're already doing the work. And two, they're excited that someone is actually caring about the quality. And to me, I think the only way that all these kind of weird pop-up companies go away is if consumers just stop buying stuff from them. Yeah. Which I know is probably a little bit of a pipe dream, but yeah.

[00:08:27] Yeah,

[00:08:27] **Dr Karen Hecht:** I'm sure there's a lot of pressures, you know, in the consumers in terms of the, their purchasing power and how they make their decisions. But I think one of the ways to, you know, encourage that transparency is to look for the brand. The more transparency you have on the label, the product, if you have a branded ingredient on there, yeah, you're absolutely right.

[00:08:46] They, that brand wants to be there because they wanna show off all the hard work they've done. Yeah. In terms of quality, safety, science, et cetera. You know, so they have a name and a reputation at stake when the name of the brand is on the bottle. And that's what, that's what you want. You want people to, you know, not be hiding in some unlabeled, unspecified shadow.

[00:09:07] So, yeah, we love, we love the that transparency on a label.

[00:09:12] **Dr Mike T Nelson:** So how did you get into studying ast? So

[00:09:16] **Dr Karen Hecht:** I was really fascinated by algae because they're just such incredible little biological machines that can seem seemingly make and do everything. So they're, you know, biofuels they're great for sequestering metals and pollutants in the air.

[00:09:34] They're excellent for nutrition in multiple ways as sources of protein and carotinoids and omega threes. They, they just, they even biomaterials, which is what I was working on in my postdoc, was, Hmm. I was working on a type of algae called a diatom, trying to develop it as A lab on chip device that could detect environmental contaminants.

[00:09:56] Oh, wow. Yeah. And so the diatoms are fascinating. You should look up

[00:10:00] **Dr Mike T Nelson:** di what, what is a diatom? How would you explain it for people who are like, I've never even heard of that.

[00:10:04] **Dr Karen Hecht:** Yeah, they're like, basically a lot of the sand that you see on beaches, those are diatoms, they're little algae with silica shells.

[00:10:13] That's what their walls are made up of, silica, and they're very intricate little, like imagine looking through a kaleidoscope. That's what it feels like to look at diatoms under a microscope. And there's a whole field of diatoms that popped up in the 18 hundreds in England when microscopes first came out.

[00:10:33] And like all people started to play with the microscopes and they had these tiny little needles. They would just arrange all these different types of diatoms that come in different shapes and sizes and different colors when you when they refract light. And they would just make these rosettes. So there's this whole, on the internet, you'll find a bunch of diatom art if you look good stuff.

[00:10:53] And the specific glue that they use to set the rosettes, it's like a big secret. And there's only one guy in Germany who still has, you know, a viable recipe. And he promised not to share until he passed and then he'll release it. So exciting stuff. And yeah, so that's where I started. Diatoms, algae, just incredible little beings.

[00:11:14] And I. Then I had you know, my inclination was always to make science accessible. So it's great to do the science, the data's fantastic, but you don't wanna bury it in a dusty book. You know, the whole purpose of science is to be able to use it and share it and learn from it. And so there's this concept of like the democratization of science where you take it out of the ivory tower and you put it into some accessible language that more people can leverage.

[00:11:40] And that was an area where I really wanted to involve myself more in. So I was looking for opportunities in science communication and I saw as real was in Washington State, which is the same state where I was doing my postdoc. And nobody knew about astaxanthin. I would say still very few people know about astaxanthin.

[00:12:00] So that was about seven years ago. So there's this great opportunity to. Tell people about this molecule that's been around for 35 years and 80 plus clinical studies. So, but a big gap in, in awareness. So there you are. Seven years later, I'm still enjoying and still learning about this molecule.

[00:12:20] It's crazy. I thought, okay, one molecule, how much could you really, you know, how, how interested can it really keep me for this time? But I'm still learning. So it's a good time.

[00:12:30] **Dr Mike T Nelson:** Yeah, I think that's one thing people don't realize if, when you do even just a PhD, which is a small portion of your career that you get, yes, you have a, a background of knowledge.

[00:12:40] You have classwork, you have things you have to do, other studies you work on, but you ended up becoming like a, a hyper expert on this one little teeny, teeny tiny area of, of stuff. So it's, it's cool to see that you've been able to kind of branch out into something that's related, but yet in a, a different field altogether.

[00:12:59] **Dr Karen Hecht:** Yeah, it's always those transferable skills. Those words really resonate once you start to transfer them and you're applying the concept. Because, you know, I was, went directly from pipetting all day to being a technical marketing specialist and now, which, what did I know about marketing right at the time, but the role really was talk to people about science.

[00:13:23] I'm like, go, okay. That's something I can do. I

[00:13:25] **Dr Mike T Nelson:** can do that. Yeah. I worked in the biomedical industry for about 10 years. The company that made implantable cardiac

pacemakers and defibrillators my. Master's was in actually mechanical engineering biomechanics, and I did my PhD in exercise fizza. So when I was working there, I was basically the glorified translator between the engineering team and the marketing and the physicians.

[00:13:49] So part of my job is I would go out and talk to electrophysiologist people in planning the devices and you know, get their feedback, all that stuff, and then it would come back and try to translate it to engineering and try to translate it to, to marketing. So the, the running joke was, I was just this overqualified, glorified translator because the, you know, engineering and marketing, even the physician feedback worlds are all completely different.

[00:14:13] They all have their own language and everything too. So it's interesting, even in science we see that too. You've got hardcore academics who are great at doing research, but explaining it to the general public. Not so good. Just because it's, at least in my case, that was a skillset I was never taught.

[00:14:31] You know, my PhD is like, just write papers, you know, become first author, do all that kind of stuff. But I think. Now it's becoming expected that you should be able to translate, you should be able to teach it. But at least when I did it, this, those skills were never really part of the curriculum. It was just this thing that just kind of got tossed on towards the end that you were expected to do somehow magically.

[00:14:52] Yeah.

[00:14:52] **Dr Karen Hecht:** I wholeheartedly grew with you. It sounds like you, you really mastered probably several languages in, in that work as you, each audience has a different set of priorities and a different set of interests and a different knowledge base. But I love what my principal investigator in grad school taught me this, and it's just stayed with me, is that just assume that your audience is uni uninitiated, but infinitely intelligent.

[00:15:16] Mm-hmm. So I like that, know specifics exactly of what, of what you're talking about, but they're able to grasp it as long as you present it in a language that they can understand.

[00:15:26] **Dr Mike T Nelson:** Awesome. I first heard about Astor Real and actually asked Suzanne thing. Oof. I think it was at I S SS N like eight or 10 years ago.

[00:15:36] And it was a guy from Japan was presenting about fatigue in the eyes. And I remember going to the talk thinking, I don't know, why am I interested in fatigue in the eyes? I don't know. And then he was, I talked to him for a while after I, I can't remember his name, but the muscles in the eyes have to work so much at such a high rate.

[00:15:56] They produce a fair amount of fatigue and react oxygen, oxygen species, Ross, and all this other stuff. And he was talking about astaxanthin, which I'd never heard of. And I was like, oh, that's kind of interesting. So I'd just been following, you know, at a glance some of the research in since then. And there's been some very interesting stuff that's come out.

[00:16:16] But for people who have never heard of astaxanthin, how would you describe what is astaxanthin itself?

[00:16:24] **Dr Karen Hecht:** Yeah. Well, well first of all, I would say it's a very powerful antioxidant and it's found in your food. So it's a member of the Carotenoid family. And I think the carotinoids that we're most familiar with, that we would recognize in foods are betacarotene, which makes carrot orange.

[00:16:39] Mm-hmm. Now maybe some people would know about lutein and xanthin, which are yellow, but are found in leafy green vegetables like kale and spinach. Then lycopene, which is red, found in tomatoes, most of the carotinoids in our diet. So these are all the pigments that make the yellow oranges and reds in our diet.

[00:16:58] They come from fruits and vegetables, but astaxanthin is not found in any edible fruits and vegetables in our diet. So it really only comes from aquatic sources. So red colored seafoods like salmon, lobster, shrimp, prawn, you know, so on. So that's where you would recognize it is if you've ever eaten salmon, the salmon is red because there's astaxanthin bound to its muscle.

[00:17:23] So, The reason that that astaxanthin exists, really the reason we have all these studies is because the research started in salmon and we were wondering why is salmon an essential nutrient that the salmon don't grow as well if they don't get astaxanthin? They're kind of like white gray color if you don't feed them astaxanthin.

[00:17:44] And so it seems to be this important thing and, and it supports their muscles. And we know that salmon are these like incredible aquatic athletes because they undergo these spawning migrations during, you know, spring they,

they come up from the oceans and they go up to the little stream where they were born and lay their

[00:18:02] **Dr Mike T Nelson:** age like hundreds of thousands of miles upstream, isn't it?

[00:18:05] Yeah.

[00:18:06] **Dr Karen Hecht:** Like 900 miles, 7,000 foot elevation, 12 foot jumps, and they're not eating the whole time, by the way, while they're doing that. So crazy. It's crazy. They're fully dependent on the fat stored in their muscle for that. So that's where the oxidative stress really becomes a challenge for them, right? For, for muscle function, but also for maintaining those fat stores that will power them through the migration.

[00:18:30] And that's where astaxanthin plays a role because it's able to protect that fat from oxidation able to protect the muscles from oxidative damage. And when the researchers first saw that, they said, oh wow. Well if it's so great for salmon, you know, could it translate to humans? And the studies really began the, a asteroid studies began in the eighties late eighties, early nineties.

[00:18:55] And we saw that in fact, you know, it does have an impact on athletic performance, mainly on endurance and aspects of muscle recovery because in addition to being an antioxidant, it also has anti-inflammatory properties and it seems to be found in mitochondrial membranes. It's a membrane bound antioxidant.

[00:19:14] And as much as half of all membrane bound astaxanthin is found in mitochondria. So you can start to think now, okay, we know muscles are metabolically very active, we know eyes are metabolically very active. And astaxanthin is sort of in the right place in the right time to address free radical production and, and damage early on where, where the free radicals are first formed as a byproduct of energy production.

[00:19:39] So that was a very. Long-winded answer. Oh, that's good. Basically to say it's a red carotenoid antioxidant. We get it in in the supplements from algae. That's the other thing. So it comes in your diet from salmon, but if you're vegetarian, you're vegan, of course you're not getting any. And so the supplement version solves that by getting it from this algae that, that in nature produces it.

[00:20:01] As part of its biology, it's a freshwater green microalgae called hemato oculus blue. Mm

[00:20:08] **Dr Mike T Nelson:** mm-hmm. Can you say that, and I think you were mentioning about the salmon. We had Dr. Hunter Walman on here too, so that people can see that episode where you talked a little bit about this also, but it's interesting that I think it's approved as a food sort of coloring agent for farmed salmon because if they're not given any ast asan thing, like you said, their flesh looks kind of whiteish gray.

[00:20:31] I've only seen it in pictures. I've never seen it live, but it's very off-putting to people then are like, oh, well this salmon. It doesn't look like salmon, but then you color it and you're like, oh, it looks like salmon again. And I think it was, you said astaxanthin that's used as one of the coloring agents for that, correct?

[00:20:49] Correct.

[00:20:49] **Dr Karen Hecht:** But it's different from the one that's used for human supplementation. Yeah, that

[00:20:54] **Dr Mike T Nelson:** was my next question.

[00:20:55] **Dr Karen Hecht:** Yeah. Okay. I thought you might be heading there. That's alright. The farm, the farmed salmon are fed a synthetic form of astaxanthin, which is, you know, produced through chemistry from petrochemical derivatives.

[00:21:07] And it ends up as a rmic mixture, which means you've got different optical isomers. So only about a quarter of that synthetic form of astaxanthin is the astaxanthin that has been clinically studied. So the difference in antioxidant capacity is about 50 fold greater in the natural form of astaxanthin, which is only one specific stereo isomer.

[00:21:30] It's also got some esters attached to it, which is basically saying that it's. Kind of emulsified in it in a way. It has those lipids attached to it that help with absorption early on in, in the gut as you emulsify. So yeah, quite a different, and we, there are studies that compare synthetic and natural astaxanthin, preclinical studies that have seen, we've seen that the effect on endurance in rodent models is better when you're taking this natural astaxanthin from algae versus the synthetic or other forms of astaxanthin.

[00:22:06] **Dr Mike T Nelson:** So for people listening, if they're eating farm salmon probably don't worry about, it's still considered safe, like as people sometimes hear synthetic and they get freaked out. But if they're doing that as a source of astaxanthin, then they're probably not the best source. Correct.

[00:22:20] **Dr Karen Hecht:** Right. So if we're looking at the clinical data showing benefits that's particular to the natural astaxanthin, and you would be getting natural astaxanthin if you were consuming wild salmon.

[00:22:32] And the richest source is wild sockeye salmon. It has the highest concentration of natural astaxanthin. So if that's the reason you're consuming it, that's the type of salmon you wanna stick to. And you would have to be eating at least one filet of, you know, raw wild sockeye salmon a day to get any sort of benefit that's been shown in clinical studies.

[00:22:55] And then if you move to like king salmon, you know, you'd have to eat eight filets a day to get the equivalent of four milligrams. So it really does vary. I would say sockeye salmon is probably the best source.

[00:23:06] Yeah. And that makes sense because if people over looked at sockeye salmon, it's just a super bright, bright reddish color.

[00:23:13] Mm-hmm. And I'm always surprised in. Just different foods. Like sometimes you find colors that are just super bright. Like, macho tea to me is just like super bright green, like, almost like glowing green, where like the salmon, like the sockeye salmon are just like so deeply colored red that usually, it seems like whenever you find those kind of natural colors and pigments that that's a, a good source, as you mentioned of different antioxidants and nutrients for your diet.

[00:23:43] Exactly. Yeah.

[00:23:44] I think that that visual cue is really nice to have. If it's red, you know, it's working, you know.

[00:23:50] **Dr Mike T Nelson:** Very cool. And you had mentioned some of the benefits about astaxanthin being an antioxidant, and I think it has some very unique properties where the one thing that impressed me the most if I have this correct reading the research was that.

[00:24:06] Some antioxidants, when you take them in high amounts, they actually spin off more pro oxidants, which again, doesn't mean that they're bad

for you. There's been some argument that maybe that's actually how they're actually working in the body, but I think s is Anthony, even at higher doses, doesn't seem to spin off as many sort of free radicals and other pro-oxidants, and it seems to have a different mechanism of action.

[00:24:29] Is that correct?

[00:24:30] **Dr Karen Hecht:** Right. So, astaxanthin is what's known as a pure antioxidant, which means that in in vitro studies we've seen that it never becomes a prooxidant. Whereas some other antioxidants, if they're present in very high concentrations or the free radical concentrations are very high or metal concentrations are very high.

[00:24:49] They expend those electrons and run a deficit themselves, which is how they become pro oxidants. They're looking to find some electrons to re, you know, replace or, or make sure that deficit goes away, whereas Astaxanthin, there's, is able to share its electrons as kind of a primary mechanism versus giving them away.

[00:25:11] So that's, that helps to make it this kind of more pure antioxidant. And it's also one of nature's most powerful known antioxidant. And that comes from an in vitro study where they did this head-to-head analysis of astaxanthin singlet oxygen function capacity compared to other antioxidants. And they found that astaxanthin performed, you know, 6,000 times better than vitamin C and 800 times better than coq 10, and even two to five times better than its cousin Carotinoids like betacarotene and lutein and zeaxanthin.

[00:25:44] So, as an antioxidant, it has a few features that stem from its structure that make it quite, quite unique.

[00:25:53] **Dr Mike T Nelson:** Very cool. And there isn't any negative effect then upon exercise performance. 'cause I know the literature's kind of split on taking high dose antioxidants may blunt some of the effects of exercise.

[00:26:08] And I know some of the studies, like the high dose vitamin C study was a, was a mouse study. And it doesn't happen with all antioxidants. It appears to be like the vitamin, if I remember right, vitamin C, vitamin E. Like some of 'em in higher doses appear to have those effects in humans. But other sort of plant derived ones don't seem to do that.

[00:26:29] Right? So eating more fruits and vegetables. I've never seen a study showing a negative impact upon exercise performance. So I assume, and I know Astaxanthin has some potential benefits from enhancing exercise performance.

[00:26:44] **Dr Karen Hecht:** Right, exactly. So what we've seen in our studies is that astaxanthin can actually boost the effect of exercise training.

[00:26:52] And so we've seen that in a study in training paramedics. We've also seen it in individuals 65 and older, where when you combine astaxanthin together with exercise, the outcomes are significantly better than exercise alone. And so, although there are some antioxidants that appear to have a negative effect it doesn't seem like astaxanthin is one of them.

[00:27:16] And we know that all antioxidants function somewhat differently, perhaps in different parts of the body. Perhaps they have different preference for different types of free radicals or different. Quenching mechanism. And so I don't, I think I would caution that we don't look at antioxidants, sort of blanketly as all being the same because there really are not.

[00:27:38] And although we primarily talk about their antioxidant capacity in terms of like direct antioxidant action and ability to quench free radicals, there's actually a lot more often to the mechanism of action there than, than we talk about on the surface or we communicate to the average consumer. You know, for example, I mentioned the anti-inflammatory properties in clinical studies and, and preclinical studies, we see astaxanthin modulates at least nine different markers of inflammation.

[00:28:09] We also know that in addition to being a direct antioxidant, it's an indirect antioxidant, meaning it actually upregulates endogenous antioxidants within your body like glutathione and superoxide dis mutase. And it does that through the Nerf two pathway. So some antioxidants. Hmm. Like astaxanthin function that way.

[00:28:28] So, and then we also see in certain preclinical studies, astaxanthin is actually modulating or activating AMP kinase through the phosphorylation mechanism. So that amp kinase pathway in muscle we've seen is actually influencing mitochondrial biogenesis genes and upregulating those as well.

[00:28:48] So, you know, there's a lot more going on there than just quenching free radicals. And when you start to add up all those potential mechanisms of action, you see that, you know, there's more to think about when you're thinking

about exercise performance and adaptation than just that direct antioxidant activity.

[00:29:09] **Dr Mike T Nelson:** Yeah, and I pet peeves. Using the term antioxidants and then just like you said as a blanket statement for everything, right? Because the headlines, you always hear the negative headlines of, oh, antioxidants, blood exercise performance. It's like, well, wait a minute. It was only a couple of 'em. It wasn't all of 'em.

[00:29:27] It's, but those kind of. You know, headlines get people's attention because it's a negative and it's usually this whole blanketing statement that's trying to cover everything. And then when you look at the actual details, like rarely is anything that simple.

[00:29:43] **Dr Karen Hecht:** Exactly. Nothing is simple, but in communicating it to people, you have to simplify it.

[00:29:49] And there's, and there's this like very the dangerous kind of inclination to be very reductionist because, you know, when you're, when you only have like 30 seconds to talk to someone about what it is yeah. You can't really talk about AMP kinase and PGC one. Oh,

[00:30:08] **Dr Mike T Nelson:** I think that wasn't, I don't know, all these quotes get ascribed to Einstein, but I think he said something, make everything as as simple as possible, but not wrong.

[00:30:19] Right. At some point when you're trying to simplify everything, there's that line you cross where. Oh, now it's just kind of wrong. It went from simple to being, now it's incorrect.

[00:30:28] **Dr Karen Hecht:** Right? Right. And it turns into this broken telephone situation where Right. People may misinterpret your, you know, your simplified form.

[00:30:36] So yeah, spending time, I think with people and having a conversation, you know, multiple conversations, like, like in science, you ask one question, you know, you, you do one experiment. And. Many more questions come up that need to be addressed. So yeah, it's always nice to have an ongoing conversation. The science on astaxanthin is ever evolving.

[00:30:58] You know, we have in the sports nutrition, muscle performance space, five new studies with Astro astaxanthin just this year. Wow. So, you

know, we're, we're working on it and we understand that, you know, we have to keep, you know, retesting this model and you know, adding to what we know about astaxanthin because there's all these different populations.

[00:31:18] For example, you know, we have tested astaxanthin extensively in endurance trained individuals. But the studies that Dr. Walman has done in resistance trained individuals are fairly new. They're, they're. Have not been many studies. There are some older studies done by, by Dr. Bloomer, but you know, since then, which was kind of early to mid two thousands, no one's looked at resistance trained individuals.

[00:31:45] And I think the reasoning for that is because there's this concept that astaxanthin works in. Mitochondria and endurance trained individuals are more dependent on aerobic respiration and have more mitochondrial dense muscle tissue. And so the effect, you know, the studies have been focused there, but now we're starting to see that.

[00:32:06] Maybe there are other endpoints or ways to look at it in resistance trained individuals that are unmasking benefits there as well. And that's important to, to understand. So we're looking at, you know, soreness and baseline insulin levels and oxygen consumption and graded exercise tests and, and cardiovascular benefits like to heart rate and systolic blood pressure.

[00:32:28] And we're seeing effects there. So it's exciting. Yeah. Always learning.

[00:32:33] **Dr Mike T Nelson:** Yeah. On the endurance effects. Then we'll talk about resistance training. What are some of the benefits you've seen? I remember reading some older endurance tests and mice that were pretty crazy because I was looking for, at the time, I was in some, some consulting for a supplement company.

[00:32:52] The project I was on was, can you make a non stimulant based fat burner? Right? Can you find something, you know, supplements that are legal that increase your body's ability to use, you know, more fat, expend more calories, but could it not be stimulant based? So no, you know, caffeine or other kind of stimulant add anergic type based things.

[00:33:12] And so one of the suggestions I had was, and this is back God, probably eight years ago now, seven years ago was astaxanthin because it had some very interesting studies about switching the body to use more fat as a fuel.

There's some very interesting mice performance studies. And then at the time, some of the human studies were kind of a little bit mixed, which again, right.

[00:33:37] You know, some stuff that works amazingly in mice like C1 a didn't transfer to humans at all. Some other things that worked well in mice transfer to humans, but not at the same rate. So, What are some of the, the human studies that have shown on astaxanthin in relation to the use of fat as a fuel and potentially endurance performance?

[00:33:58] Mm-hmm.

[00:33:59] **Dr Karen Hecht:** Yeah, great question. So in the early days around, you know, 2008 or so, we had these preclinical studies that showed in rodent models that were running, exercising that they had less oxidative damage to cardiac and skeletal muscle. They also had improved fat utilization and reduced carbohydrate utilization, and they were able to run longer distances before exhaustion.

[00:34:26] So that was sort of where we, we started. And then there are all these other in vitro studies that showed astaxanthin is found in mitochondria. It helps to protect mitochondria against oxidative damage. And then the question was, okay, can we recapitulate this or does this act, is this how it works in humans as well?

[00:34:45] And the studies that. First started to point towards maybe, maybe there, it does work by this mechanism. Or in 2021 out of the UK and Edge Hill, they looked at cyclists that were after 40 kilometers showed improved fat oxidation rates at the 40 kilometer mark compared to the placebo or compared to baseline.

[00:35:06] Whereas the placebo group did not show this effect. And that's, that was our first indication. And it's like kind of extreme, you know, endurance. Yeah, endurance exercise individuals. And then there was a study that just came out in overweight individuals undergoing a treadmill exercise where they were supplementing with astaxanthin.

[00:35:27] And over the course of the exercise training They actually saw a, a reduction in average carbohydrate utilization. It was an 8% reduction over the course of the exercise. So now we're starting to accumulate evidence, but quite in quite different populations. We're looking further into other measures.

[00:35:50] So things like I mentioned, the oxygen consumption and resistance trained individuals. So we saw it was lowered by 12% during the final and hardest stage of a graded exercise test. So, you know what, so they're more efficient. They're more efficient. Exactly. So it'll be interesting to see in some upcoming studies, you know, if you were at I S S N, you saw Drew Gonzalez present Yeah.

[00:36:13] On firefighters. So he saw some interesting outcomes related to some of these endurance related outcomes with related to oxygen consumption and not oxygen consumption, excuse me related to respiration and, and exhaling of c O two. So I will let Drew explain those because mm-hmm.

[00:36:33] That, you know, something that he's been presenting at I S S N and N S C A con National Conference. But it's exciting to see that we're starting to get pieces here and there in different populations, in different studies that suggest what we're seeing in rodent models may also be translating to humans.

[00:36:51] And it's now just a question of, okay. Which, you know, which endpoint do we really wanna focus on? Which population is the most relevant? To study here and, and then expand out from there. One, in terms of populations to study, I will say that not all of our studies have been done in men, but the majority have.

[00:37:11] And so that's an, an area where we also are interested in expanding on is looking at female athletes and looking at the effects there. The one study that we did that did show an effect on, you know, exercise training being boosted with astaxanthin supplementation in older individuals that included both men and women.

[00:37:31] And we also analyzed the data separately there. So men were analyzed separately from women and in both groups their fat oxidation was improved, but carbohydrate sparing was only improved in men in that study in the older. So that's quite interesting and I think we have a lot more to learn in that direction as well.

[00:37:56] **Dr Mike T Nelson:** If you were to speculate into the future, do you think astaxanthin as a, so an ergogenic or something that would enhance exercise performance would be more beneficial in people who are kind of metabolically unhealthy or different pathologies and then also exercises more on the extreme end. Because maybe both of those groups are producing more reactive oxygen species and as does Asta, real as Anthony would be more beneficial in those groups.

[00:38:31] What are your thoughts on that area?

[00:38:33] **Dr Karen Hecht:** I think we need to think about these types of nutritional interventions and supplements in terms of like a preventative and predictive kind of approach. So the goal is to maintain balance between antioxidants and free radicals. So we're talking about, you know, redox homeostasis to use the, yeah, the technical term.

[00:38:55] And so we wanna address that before the shift has gone over to the point where there are some negative symptoms or pathologies, because that's the point where, you know, we really can make a difference in terms of career longevity for athletes and performance. And you know, just in general quality of life for older individuals trying to maintain mobility.

[00:39:19] So I think that, We certainly can look at things like, okay, let's look at extreme cases like elite athletes where we know that balance has shifted. Or older individuals where we know, you know, they're experiencing higher levels of oxidative stress and less efficient endogenous antioxidant capacity. And that makes a lot of sense.

[00:39:40] But I also think that we need to be proactive as even, you know, unaccustomed to exercise or starting a new exercise regimen and thinking about staying healthy and prolonging our health span. That that's a tool in our toolkit to help us achieve those

[00:39:57] **Dr Mike T Nelson:** goals. Very cool. And what is the common dose that's used in these, in these studies?

[00:40:05] And then the second part to the dose question is, I believe you, it's best to sort of, I don't wanna say load it, but have it. Be onboard for two to four weeks or longer before you would expect some benefit. So the analogy I've used, it's sort of kind of like people are familiar with creatine, like you can't take creatine and then, oh wow, I got a huge increase on day one.

[00:40:27] It right has to be taken and stored and put into the muscle. And then, you know, after a period of, you know, five grams per day for four weeks, you see a benefit. And I think astaxanthin is similar in that regards, where it's not acutely benefited, but you need an accumulated dose for a period of time.

[00:40:46] Right.

[00:40:47] **Dr Karen Hecht:** So the studies show benefits at four to 12 milligrams a day. The most recent studies were all done at 12 and the early studies showing effects in, you know, cyclists and training paramedics and soccer players related to endurance and recovery, those were done at four milligrams a day. We do see in some studies a dose dependent effect.

[00:41:08] So, you know, some of the higher doses seem to show greater benefits in other areas. Like cognitive health and cardiovascular health. So keep that in mind as you're considering whole body benefits and not just for muscle necessarily. And then you're right. Yeah. So the study intervention, like the duration of the studies does vary from that Edgell study was one week of supplementation.

[00:41:33] Mm-hmm. Whereas, you know, we have studies going up to 24 weeks and in, in one case where astaxanthin was part of a formulation, looking at progression of age-related macular degeneration, that was a two year study. Wow. Yeah. But the effects generally that we see, Or after four weeks. And so it just depends on which, which effect you're looking for in most of those muscle studies.

[00:41:57] At four milligrams, there was an effect after four weeks in the soccer player study, it was after 90 days. So I think that there's some something yet to learn about exactly the population that we're looking at. I think if you are further out, maybe on that you know, redox homeostasis kind of scale where your free radical load is, is higher, you may benefit from a higher dose and a longer duration.

[00:42:23] But yes, it's a fat soluble nutrient, so it does take time to accumulate to, you know, a beneficial level. So that's definitely true. You'd want, it wouldn't work like caffeine where you would feel it right away. It's more of a maintenance dose that you need

[00:42:37] **Dr Mike T Nelson:** to have. And I think it's actually being incorporated into the cellular membranes.

[00:42:43] Right. You had mentioned especially in a lot of mitochondria.

[00:42:47] **Dr Karen Hecht:** That's right. Yes. So it has this unique structure where it's got these looks a little bit like a dumbbell and that there's these little oxygens on the ends, and then all the conjugated electrons in the middle. The bar is in the middle, the aliphatic chain, so it kind of fits coaxially into the membrane.

[00:43:04] It actually matches the membrane architecture quite nicely. Hmm. And we've seen in in vitro studies that that allows it to quench free radicals both on the membrane peripheries and inside the membrane. So you're kind of getting really nice antioxidant coverage of the membrane that way. Whereas other antioxidants like vitamin E, they may be found in the membrane, but they're too short to span the membrane.

[00:43:26] And then vitamin C doesn't, it's a water soluble antioxidant, so it doesn't have access to membranes. So that's a unique feature of astaxanthin. Yeah.

[00:43:34] **Dr Mike T Nelson:** Awesome. One of. Thing with, I think I asked Dr. Walman about this too is before I go kiteboarding, because it's kiteboarding, you know, I'm trying to do some jumps.

[00:43:46] Hopefully I land them, but if I don't, I make it dropped outta the sky 20 feet and risk of bad stuff happening, concussion, that kind of stuff. And then you're also usually outside in very warm and sunny environments and you're, you know, staring at the sun for four to six hours. And so based on the research, my thought was there doesn't appear to be much toxicity, at least that I could find at high doses.

[00:44:11] There's some interesting, although it looked to be a little bit more anecdotal around potential help related to sunburn. Since I'm very white Scandinavian type background, I tend to burn relatively easy. And my third thought was, does it cross the blood-brain barrier? And would it help if, you know, you took a big.

[00:44:32] To the head where the blood brain barrier could open up. And you've got a lot of this neuroinflammation kind of running amuck. My thought being that maybe astaxanthin could help from the UV and the potential risk of concussion. Any thoughts on that? I know that's probably a little bit out on the bleeding edge area of the, of the research,

[00:44:54] **Dr Karen Hecht:** right?

[00:44:54] Yeah. So, what, what I can answer to address that is that there, although astaxanthin, you know, doesn't block uv it's not, it's not a sunscreen. Although I have seen, you know, some people talk about that, I think through word of mouth. This comes, I think from one study where they looked at photoprotective properties of AST stent and we know some carotinoids have this this capacity basically.

[00:45:20] What the study showed was that the individuals who were supplementing with four milligrams astaxanthin for nine weeks, it took a higher intensity of UV exposure to produce a sunburn. But other studies have shown that the UV still gets in, free radicals are still being produced. And so I believe what's happening is you're, you know, improving the resilience of the response downstream.

[00:45:47] Hmm. So what we see in studies in healthy individuals and healthy cells is that astaxanthin is reducing the pro-inflammatory markers that are secreted by skin cells, keratinocytes, that are being exposed to UV in vitro. And then if you take that supernatant from those keratinocytes that are, you know, secreting all those pro-inflammatory markers, and you put them on the cells in the deeper layer of skin, the dermal fibroblasts, the inflammation causes them to express.

[00:46:17] Collagen degrading enzymes, and we see that by reducing the inflammation markers, they also then reduced the collagen degrading enzyme expression. So that's just to give you an idea of how UV signals, you know, down through the layers of skin and you know, starts this cascade of, of response and astaxanthin seems to work in that downstream area and perhaps is improving the resilience that we observe in that one clinical study.

[00:46:45] Looking at erythema, that study also showed that the. Part of the skin that was exposed to uv actually helped, was retaining moisture better. So, that's part of that resilience. But I would just caution to say that this doesn't make astaxanthin a sunscreen in any way because again, it's not blocking uv.

[00:47:07] So what you're doing really is you're just improving the health. The, the basal health is optimizing the health of the skin so that it's more able to respond to normal levels of, of physiological stress or environmental stressors. In terms of the brain aspect, yes, astaxanthin does cross the blood retinal barrier and the blood brain barrier.

[00:47:31] So we do see in preclinical studies that it's found in the brain and the studies in that area are, I would say there are some in, in terms of clinical studies, still somewhat limited, but we do see that it does affect reaction time to computer tests. It, it improved the reaction time to delayed recall tasks and accuracy to one memory task in a clinical study at 12 milligrams.

[00:47:58] Astaxanthin. And there's a really interesting preclinical study where they looked at exercising rodents and they looked at the effects. We know exercise has an effect on adult hippocampal neurogenesis. Learning memory

[00:48:15] **Dr Mike T Nelson:** increases. It makes it better. Exactly.

[00:48:17] **Dr Karen Hecht:** Well, in that particular study in rodents that were supplementing with astaxanthin and together with exercise, there was a synergistic effect, meaning that the effect on adult hippocampal neurogenesis that you got from exercise alone and astaxanthin alone was more than the sum of the two when you combined exercise in astaxanthin.

[00:48:38] So I think that that's an interesting area for future research. And there's definitely potential, I would say seeing how astaxanthin is, you know, found in the brain, at least in, in rodent models. And we have these studies in humans suggesting it's improving performance to mental and physical fatigue.

[00:48:59] There's one study that showed that, but that one was combining astaxanthin and vitamin E, which we've seen some studies. So yeah.

[00:49:07] **Dr Mike T Nelson:** Awesome. Two questions as we sort of wrap up. Is there any reason we would need to cycle astaxanthin? Is there any recommendations to take it for a period of time and then not take it?

[00:49:20] Or is there any data looking at that? I don't know of any data that I've seen that shows any reason you would need to kind of go on and, and off it, per se.

[00:49:30] **Dr Karen Hecht:** Yeah, there's no data I've seen either. So we do see that when individuals stop supplementing the benefits kind of go away. So, and there are, you know, 40 plus safety studies showing no adverse effects, and the recommendation is that you supplement together with a meal or within 30 minutes after a meal, you take that supplement because it does help to optimize absorption.

[00:49:58] So that yeah, I would say that the really, the, the. The purpose of the astaxanthin supplementation is to have this continuous maintenance dose, which you could do up to 12 milligrams a day in the us in other countries that may differ. In Japan, there is no limit in, in Brazil it's six milligrams. In Europe it's eight milligrams.

[00:50:20] And that just depends on the regulatory bodies and, and their, how they interpret safety factors and, you know, things like that, how they interpret the studies. But yeah, in the US it's up to 12 milligrams a day and a continuous supplementation. And the reason is that you, you want to maintain that redox homeostasis.

[00:50:41] And so, part of that means you, you know, since astaxanthin is cleared from serum within 72 hours you wanna be able to, you know, replenish that supply.

[00:50:55] **Dr Mike T Nelson:** Awesome. And you were telling me some very cool stuff about how astaxanthin and specifically Astor Real is made and how it's a little bit different from other maybe astaxanthin products on the market.

[00:51:07] Because I think one of the confusing things is people look and they're like, oh, astaxanthin must be astaxanthin. But we've talked a little bit about, you know, some of the differences early on is how is Asta real different? Or maybe it's similar. And then if you wanna discuss a little bit about how do you, how do you actually manufacture the product?

[00:51:29] **Dr Karen Hecht:** Oh, sure. Yeah. I mean, it's fascinating when you go and visit the facility. So we're, we have two manufacturing facilities and one is in Sweden and one is in the US in Washington state. And what is unique about the way that Astri cultivates the algae is that they do it in this indoor environment, whereas conventionally, the algae are grown outside, either in open ponds or in these tubular systems that, you know, span miles and are quite quite impressive looking.

[00:52:00] And the, the trouble is that, you know, when you're growing things outside, you're kind of, You know, subject to the elements and weather and availability of sunlight and also higher risk potentially of biological and chemical contamination. So what as oil does sort of mitigate that risk and provide a more consistent environment.

[00:52:25] 'cause these algae are quite finicky actually, this particular species. So we grow all of ours indoor. That allows us to hepa filter the air to remove any persistence. Air pollutants, it helps us to minimize the risk of biological contamination and essentially just like nurture the algae and make sure that they have a safe, consistent, cozy environment to grow in so that when

[00:52:48] we harvest happy algae.

[00:52:50] Yeah. Just like, you know, cuddle them for poetry.

[00:52:54] Sing to them at night.

[00:52:57] Exactly. And that basically it means that when we harvest the algae, we harvest fully mature. What we call red phase algae that have no green

chlorophyll left. And that's important because the green chlorophyll reacts with light. So it's photosensitizing and it contributes to astaxanthin degradation.

[00:53:16] So we have, you know, high yield you know, more stable outcomes that way. And yeah, it's just our parent company, Astro's parent company is actually a pharmaceutical company based in Japan. Hmm. So they're, you know, the culture of, you know, making sure everything is zipped up and all the T's are crust and i's are dotted, is very, very important to us.

[00:53:39] And all the research investment is very important to us. And I think that in the end, if you're gonna put something on the market that's gonna be, you know, a lot of work to grow this algae, you wanna make sure that it's efficacious. And the, the company's goal really is to make sure that people live happier, healthier lives.

[00:53:59] And you can only do that. If the product is effective and safe. So that's what we try to achieve with this very particular cultivation process.

[00:54:10] **Dr Mike T Nelson:** And if people are looking to purchase Astra Real, would they just look for it on the label of certain products then, I assume?

[00:54:18] **Dr Karen Hecht:** Yeah, so there's three places you might find it.

[00:54:21] You might find the logo on the front of the label. You might find the brand on the back of the label, or some people will put it in the actual supplement facts panel. And those are the three places you would look and do you just look for Asil on the label. And you can also visit astaxanthin.net where we have, you know, several products listed that are using Asil

[00:54:47] **Dr Mike T Nelson:** Astaxanthin.

[00:54:48] Awesome. Very cool. Anything else that you think is your top. One or two things about astaxanthin that people should know about that we maybe didn't cover or something you wanted to highlight?

[00:54:59] **Dr Karen Hecht:** Yeah. Just to say that you know, it doesn't have to be a pill either. We see astaxanthin available as beverages and as gummies and as chocolates.

[00:55:11] So you can be creative if that's something you prefer. There's, there's powder mixes out there too that you could just put into your shake. So keep an eye out for that. And yeah, if you have any questions as realusa.com is a good

place to go for resources as well as astaxanthin.net and there are more studies coming out, so keep an eye out on those.

[00:55:35] And that's it. Thank

[00:55:37] **Dr Mike T Nelson:** you. And if manufacturers or people who do supplement formulations are interested, they can obviously just contact you guys directly to license the product for some of their different supplement formulations, correct.

[00:55:50] **Dr Karen Hecht:** Yeah, absolutely. Yeah. I think that's one of the things that we pride ourselves on is we don't just you know, drop the astaxanthin at the doorstep and, and leave.

[00:55:59] We really do to partner with our with people and help them really leverage it. 'cause again, when you've invested 80 plus human clinical studies and you know, 35 years of experience and research, we have an r and d team, you know, we wanna be able to share that knowledge and make sure that people can leverage all the hard work that we've done to get the best use and the most benefits out of it.

[00:56:23] So yeah, we work very closely with our customers to find ways to explain what Astaxanthin does, to formulate it, and exciting and new ways to make it taste good and help people feel better. So that's what we do.

[00:56:40] **Dr Mike T Nelson:** Yeah, and I think that's great because as you know, in the supplement world that. Doing human studies, even preclinical work is a pain in the butt.

[00:56:49] It's expensive, it takes a long time. Like you don't know exactly how the result is gonna work out, but you're doing it because you're interested in trying to figure out, okay, what are the mechanisms, what's actually going on? And so I always like supporting companies that are actually doing the research on it, because I think it's very easy for a company to put out a product and say, oh, it does whatever, and not have any studies on it, or even have any ingredients that are backed by any, any research at all.

[00:57:22] And the only way that anything goes forward is you know, primarily the company is, and yeah, there's some academics that'll do research in that area, but someone's gotta pay for it. Someone's gotta put in the time, someone's gotta put in the expertise in order to. To make that happen. And that's very much a, a longer play.

[00:57:38] So kudos to you guys for, for doing all that hard work because that it's far from easy. And there's also, I think people don't understand some risk as a, a company because you can't predict how all the studies are gonna turn out. Right. So, you know, you kind of have to do it just for the sake of, this is something we wanna figure out.

[00:57:57] We think it's beneficial, you know, and here's our contribution, you know, to the science, which I think is great.

[00:58:03] **Dr Karen Hecht:** Yeah, thank you. You know, and ultimately those negative outcomes teach us something too. Yeah. And it helps us to refine the recommendations to the consumer. So, hey, you know, if you wanna see a benefit, then you're gonna have to take it for four weeks, not two weeks.

[00:58:17] You know? So it helps. Again, it's all these things that are, are beneficial even though it might seem scary, you know, to get a negative outcome. I think if you could, if you approach it from like a long-term perspective, like we're not just doing one study and then calling it a day, we're, we're in it.

[00:58:34] You know, we're, we're working with these researchers over, you know, creating these relationships and relying on their expertise to tell us, you know, where to go next and, and learn and, and figure out how to optimize this ingredient.

[00:58:50] **Dr Mike T Nelson:** Thank you so much for all your time here. I, I really appreciate it.

[00:58:53] That was great. And hopefully it gives, People send good information and yeah, a lot more detail about something they may not have heard of before.

[00:59:02] **Dr Karen Hecht:** Yeah. Thank you so much, Mike, for having me on and all the great questions and your insight too. I really appreciate it.

[00:59:08] **Dr Mike T Nelson:** Oh yeah, no problem. Thank you so much.

[00:59:09] Thank you so much for listening to the podcast. Huge thanks to Dr. Karen for... All of her great information about astaxanthine. It's always a pleasure to talk to her and I learn new stuff every time too, which is great.

[00:59:25] **Dr Mike T Nelson:** Especially about even just the, the manufacturing, the differences between something labeled astaxanthine what are some potential uses for it and some cool new research that's coming out. So huge thanks to her. Make sure to check out all the links in the podcast notes below. And the Physiologic Flexibility Certification is still open until midnight, September 25th, 2023.

[00:59:52] So this is the Level 2 to the FlexDyed Certification. If you're looking for ways to increase your body's robustness, become more anti fragile, and just generally much harder to kill, this is the certification for you. Cover everything from temperature. to breathing techniques, to cardio, true high intensity work, the use of ketones, the use of lactate, many other things.

[01:00:20] The good part is that it doesn't usually take a whole bunch of time to add to yourself or to your clients, and if you have any questions so far, I don't know if I'll continue this next year, but so far you can literally just email me. I'll give you my private email access. And you can ask me any questions you want about the certification.

[01:00:42] Because the biggest question or concern most people have with longer certifications, this is about a 25 hour certification, so it is not short. But we do try to break it down into terms you understand, and if there's still something that you don't understand, or you're having a problem implementing it, you can literally email me, and I will help you out.

[01:01:02] So, go to [PhysiologicFlexibility.com](https://www.physiologicflexibility.com) for all the information. If you're listening to this outside of that time period, you can still go there and get on to the wait list for the next time that'll be open sometime in 2024. Thank you so much, as always, for listening to the podcast. We really appreciate it.

[01:01:23] Huge thanks to Dr. Karen for all of her time and sharing all of her wisdom here. If you can leave us whatever stars you feel is appropriate, any feedback is always welcome. And stay tuned because we've got a ton more of guests coming up from people such as Dr. Alan Bacon, Dr. Dwayne Jackson. We're talking all about neuroprotection coming up, Dr.

[01:01:47] Matthew Stratton about fasting Luca Josevar about business, Dr. Kurt Escobar about autophagy, Dr. Eric Helms and Dr. Grant Tinsley about how to measure body composition. And much, much more. So stay tuned to the podcast. All of those are coming out yet this year. Thank you so much. Again, if you're interested in the Physiologic Flexibility Certification, go to [physiologicflexibility.com](https://www.physiologicflexibility.com).

[01:02:13] com. And thank you once again. Have a wonderful day.

[01:02:17] Well, they say all good things come to an end. What's that got to do with this show?

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