



EPISODE #199  
DEEP DIVE INTO MINERALS  
WITH DR. CHRIS MASTERJOHN

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### Wendy Myers:

Hello everyone! Welcome to the Live to 110 Podcast. My name is Wendy Myers. And I'm going to be your host for today.

We are going to be talking to Dr. Chris Masterjohn. He has a PhD in nutrition. And he's going to be taking us on a deep dive into the world of minerals—glutathione, folic acid and folate.

And this is a very interesting conversation. I think a lot of the answers are going to surprise you. We talk about selenium, iron, copper, zinc, glutathione and folic and folate acid, MTHFR and even the vegan diet (we talk about some of the perils of the vegan and the vegetarian diets and why many do not do well on that diet).

But before we begin the podcast, I have to do the disclaimer.

Please keep in mind that this podcast is not intended to diagnose or treat any disease or health condition and is not a substitute for professional medical advice. This podcast is for informational purposes and entertainment purposes only. So please consult your healthcare practitioner before engaging in anything that we suggest today on this show.

My book is out on Amazon. It's called Limitless Energy: How to Detox Toxic Metals to End Exhaustion and Chronic Fatigue. I wrote this book because I know so many of you out there are so tired. You're exhausted—especially our mothers out there who have children and are working and trying to take care of their home and cook the meals and take care of their husband and do all these amazing jobs. But a lot of us end up feeling very, very depleted and very exhausted.

And it's not just because you're overworked. There are toxic metals that interfere in your

mitochondria's function. And these are metals that are present in everyone—some more than others. These metals will poison enzyme that actually transport nutrients into your mitochondria that make your body's energy.

And so if you have these toxic metals, you're going to have a reduced ability to produce energy.

And so, in my book, I provide some simple solutions and supplements that you can take and a lot of great information about how to detox and what these toxic metals are that are causing fatigue because I want to help educate people about why they're tired and try to stir them away from taking stimulants and drinking coffee and 5-Hour Energy and making Starbucks millions and millions of dollars. It has to stop!

I want you guys to learn about how you can naturally produce more energy with detoxification.

So, check it out on Amazon. It's called Limitless Energy.

## 02:56 ABOUT DR. CHRIS MASTERJOHN

Wendy Myers:

Our guest today is Dr. Chris Masterjohn. He earned his PhD in nutritional sciences in 2012 from the University of Connecticut at Storrs. He served as a post-doctoral research associate at the University of Illinois at Urbana-Champaign from 2012 to 2014 and served as Assistant Professor of Health & Nutrition Sciences at Brooklyn College from 2014 to 2016.

He now works independently in health and nutrition research, education and consulting.

Chris has authored or co-authored 10 peer-reviewed publications. His podcast, Mastering Nutrition has two video series—Chris Masterjohn Lite and Masterclass with Chris Masterjohn—and his blog which can all be found on this website at [ChrisMasterjohnPhD.com](http://ChrisMasterjohnPhD.com).

Chris, thank you so much for coming on the show.

Dr. Chris Masterjohn:

Thanks for having me, Wendy. It's good to be here.

Wendy Myers:

I've been following your work for a while. And I really wanted to have you come on the podcast because you do a really deep dive on supplements. And I wanted to talk today about a lot of different minerals and glutathione and folic acid and dispel a lot of the myths that people have

about proper supplementation of these minerals and nutrients.

So, why don't you tell the listeners a little bit about yourself and your background and how you got into the work that you're doing.

**Dr. Chris Masterjohn:** So, right now, I do a number of things that all revolves around taking really complex science, breaking it down to find simple, practical things to do with it. And in some cases, that's working one-on-one with people to try to help them solve their health problems. In other cases, it's trying to figure out how can I get someone to understand this thing that would otherwise be super, super mysterious.

And that is what I'm doing right now. It's really something that's evolved over the last year. My trajectory over the past 15 years or so (maybe the longer) has been to slowly get more and more involved as my central focus. And that started by seeing people in my family with health problems.

My mom was a major inspiration to me because she had a lot of seemingly unsolvable problems like fibromyalgia that had her in pain every night. And she, through her own research and experimentation in alternative health, found her way to resolving that.

It was personal to me because I was a teenager and we were living in the same house. So I didn't have any choice but to be perceptive of the pain that she was in.

But then my own modeling of that path for her led me into a lot of trouble.

I would say when I was 15, I started the Zone Diet. And that worked well compared to what I was eating at that point. But I eventually was convinced that I should become vegan.

And while I was vegan, I continued to follow the Zone Diet. I bought a book called [The Soy Zone] which was advertised as the "healthiest Zone diet ever."

And you can imagine, when you're a vegan, it's harder to get 30% of your calories from protein, so I had to try really hard. And that meant when I was making muffins, I was making them out of soy flower which was a real shocker when I first tasted the batter before they've been cooked because then you can handle that with regular muffins, but that actually tasted like freshly cut grass and I've never been a cow.

So, anyway, I'm sure that I could've done a vegan diet better than I did because trying to eat so

much protein led me to eat a lot of things that weren't quite what we would call food—at least those of us who are coming from a more natural background.

But at the same time, my journey has definitely clarified for me that I just do better with animal products in my diet.

I think there's a lot of variation between different people. For example, one of the things I've learned recently about myself is that there are genetic mutations in the enzyme that allows us to convert beta carotene and other similar compounds called carotenoids and plant foods into retinol which is a physiologically essential form of vitamin A. And I have a bunch of them all loaded onto the same enzyme.

So basically, for genetic reasons, I'm terrible at deriving vitamin A from plant foods. And that's just one of many examples where I believe that even if I had done the vegan diet better than I did it, I'm still just really vulnerable to developing health problems when my diet is low on animal products unless I'm sophisticatedly designing the perfect supplement regime.

But perfect supplement regime for any one of us is going to be unique. And so that's something that could take a long time to figure out what it is. And I didn't have 10 years to figure out exactly how to precisely make the perfect vegan diet with the supplements that would allow me to thrive on it. I basically, in a year or two, developed really serious health problems where my teeth were falling out—I went to the dentist, and in a single appointment, I found that I needed two root canals, I had a dozen other cavities. I don't remember the exact number. It was about 15 in one sitting—and I had digestive problems, I had anxiety problems.

I discovered the work of Weston Price at that point who was a nutritional anthropology pioneer. And to cut a long story short—we can talk more about his work if you want to—for me, what I realized was that traditional diets before modern society kind of made everyone eat the same refined foods, traditional diets put a lot of emphasis on nutrient-dense animal foods like shellfish and organ meats.

People ate the bones when they eat the animal. They ate the organ and the skin. They ate nose to tail.

And it was really at that point that instituting these principles really turned my health around and

made me decide to do this for a career. The rest of that story has continued to evolve a lot. When you do something for your career, you can lose sight of the really simple things that made you healthy because you're trying to learn everything and you're trying to teach everything.

And also, when you have a revolution in your health where you see that food is so, so powerful, you can start to think it's all about food. And if you think it's all about food, then maybe you don't really care whether you're sleeping or whether you're playing or resting or spending time with your family.

So, I've learned the hard way that health is really a multifaceted thing.

And so, right now, what I'm doing is trying to translate mainly the nutrition for people because that's where I have the greatest skill and knowledge base. But I try to do so in a way that doesn't lose emphasis on all these other things that we need to be healthy like proper stress management, relaxation and other things like that.

Wendy Myers:

Yeah, I had a very similar story. My health crisis from going vegan is what led me to the doctor, that led me to trying to recover my health, that got me into health and having a health website—which is not always right, not always very healthy. It's not always very healthy to run a health website. It's a lot of work.

But yeah, I was vegetarian for 18 months, then vegan for six months. And my health tanked so fast. You go to the doctor, "What's wrong with me?" and you don't think that it's your diet because you're eating so healthy, right?

But yeah, I do much better on animal foods for sure.

Dr. Chris Masterjohn:

A lot of health problems are caused by eating healthy.

Wendy Myers:

Exactly!

And one of them, it's interesting, is when you're a vegetarian or vegan, you don't get enough cysteine in your diet. And if you don't have enough of that amino acid, you're kind of limited in the amount of glutathione that your body can make. And you need glutathione to detox your body, which is the reason vegetarian and vegans can still get cancers even though they might have safe distance from diabetes or other kind of heart disease or what-not. They solve one problem to

create another.

## 11:59 GLUTATHIONE

Wendy Myers:

So, let's talk about glutathione. What are your thoughts on glutathione? Should you take glutathione directly or should you supplement the co-factors like NAC and acetylcysteine and selenium to make it?

Dr. Chris Masterjohn:

Okay, I'll try to answer that specific question instead of the first one which was "What do I think about glutathione?" because I think a lot of things about glutathione.

I actually did my doctoral dissertation in glutathione...

Wendy Myers:

Hmmm... so you might know something.

Dr. Chris Masterjohn:

I have an endless abyss of thoughts about glutathione.

So yeah, you can buy glutathione supplements. That's for sure. But I think there are a lot of aspects to this.

First of all, glutathione itself, apart from supplements, is actually found in food. Glutathione is found in meats. It's also found in vegetables. It's basically found in anything that's rich in cellular water.

And what I mean by that is if you imagine our cell, there are lots of stuff going on in that cell. But there are some cells where all the basic mechanics of the cell are displaced by fat or starch because their main purpose is to store that stuff.

So, in humans, we have our adipose tissue. But in foods, we have seeds that have a lot of fat. We have potatoes that are storing starch granules and so on. And because they're primarily specializing in storing energy, then that energy molecule is taking up most of the cell and displacing the normal—"normal" is not a good word—or displacing the rest of the constituents of the cell wall where the glutathione is.

And so if you look across foods, you'll find anything that is relatively low in starch or fat is going to be pretty rich in glutathione.

So, if you ate a steak, and you have a bunch of vegetables on the side, you're getting glutathione from the lean portion of the steak and you're getting it from the vegetables.

So, it's natural to eat glutathione. And I don't think there's anything wrong with taking a glutathione supplement, but there's a few reasons why it's preferable to make your own glutathione.

First of all, I think if there's any uncertainty, you always want to fall back on what's natural. And what's natural is to get a little bit of glutathione in your food and to make a lot of your own glutathione.

Second of all, if you're eating a diet that's deficient in the things you need to make the glutathione, it's probably deficient in a bunch of other things. And a good example of that is protein. It's not just cysteine that we need. Cysteine tends to be limiting in general. But as soon as you start supplementing with something like n-acetylcysteine where you're targeting that limiting amino acid, all of a sudden, glycine is going to become limiting. And you're going to need to get glycine somewhere.

But even if you're getting all the amino acids that specialize as glutathione precursors, that doesn't mean you're getting all the amino acids that make up all the proteins that use glutathione.

So, glutathione doesn't just do stuff. Glutathione is used by other enzymes. And those enzymes are made up of lots of amino acids. So, you really need to get enough protein to be able to do anything with the glutathione.

And I think when we're talking about vegans, we also have the total opposite side of the spectrum where we could have someone that's only eating protein and fat, and it's all coming from animal foods. Well, those people have really low carbohydrate intake. And carbohydrate, we can make our own carbohydrate from protein, so we're not going to die if we don't eat carbohydrates. However, the insulin that's provided from the carbohydrate not only increases the synthesis of glutathione, but it also increases enzymes that use glutathione.

So, to give you an example, I have someone that I know who developed cataracts that got much, much worse when they were doing a combination of carbohydrate restriction and fasting. And so they're undergoing chronic restriction of insulin.

And there are so many people out there pointing out that overweight, insulin-resistant, type II diabetes have way too much insulin. Well, fine! However, some insulin is good. If you look at what's happening in that situation in the lens of the eye, glycation—when you say the word "glycation," it sounds like it's all about sugar. Actually, it's about lots of small molecules that come out of our metabolism that damage proteins. And the proteins start to stick together and they cloud up the lens of the eye, and you can't see as well. And that's the basis of cataract formation.

Well, glutathione is the principal defense against glycation.

But what happens if you chronically restrict all of the things that help you make your own glutathione and you just throw in a supplement?

What happens is the glutathione probably gets into the eye—I don't know that, but it certainly gets into you somewhere. The glutathione probably gets into the lens of the eye. But because you don't have the insulin and other things that would naturally come with your own synthesis of glutathione, you don't have the regulatory signals to make the enzymes that use glutathione to protect against the glycation that's causing the cataracts.

So, you have the glutathione, it gets in there, and it sits there, it says, "So, what do you want me to do?" And there's no answer.

So, I think because the things that we need to make our own glutathione and use it are so broad-based, you could look at that as an index of the diet quality in general.

If you look at someone whose glutathione status is terrible, sure, you can improve it if you add glutathione with a supplement. But there's probably at least a dozen other things underlying that poor glutathione status that you're not fixing.

So, I think it's a much safer practice and wiser practice to look at the poor glutathione status and say, "Let's figure out what's causing this and try to fix those things."

You may get a case where someone has a serious disease, and there's an intractable tax on the glutathione supply, and you may say, "This person needs glutathione. They need liposomal glutathione. They need intravenous glutathione," or whatever, but you arrive at that conclusion because you looked for the low hanging fruit on how to improve the diet quality and you didn't get where you needed to go.



Ninety-nine percent of the people listening to this, I'm guessing, could probably just try to optimize their diet and that would be the wisest things for them to do.

Wendy Myers:

Great! That makes a lot of sense.

I think a big problem people have today is that the foods are nutrient deficient because the soils that they're grown in are nutrient deficient or mineral deficient. My uncle grows all his own food. He's got a gigantic garden...

Dr. Chris Masterjohn:

That's actually a great way to get mineral deficiency.

Wendy Myers:

No, no. He's a master gardener. He's been gardening for 30 years. He knows what he's doing. I've never seen vegetables like this—broccoli that smells up your whole car.

Dr. Chris Masterjohn:

Well, not knowing what you're doing and doing that can be a risk.

Wendy Myers:

Yes!

Dr. Chris Masterjohn:

I think that one of the things with minerals, like you said, the soil, you can really be very well-intentioned and give yourself a mineral deficiency because you're trying to pick what you think is the best food and eating that food, and as soon as all your food is coming from one place, then suddenly, your nutritional status is entirely dependent on whatever the limiting thing in that environment is.

So, in this case, if the person is an expert in this and is conscious of all those potential mineral deficiencies, that person can live in a selenium- and iodine-deficient soil somewhere in Illinois and they can make their food perfect because they know the exact things to replete that soil with. They study it and they do the analysis.

By contrast, someone could live in one part of the country, eat the same things, feel great, and then suddenly move somewhere, and because they're conscious about eating local foods, suddenly, they don't realize that they're eating all local foods from a specific environment that now is mineral-deficient. And all of a sudden, that could be the thing that flips the switch for someone.

Wendy Myers:

Yeah, that's a very interesting point. Very, very interesting.

## 21:15 SELENIUM

- Wendy Myers:** And a very common mineral deficiency—and I talk a lot about minerals in the podcast. A very common one I see is selenium. Almost everyone I test is deficient in selenium.
- Let's just talk about your recommendations for selenium. Why are people deficient in that?
- Dr. Chris Masterjohn:** I have a question for you. Are all these people coming from the same area? Or are these people coming from all over the place?
- Wendy Myers:** All over the place. So, the only people that are not deficient are the ones in Hawaii or eating Brazil nuts. But for the most part...
- Dr. Chris Masterjohn:** If they get lucky and where those Brazil nuts came from.
- Wendy Myers:** But most people, I find, are deficient in some way (if not drastically deficient).
- So, why are people selenium-deficient? And why do we need selenium?
- Dr. Chris Masterjohn:** Sorry, I have another question for you. These people, do they have a similar set of health complaints that they're coming to you for?
- Wendy Myers:** A lot of them have low thyroid function. That's very common.
- Dr. Chris Masterjohn:** I actually think this is a case of every practitioner, whether it's a doctor or a coach or a dietitian or anything else is a magnet for the people who can get the most benefit from them.
- So, you and your audience probably follow a lot of the people I follow. Chris Kresser massively over-represented clients with thyroid problems. Emily Deans who's a psychiatrist gets massively over-represented MTHFR mutations and folate metabolism. And that's because she is a psychiatrist.
- And probably if you look at people across the board, the people who have problems with folate and B12 metabolism are the most likely to have psychiatric problems. And so instead of having 10% prevalence of certain mutations, they get 50% or something like that.
- So, I think that in your case, if you're seeing a lot of people with thyroid problems, then probably in people with thyroid problems, selenium deficiency is massively over-represented. And that's

because the highest concentration anywhere in the body of selenium is in the thyroid gland.

The thyroid gland needs that selenium because to make thyroid hormone is a profoundly risky process. In order to metabolize the iodine, you need to make massive amounts of hydrogen peroxide. And massive amounts of hydrogen peroxide are really damaging to the cells.

So, the thyroid gland has a specialized compartment where it dumps all the hydrogen peroxide and then it uses selenium and glutathione to keep everything that could possibly be damaged by that hydrogen peroxide protected.

And on top of that, selenium, one of its other roles apart from neutralizing dangerous reactive oxygen species is to metabolize thyroid hormone from the T4 precursor to the fully active T3. Actually, all of the enzymes in the downstream metabolism of thyroid hormone are selenium-deficient.

So, I would suspect that, probably, most people with thyroid problems—I don't know if it's most, but very many people with thyroid problems—probably are selenium deficient.

If you were to take a general sample of the population, I think what you would see is some people with good selenium status and a massive number with too much and a massive number with too little.

I actually think selenium is one of the mineral—I would probably say it's one of the minerals that I think that everyone is better off just getting their selenium levels tested. And that's because there's a lot of minerals where they can cause damage at high doses, but we have a really sophisticated way of controlling them. With selenium, we have a limited degree to control it, but more than any other mineral, selenium status in a food is highly dependent on soil selenium status. And more than any other mineral, there's massive variation across soils in selenium status.

One of the key things to understand here is that selenium doesn't play any known role in plants. And so the degree to which a plant takes up selenium is an almost random reflection of the amount of selenium in the soil.

If you look at something like zinc, if you look at a person who undergoes zinc deficiency, that person shrinks. They'll lose weight and they'll be overwhelmingly lean muscle mass. And that's because zinc is so critical to basic cellular processes that your body will do everything in its power

to maintain a normal concentration of zinc, and it will say, "What? We're zinc deficient? Let's just be a smaller person so that we can get by on the same amount of zinc."

It's exactly the same with plants.

So, if you have a soil that's zinc-deficient, those plants—there are pictures of Turkey in Anatolia. Anyway, in the 1990s, they were profoundly deficient, zinc's levels in soils. And so they turned these fields where the plants weren't even growing, they were all brown wheat and barley. They just sprayed zinc on them, and all of a sudden, they turned green, and they started growing like crazy.

So, there are some variation of zinc in soil. But to the degree that there is, you're probably going to get less food out of that soil. And so the actual zinc content of the food isn't going to vary that much.

With selenium, it's the exact opposite of that. Selenium is super critical to us; not so for the plant. So if you have a soil with high selenium, the plants are going to be high selenium. If you have a soil with low selenium, they're going to be low.

Those Brazil nuts are a great source of selenium, on average, but they vary twenty fold. Some Brazil nuts are ridiculously high in selenium. Certain ones growing in certain soils, I'd be careful about eating them. Some Brazil nuts, you'd have to eat plenty of them in order to get your selenium content.

So, I think that as a general rule, most people should probably just have their blood levels of selenium checked. And the units that are usually used, the sweet spot seems to be somewhere around 100 or 120. There's evidence that if you take someone with that kind of selenium status and you add 200 micrograms of selenium per day, you may increase the risk of diabetes and maybe some other problems—so I think measuring it and hitting that sweet spot.

The thing is you could look on a map at selenium and say, "Well, where am I in this map? Am I in a highest selenium area or low selenium area?" But you don't know where your food is coming. And you don't know what the farmers are necessarily doing to replete the soils or not. So you really just want to look at the blood.

If you're looking at foods, one of the things to note about selenium is that because plants don't

need selenium and animals do, the selenium content of animal foods is a lot less variable than plants. So if you just include animal products in your diet, and you especially emphasize organ meats and seafood, that's going to go a long way towards keeping your selenium status up—and even protect you against getting too much selenium.

If you're in a selenium toxic area, the animal foods are actually going to be less excessive in selenium than the plant foods will be.

I think that if you're not measuring your selenium status, if you take something like 50 micrograms a day of selenomethionine, it's not going to hurt. It might help. But I think that if you—

I think that a lot of people could maybe use like a hundred micrograms. There are some studies showing that, with thyroid problems, you can use 200 micrograms and get something out of it. But I really think that if you're doing that, you should monitor the selenium status pretty closely.

Wendy Myers:

That's a very, very interesting point. What I do with clients is I find that a lot of clients are mercury toxic, and I will give selenium not just for a nutritive goal, but to detox mercury. They can take a little bit more selenium than what you would need by the recommended daily allowance or what-not. It's not about your physiological needs as much as the goal of detoxing mercury. So I kind of give people a little bit more. It depends on your goals.

Dr. Chris Masterjohn:

Yeah. Well, I think the important thing there is that you would want someone to do that under supervision because, as I'm sure you're taking into account, if you have someone that's mercury toxic, they're prone to oxidative stress and actually making any chelation therapy safe is something that I wouldn't want to do to myself without any help.

So, yeah, I think that makes total sense. My points about the dosing is for someone who's just listening to this and is saying, "Oh, what should I have in my cabinet?", I think in those cases, the selenium should be—

If you're going to take someone who's going to supplement themselves indefinitely, then I would say buy a hundred microgram supplement and use it every other day. But for sure, there's a lot of uses where if you have the right supervision, then selenium can play a lot of important roles in protocols like that.

## 31:56 ZINC

Wendy Myers:

And you talked about zinc. Zinc is obviously something very deficient in vegetarians/vegans which is why they run into a lot of problems and lose a lot of weight (they tend to be really skinny). And so let's talk about zinc.

Do you need to supplement zinc if you're eating red meat regularly? And what is important to know about supplementing zinc properly? And what are your favorite forms of zinc?

Dr. Chris Masterjohn:

I'll get to that. But you just made me realize something that I hadn't realized before.

If you look at studies of zinc status in vegetarians compared to omnivores, it's lower. But in the United States, it's not like there's profound—or at least in these studies where they looked at it. It's not profoundly lower to the extent where you'd say "vegetarianism is clearly the leading cause of zinc deficiency in the United States."

However, if those people have lower lean body mass, then that is actually the principal defense against severe zinc deficiency.

I never made that connection before, but yeah, it's probably the case that if you are looking at people with a diet low in animal products, you have lower lean body mass, it's not fair to say, "Well, they're only 10% lower than their zinc status." They may have lower body mass because their body is mitigating a further decrease in their zinc status.

Wendy Myers:

Well, I also thought too, the vegans, they have a lot less fat in their diet. So their body is probably cannibalizing all their various fat stores to use for their brains or what-have-you. And that, of course, is a potential reason too.

Dr. Chris Masterjohn:

Yup! That's possible. But I think that vegan diets are, almost across the board, low in protein compared to omnivorous diets (and even compared to lacto vegetarian diets). So my guess is going to be in a vegan—

I would also say any restrictive diet is going to lead to a spontaneous caloric deficit. I mean, almost every diet that's low in anything is good for weight loss largely because you kind of get sick of eating the same thing. If you have a restricted variety in your diet, you're going to eat less.

So, my guess is that vegans, they're eating lower calories and they're eating less protein. That's

probably the big thing. But who knows? Maybe adding the zinc thing to it, and I don't know, the fat too, it could add to that.

To get back to your question, do you need to supplement with zinc if you eat red meat? It kind of depends.

Zinc is another mineral where if you have any kind of skin problems or a sluggish immune system, you should probably just get your zinc checked. The most sensitive indicator of zinc deficiency is dry patches in the skin. And it can progress to acne. If it's really bad, it can be like boils and pustules. So, almost every kind of zinc condition could theoretically be zinc deficiency. And getting three or four colds for winter, that person would benefit just from getting their zinc tested.

There are a lot of things that get in the way of absorbing zinc in your diet. The biggest one is phytate. It's an anti-nutrient that's found in any kind of taxonomical seeds—so whole grains, legumes, nuts and seeds.

If you look globally, the World Health Organization estimates that 50% of the world is at risk of zinc deficiency. Everyone who cares about fixing that problem is all doing something based around trying to reduce phytate in the diet.

You have the biotech people who are trying to engineer grains that don't have phytate [...] Then you have the traditional diet people trying to enhance the phytate degrading processes that are involved in the fermentation of grains.

In Ethiopia where they make teff, there are people saying, "Well, if we add this specific probiotic to the teff, then we get rid of 75% of the phytate instead of 40%."

The general thing across the board that's really going to predispose you to zinc deficiency is a diet that's high in phytate and low in zinc-rich foods. Zinc-rich foods are 1) oysters, 2) red meat and 3) cheese. And it's like oysters are up there, and beef somewhere around here, and cheese is somewhere around here, and everything else is somewhere way down there.

So, you could probably eat a ton of cheese and not eat a lot of phytate. Maybe you can find a way to do that in a Mediterranean way. But definitely eating red meat is a super easy way to get enough zinc.

But the thing is if you're eating your red meat with lentils and whole wheat and some other stuff, you may not be absorbing very much of that. If you have digestive problems, you may not be absorbing very much of that.

So, in general, if you eat a couple of oysters a day or you eat two servings of red meat a day or you eat three servings of cheese a day or you somehow combine those things to do the equivalent, you in theory have enough zinc as long as you're absorbing it.

So, if you want something to do prophylactically, then the best thing to do in my opinion is to take a low dose zinc supplement. One that I like is Jarrow's Zinc Balance. And I like it because the dose is only 15 mg. and there's a pretty good ratio to copper. The principal risk of getting too much zinc is a copper deficiency. And so if you take that on an empty stomach, you'll absorb 70% of it. That's going to be more than enough for somebody who doesn't have any kind of serious problems.

But you were talking about selenium before. You could say a lot of the same things about zinc—I mean, not exactly in the sense of a detox protocol, but in the sense that someone with health problems can have increased needs for zinc, someone with health problems can have decreased digestive absorption of zinc.

And whenever you have a tricky situation like that, just test the zinc status.

## 38:44 COPPER

Wendy Myers:

And then, zinc is very intertwined with copper status. And so let's talk about copper. What are your thoughts on copper supplementation? Who should be taking it? Who should avoid it?

Dr. Chris Masterjohn:

So, copper is kind of in between zinc and selenium in the sense of how much is it going to vary in foods. On the one hand, copper is not so essential that plants will just not grow if they don't have it. But on the other hand, it is essential to plants. So it's not going to be a random reflection of the soil copper like it would be with selenium.

What you'd have instead is a moderate variation where copper-rich soils maybe have two or three times as much copper in the foods as copper-poor soils, which is way more variation than you'd get with zinc, and it's nowhere near the twenty fold variation that you get with selenium.



And so, because of that, I think it's relatively unlikely that someone is going to get copper toxicity from eating foods. And given that, I think if you just eat liver once a week, that will probably take care of most of your concerns about your copper status. If you just eat a lot of unrefined plant foods—

There are lots of specific things that you could say about it. But really organ meats and unrefined plant foods and shellfish, if you work those into your diet, you should be, most of the time, getting enough copper.

Where you wind up with copper deficiency is usually going to be some kind of digestive problem which that's going to affect the upper GI tract. So if someone is taking proton pump inhibitors or if someone has any kind of digestive disorder that affects the small intestine, any of those kinds of things could create a situation where they're not absorbing enough copper.

And I would say that among health conscious people, the main reason for copper deficiency is zinc supplementation. And so that's why I'm pretty conservative about supplementing with zinc if you don't have a strong reason to know that you need it.

Zinc is stimulating a protein called metallothionein in the intestine that binds the zinc, but also binds the copper. And so if you're supplementing with 40 mg. or 50 mg. of zinc per day, and you're not paying attention to your copper, your copper can get bound to that protein and get stuck in your intestines and wind up never making it into your body.

So, my opinion with copper is most people don't need to supplement with copper. It's not that hard to design a good copper-replete diet. But people should be conservative about overdosing with zinc, should balance copper with zinc if they're using high doses, and should definitely be thinking about supplementing with copper if they have either anything that would make it plausible that they have a deficiency (like digestive disorders or chronic diseases) and they have any symptoms of copper deficiency.

Osteoporosis, anything related to neurotransmitters, poor immune function, oxidative stress are some of the key things that you could attribute to copper deficiency.

## 42:17 IRON

Wendy Myers:

And let's talk about iron. Iron and copper can be intertwined as well. How does one go about managing their iron status? And can someone with a low iron or ferritin status on blood tests actually be iron-toxic?

Dr. Chris Masterjohn:

Yeah, iron is really different from all of these in the sense that, in theory, if the system is working properly, no one should need to think about their iron unless they have conditions with a lot of blood loss.

And so, actually, pre-menopausal women tend to fall into that because of menstruation to some degree. But even still, if everything were working properly—which it's not, but if they were—generally, there's a great excess of iron in any well-constructed diet that allows us to just pick and choose how much iron that we take from food.

And we have a really sophisticated system to sense our iron status. If it gets too high, we do two things: we ramp up ferritin which is an iron storage protein (and that sequesters the iron and prevents it from doing any kind of damage) and then we also shut down the transporters in the intestines that help us absorb it from food.

There are really two problems. One is that if you do have a disorder of excess bleeding or you simply are a young woman with a heavy menstrual flow, then it becomes such that you could be marginal iron status depending on your diet. Most of the time, in that case, if you have someone who's eating a lot of red meat and liver and clams, then they're probably not going to become anemic just because they're menstruating. But if you have a hormonal condition that causes a great increase in menstrual blood flow or you're giving blood all the time or you get injured and you lose blood because of that, that could change.

And also, let's face it, not everyone eats a lot of red meat, liver and clams. So if you're eating a mostly plant-based diet, and you have those two things come together, then that can be the collision that leads you to develop anemia.

On the other hand, 30% of people overall have a genetic mutation in the protein that coordinates that system for the body to manage its own iron status. And actually, I have two copies of a defective gene. This is the HFE gene. It's the main gene that's involved in haemochromatosis.

There are two major mutations—one is called c282y and one is called h63d. The c282y is really severe, h63d is more moderate. I have two copies of h63d that puts me in the top 2% or 3% globally of people who have defective coordination of their iron status.

And so what happens is I get enough iron, and that communication doesn't happen. And so I just keep accumulating the iron. I don't make enough ferritin to store it. Eventually, if I don't give blood, my ferritin will get really high. But that's because the ferritin kicks in too late because of damage control.

In that case, it's like the fireman who shows up to the house to put the fire out the day after the house burned down.

And at the same time, I'm also not telling my intestines to stop absorbing it. So I just keep and keep absorbing it. And then, I don't put it into the right places. And that can cause oxidative stress.

The people who are going to develop haemochromatosis—true haemochromatosis—where their doctor would diagnose them with that are very, very rare. But when someone is diagnosed with haemochromatosis, they generally have organ failure, and their internal organs (especially their liver and maybe their heart) become like iron ore mines. If that person were bigger, then industry would say like, "Let's cut this person open. We found more natural resources. We're not going to run out after all." Why would you want to wait until that happens to you?

Actually, let's take the best case scenario here. Someone who will probably never get haemochromatosis—I'll probably never get haemochromatosis because I figured this out when I was 25. But even still, it's generally thought that people with 2h63d aren't going to get haemochromatosis. What do we do get? We get Alzheimer's instead because we have iron accumulating in the brain and doing oxidative damage here.

Why wouldn't you want to know that 20 years before the Alzheimer's starts developing and make it not happen?

Wendy Myers:

Yeah, I think people have got to realize that one of the causes of Alzheimer's is iron toxicity because a lot of the grains, refined grains and flours are enriched with iron. That's a form of iron that we can't absorb. Can you talk about that?

**Dr. Chris Masterjohn:** So, the inorganic iron that's used to fortify grains, you can absorb it, but not before it does all kinds of nasty things in your intestines.

**Wendy Myers:** But you don't utilize it? Maybe utilization is a better word.

**Dr. Chris Masterjohn:** Well, if you took two people, one who is profoundly anemic and had no iron in the diet and someone else who is equally anemic and they took iron salts, ferrous sulfate supplements or they ate refined wheat flour, that's probably going to do something to normalize the iron. It's just in the process of doing that, it's also going to cause a lot of damage because it's not shuttled into the right places efficiently.

So, it's not the case that it doesn't do anything to help. It's just the case that it also does lots to hurt at the same time.

And so, most people can't fix their anemia with that anyway because the side effects, the gastrointestinal side effects of—like the same form of iron that's in the wheat flour, you can take supplements for that. And those supplements cause constipation. They probably cause oxidative stress in the intestine. They're probably causing a lot of disruption to the microflora in the intestine. And then they're getting into the body. They're relatively sluggish to utilize, so the iron, it's getting to the red blood cells, but it's also getting into these nasty areas where it's causing oxidative stress. It's way, way far from the ideal.

I think in most cases, if we can get somebody to eat liver and clams, they probably don't need to do more than that to fix anemia. But if someone does need a supplement, then there are some heme supplements and there are some supplements that have that iron, but they put it in a liposomal form, and the liposomes carry it into the right places and help it get metabolized more efficiently.

Personally, I would go with a heme iron supplement. I believe Proferrin ES is an example of that (if I have that right). People can check me on that. I believe that's the heme one.

But a heme iron supplement is going to mimic the form of iron that we're getting from clams or liver. And I think that makes way more sense. It's a little bit pricier, but you're getting more benefit out of it when you're not getting the harm out of it.

**Wendy Myers:** And people, they're cooking out of cast iron pots. I'm not a big fan of that because that's the form

of iron that can cause a lot of oxidative stress in the body. Just because grandma did it doesn't mean that it's probably a good idea for you to do it. What are your thoughts on that?

**Dr. Chris Masterjohn:** I agree! If you take someone who's not me—I probably shouldn't be cooking in cast iron—if you take someone who's iron is working normally, they're pretty resistant except for the possibility that maybe that iron causes some stress in their intestines. And that's probably more likely to be the case if they're eating foods cooked in a cast iron, and they don't have a lot of the [protective] factors.

If you're eating lots of fruits and vegetable and other nutrient-dense foods, and it's all in there together, you can probably tolerate that iron. But you're right, inorganic metals are probably not something you want to be accidentally adding to your diet.

Although I'm not the guy with all the answers about pans. I don't know. What would you cook with instead?

**Wendy Myers:** Well, I like to use stainless steel. There are a lot of non-toxic cooking services.

**Dr. Chris Masterjohn:** You checked there's no nickel in this?

**Wendy Myers:** Well, yes, that's the problem. It depends on the form. If it's a new pan, and it's a higher quality, you can get a nickel ratio, that's okay. The nickel is used to make it shiny. But it depends on the quality of it. And as it get older, it can get pit marks and things and the metals can be more likely released into the food.

**Dr. Chris Masterjohn:** Yeah! And do you think that burning things on a pan does that too? I think of like when I have pans...

**Wendy Myers:** And you're burning the pan...

**Dr. Chris Masterjohn:** ...and the burning material accumulates in the pan, then it's harder to get other foods off of it or you have to clean the burnt material off and you wind up scratching the surface with steel wool.

**Wendy Myers:** Yes...

**Dr. Chris Masterjohn:** It seems like probably anything you do to disrupt the surface is going to make that metal more likely to get into your food. Do you agree with that?

Wendy Myers: Yeah, for sure, for sure. And then, there's ceramic. You can use that, but it does break.

Dr. Chris Masterjohn: I feel this is an intractable mess to try to figure out what pan to use.

Wendy Myers: Yeah, it is. I wrote an article on this if anyone wants to read that. I go into a deep dive into stainless steel and aluminum which is really bad, non-stick and all that stuff, and the pros and cons of each if you guys want to read that.

Dr. Chris Masterjohn: Well, I guess if you're not a bird, you won't die if someone cooks non-stick in them.

Wendy Myers: Exactly! I use Scan Pan for non-stick. That's a pretty good one.

Dr. Chris Masterjohn: Speaking of non-stick, I was in a lab once and we were looking for hexane in different foods. We looked at the non-stick spray, the pan spray—I don't remember the brand, but that kind of thing. And there were massive amounts of something that wasn't hexane, but looked kind of like it on the chromatogram (that's what we used to figure out what's in a stuff in the lab). I don't know what it was, but there's something in the propellants that's definitely in that oil.

Wendy Myers: Yeah, yeah. I mean, just use butter. Please don't use pan spray or...

Dr. Chris Masterjohn: What I have found with my pans is that if I take a very small amount of butter, and I spread it with my fingers in the pan before I turn the heat on, it winds up being much more effective to prevent speaking. I think if you melt it in it, you have lots of areas of the pan that aren't actually coated in butter.

Of course, I learned by trial and error not to do this after I turn the heat on which could damage your fingers. But I don't know, that's my secret. Just spread things out before I turn the heat on. It seems to prevent—I guess it's the old way of preventing stick, but...

Wendy Myers: Yes! That's a very good one—a very, very good one.

## 54:23 FOLIC ACID

Wendy Myers: And so let's talk about folic acid. There are a lot of panic about folic acid being added to a lot of the foods and refined grains in our diet. A lot of people are getting folic acid in. And there's a lot of talk about why you want folate, not folic acid and MTHFR which interferes in folate metabolism.

So, let's talk about your theories on that and why synthetic folic acid might be good for some people.

**Dr. Chris Masterjohn:** Sure! Should I get into the enzyme names? Is your audience comfortable with that?

**Wendy Myers:** Yes, I think they would love that.

**Dr. Chris Masterjohn:** Okay, alright. So, we talk about folic acid, we should really talk about folates. And there's a bunch of different forms of folates that all play different roles in the body. And so we have this really complicated enzymatic system to metabolize them into the different ones.

People who have an MTHFR mutation have a decreased ability to construct a methyl group on folate. And a methyl group is just a single carbon atom. And we use these methyl groups for hundreds of reasons in the body.

And we have a system of methylation where we take that methyl group, we pass it to vitamin B12, vitamin B12 passes it to homocysteine, regenerate methionine, methionine goes and methylates something through a more complicated pathway. And then, the homocysteine gets generated, and we need to recycle it.

So, people with an MTHFR mutation are less likely to be able to do that well. And so homocysteine accumulates because they're not re-methylating it to methionine. All the problems that result from not enough methylation are increased because you're just less efficient at methylating.

And actually, I think this is less well-recognized, but it's going to increase your need for glycine and choline—and choline because choline has a whole independent system of supporting the methylating process that's actually interchangeable with folate and B12. It's not totally interchangeable because some tissues use more choline, and others use more folate and B12. But they're doing the same thing.

And so if you're not good at making methyl folate, you need to use more choline to support the alternative pathway.

But also, when you have too many methyl groups, you get rid of them by using the amino acid glycine as a buffer. Let's say you eat a steak, and you have lots of methionine coming in. You're

temporarily in the position where there's too many methyl groups coming in all at once. And your body takes whatever methyl groups aren't needed for the regular process of methylation. It methylates glycine. And to some degree, you may salvage glycine, but a lot of it is going to get peed out in the urine.

And usually, if you don't have an MTHFR mutation, whenever you have too many methyl groups, you also have lots of methyl folate. That's the usual pathway, to get the methyl groups to come through methyl folate and then provide methionine.

If you're defective at making methyl folate, then you have a situation where if you're supplementing with SAME or you're eating a steak or you're supplementing with methyl B12, then you do have lots of methyl groups, but you don't have the usual methyl folate that's usually there when you have the methyl groups.

It turns out that the signal to shut off the wasting of glycine as a buffer for methyl groups is methyl folate.

So if you don't have methyl folate, just using choline for that alternative process, you're not necessarily in the clear. And if you get around that pathway with methyl B12 or s-adenosyl methionine, SAME supplementation, you're not necessarily in the clear.

You're adding methyl groups, so you're fixing one thing. But you don't have the methyl folate, so you're not turning off the glycine wasting. We don't have the other thing.

A lot of those methyl groups, when you take methyl B12 or SAME, and you don't fix the folate issue are probably being peed out as glycine conjugates in the urine. You don't have enough glycine for glutathione synthesis, you don't have enough glycine to make collagen which you need if you don't want lots of wrinkles or you want strong bones or things like that.

And so, that's the general problem with MTHFR mutations.

By contrast, there's an anemia of folate deficiency called macrocytic anemia. And that happens because folate is needed to support DNA synthesis which is what cells use to divide.

If you have a red blood cell precursor, that cell needs to double its DNA every time it divides. If it's growing, and it's not doubling its DNA, it just gets bigger and bigger. So you have too few



red blood cells and the cells that you have are too big and they don't function properly. That's called macrocytic anemia which means literally "big cells" or it's called megaloblastic anemia. They occur together. That's referring to an erythroblast which is a precursor to a red blood cell. So if someone talks about megaloblastic macrocytic anemia, then they mean your red blood cells are too big. And it's because you didn't have folate in a specific form.

The specific form of folate that's needed for that process is actually 5, 10-methylenefolate. It's the form of folate that's directly before the MTHFR enzyme. So, that form of folate supports red blood cell health. Then MTHFR takes it, turns it into methyl folate and supports methylation.

So, actually, MTHFR is devastating to methylation. It's got almost nothing to do with macrocytic anemia. In fact, even people with severe MTHFR mutations—not the common one, but really bad MTHFR mutations—that's the one genetic disorder, folate and B12 metabolism—that doesn't cause macrocytic anemia.

And the role of B12 is actually to take the methyl group off of folate. So if you imagine a methylene folate before the MTHFR mutation (it gets turned into methyl folate), the methyl group goes to B12, that generates the unmethylated folate. Then it can then go back into that process.

In a B12 deficiency, you get the same anemia, but it's because folate is stuck as a methyl folate.

And so, the point that I was making in the video that you're referring to is that if that's the problem, adding methyl folate doesn't do anything to solve it. Let's say the person is deficient in B12, your problem is that you're trapping folate as methyl folate. And then you're going to fix that by adding methyl folate? How?

So, the point I was making is someone who eats folic acid from fortified foods is going to get unmethylated folate because folic acid isn't methylated. And so that will help their anemia.

I wasn't making the point that they should eat refined grains in order to get folic acid fortification. What I believe is that there are people out there who are saying, "How come I'm always eating healthier and healthier and healthier, I eat them more, I feel like crap?" And what I'm trying to do is offer an explanation to a specific subset of people who felt great when they were eating refined grains, and then switched them out for vegetables, and they're getting plenty of methyl folate in their diet, but maybe they have some underlying B12 deficiency.

They could have [...] anemia and not know about it or they could have gastritis and not be absorbing B12 or whatever. They get set up in that situation, and suddenly, they feel like crap because they're actually anemic.

And maybe their doctor looks at elevated MCV on a complete blood count (which is the sign of macrocytic anemia) and can't explain it, it's like, "You're eating tons of folate. It must not mean anything." And so then that person is stuck saying, "Well, if my diet is great, and I feel like crap, there must be something wrong with me." No, there's something wrong with that situation.

So, what I'm trying to do is provide a way of understanding these edge cases where people are doing the right thing and they're getting worse.

So, when it comes to folic acid, there are two sides to the story. One is what everyone in the alternative health field recognizes (which is totally true) which is that folic acid is synthetic, it's not found in the food supply, it is added to fortified foods, it is put in multivitamins, it is put in prenatal vitamins, and it's put in enriched flour because as public policy, we don't trust women of child-bearing age to know when they're going to get pregnant and to prepare for that with prenatal vitamins in the right time course. So we put folic acid in there to prevent neural tube defects which is a serious birth defect.

Folic acid works for that. It probably wouldn't work as well as natural folates. But if you take someone who's eating mostly un-enriched flour and they're not eating folate, you add that folic acid, it will work for that.

Why is that the case? Because we have an enzyme called dihydrofolate reductase or DHFR. The normal role of dihydrofolate reductase is to take folate after it's been used to support red blood cell health. After 5, 10-methylenefolate is used to support red blood cell health, what's left over is dihydrofolate. DHFR takes the dihydrofolate, turns it into tetrahydrofolate. Then there are a bunch of other enzymes—we could talk for three hours about all of them—that allow it to enter the normal steps of metabolism that allow it to go methylation, to go to other things, to go back to red blood cell.

And it turns out that DHFR, all it does is to dihydrofolate to make it tetrahydrofolate. It's just what those names sound like. Break them down—di (two), hydro (hydrogens), folate (folate), tetra (four), hydro (hydrogens), folate (folate). It just adds two hydrogens to dihydrofolate to make it

tetrahydrofolate.

Well, what's the difference between folic acid in enriched flours and dihydrofolate? Two hydrogens. That same enzyme does the exact same thing to folic acid. It turns it into dihydrofolate. It just does it again. It turns it into tetrahydrofolate.

Once that folic acid you get from your enriched wheat flour becomes dihydrofolate, boom, they're ever more, until it leaves your body, exactly the same as the folate you got from food.

And so if you have macrocytic anemia, what you really need is unmethylated folate. You could get that—if you eat liver, you'll get plenty of that. We get tetrahydrofolate in liver. But there are a lot of vegetables that only have 5, 10-methylfolate.

And the vegetables, furthermore, are severely affected by processing. You get frozen leafy vegetables, count that as zero. You crush, you blend up the vegetables and then rinse them, you're losing huge amounts of folate when you do that. Even if they're sitting in the refrigerator, you're probably getting moderate loss because it's wet.

So, it's super possible that someone just isn't getting enough folate and what they really need is unmethylated folate.

If you observe that, if you get better in response to folic acid than in response to folate, it doesn't have to be enriched flour, it could also be—I've talked to people who were supplementing and wasn't doing anything. And then they supplemented with folic acid, and their problems started resolving. If that's the case, you want to know why.

Normally, B12 just takes the methyl group from folate, and now it's unmethylated. Now it can support red blood cell health. That doesn't matter.

So, if you respond better to folate acid, that indicates an underlying problem. And you want to find out what that is. The first thing I would look at is B12 deficiency, but there could be other things as well.

My thing is I don't want people to not know that that can happen because if that person just gets better with folic acid or if that person, for ideological reasons—or maybe not even that, just because of what they learned about folate is that leafy greens are good, enriched flours are bad,

synthetic folate acid is bad, l-methylfolate is good, all of those things [...] are based on truth, but if that's all you know about the story, then when your story doesn't conform to that story, you either:

- a) Blame it on yourself because your body just doesn't work right, it's not responding to the good things (it does respond to the bad things, but those are bad, so you're not going to do them) or;
- b) You're the person who just says, "Well, I'll just supplement with folic acid," but what that means is why do you need that folic acid. Probably because there's some underlying problem that now you're not looking at because you use folic acid.

So, I wanted people to know about this so that they can see that pattern and realize that there's a lot more to the story to look at when they observe it.

Wendy Myers: Yeah, that's so, so interesting, just to make all those distinctions. It's not always black-and-white.

Dr. Chris Masterjohn: That's very true.

Wendy Myers: Yeah, not always black-and-white. There are always exceptions to the rules.

## 01:09:32 WHERE TO FIND DR. CHRIS MASTERJOHN

Wendy Myers: So Chris, thank you so much for coming on the podcast. I really appreciate your insights. Your depth of knowledge I think is really unmatched in the nutritional world.

And so I encourage everyone to go to your website, [ChrisMasterjohnPhD.com](http://ChrisMasterjohnPhD.com) and learn more. You have your own podcast, right?

Dr. Chris Masterjohn: I encourage that as well. Yeah, I have a podcast called Mastering Nutrition. And I'm doing a lot of things right now. So, I had a blog for a long time. But now, I have a podcast called Mastering Nutrition. I'm doing classes called Masterclasses with Masterjohn. I'm doing these 5-minute YouTube videos and Facebook videos called Chris Masterjohn Lite.

And so the easiest way to keep track of all that is just go to my website, [ChrisMasterjohnPhD.com](http://ChrisMasterjohnPhD.com). Some people will want to follow me on YouTube, some people will want to get my podcast from their podcast app. But you can figure all that out after you just go to [ChrisMasterjohnPhD.com](http://ChrisMasterjohnPhD.com).

[com](#) and you just see what's there because everything gets posted to the front page of the site when it comes out. And so that's the easiest way to figure out where the many places are that you can find me.

Wendy Myers: Fantastic! So guys, I highly encourage you guys to go do that.

Dr. Chris Masterjohn: Me too, me too.

Wendy Myers: I've been following Chris for a while. I'm learning a lot from him.

And if you guys want to learn about me, you can go to [Liveto110.com](#) and learn about my healing and detox program at [MineralPower.com](#).

Thank you so much for listening to the Live to 110 Podcast.