There has been a notable shift over the past several decades towards dairy alternatives such as soy milk. There are plenty of reasons such as lactose intolerance, concerns over animal welfare, and a lower environmental impact. But did you know that consuming soy products may also affect your body's ability to deal with fat? Open your ears and mind? And let's chat about that.

Welcome to GryphonCAST, a podcast where we casually chat about science coming out the College of Biological Science at the University of Guelph, and how that work affects lives around the world. I'm your host, Michael Lim.

With me today for a special dual guests episode is Dr. David Mutch, and PhD student, Melissa Gonzalez-Soto. And we'll be chatting about how researchers are uncovering the impacts of soy diets on fatty acids in our bodies, and what that might mean for human health. Welcome. Hello, thanks for having us. Thank you. Very happy to have you. So how would you to describe what your field of research is? I go first.

Okay, I'll start off first with the big picture of the lab, and then I'll pass it over to Melissa. So the research, in my lab is very much focused on nutrigenomics. So the study of diet gene interactions, and that can happen in two ways. We're very interested in looking at how nutrients affect gene function and subsequently protein activity and metabolite abundance, so forth. So we're very interested, for example, in the study of obesity and insulin resistance, and how different nutrients could influence those outcomes. We're also kind of conversely, looking at it from the other perspective. Digene interactions, where we also are very interested in looking at genetic variants that might vary between any group of individuals, and how that could potentially change how a person reacts or responds to a particular food. So there's sort of two sides of that coin when we're looking at diet gene interactions. One is how does diet affect all of our genes and function and so forth? And other is how do our genes affect how we respond to diets?

My research is mostly focused on omega 3 synthesis. So I became interested in this because we actually noticed, I guess, it was like, what, two years ago that no one was really, I don't want to say no one as a whole, but not a lot of people were looking at kind of how omega 3 endogenous synthesis is regulated in the body by other nutrients. So, there was evidence of non-nutrient factors like, for example: BMI, sex, and other factors influencing this pathway but not really specific nutrients and how they affected the process. So, we started looking into that and we came across very old papers from the 80s, actually comparing soy protein with casein mostly (calling it dairy). And they saw that soy protein actually decreased the activity of the enzymes involved in the pathway of both omega 6 and omega 3 production. We thought it was very interesting but for some reason, we don't know why investigators stopped looking at it for so long? So recently, no one has done research on this area. So we decided to start doing it. And actually, my original Master's project was to have an animal product comparing soy and dairy and seeing how that affected the omega 3 synthesis. But of course, because of Covid, I had to...
change it to something more. Yeah, I guess everyone can relate with that. So I did this analysis on the one we'll be talking about today. And I shifted my way of seeing things to more an applied thing and more as an observational study with this dataset. So yeah, that's mainly what I'm looking at.

Michael Lim  4:11
I know you talked about your background just now in terms of how you got to this point. But could you briefly describe what omega 3's are for our audience and what the importance of them are for human health?

David Mutch  4:22
All right. I'll take this one then. So, omega 3's are a class of fatty acids known as polyunsaturated fatty acids. In our diets we have two essential fatty acids that are required that we have to get from foods because our bodies can't synthesize them. One of them is an omega 3, one of them is an omega 6. The omega 3 is known as linolenic acid and the omega 6 is known as linoleic acid. What our body then can do is using these two essential fatty acids, the linolenic acid, the omega 3 and the linoleic acid, omega 6 is through various enzymes, we can convert those fatty acids into a whole other group of fatty acids. So, omega 3's are very important because for the most part, our diets now we don't get enough omega 3's in our diet. The primary source of omega 3's that the essential one linolenic acid is from grain products. So, things like flaxseed, for example, is a very rich source. Canola oils is another one that's now enriched with it. Whereas the longer chain omega 3's are the ones that we're very familiar with as being from fish oil. So you get a lot of supplements with EPA and DHA. And the reason those supplements are so popular and prevalent is because people don't really eat a lot of fish. And, so those are the primary sources, the natural sources for EPA and DHA. And so those omega 3's are all very, very important. And they have functions in a wide range of different processes. For example, anti inflammatory. They play a role in signaling pathways. They serve as precursors for a whole family of reactive lipid mediators that are also involved in controlling inflammation. They're an important part of plasma membranes and cellular membranes, and so affect the fluidity of those membranes. So, there's an awful lot of functions that are attributed to these omega 3's, as well as the omega 6's. They're equally used in those ways as well.

Michael Lim  6:26
So clearly, there's a really large importance on omega 3's and omega 6's for health. But did you always want to investigate omega 3's and 6's and fatty acids in general? Or was there something that kind of steered you in that direction.

David Mutch  6:38
This has definitely been an area of great interest for me. I mean, from my own training along the you know, whether it was a PhD and then postdocs positions. I was pretty fortunate to work in a number of different areas that I was then able to bring together here in my own research program here at Guelph. And in doing so, that allowed me to really to focus in on the dietary fats. And so omega 3's are a big part of that investigation in my lab. But not all. We do study other fatty acids, omega 6's. We look at the monounsaturated fats and saturated fats
because they all play a very important role in health and disease outcomes. So, every fatty acid does something different. They're handled by the body differently. They come from different sources. They have different cellular functions. So, we're really very interested (as a lab) in a lot of these different pathways and processes.

Michael Lim  7:35
I guess for myself, actually it's funny now that I'm thinking about it in my undergrad, I used to think that lipids were so complicated that I would always say like, no, like, that's not a thing that I want to do. ... But here I am. So, it's definitely not since like, I started being interested in research that I've been interested in omega 3. It was more of like a functional food interest in general. Just kind of like how some foods can actually help prevent diseases. And omega three is a big one that most people are interested in. So yeah, when I got here to the lab, I was like okay, this is actually pretty nice. I think I'm into omega 3's.

So speaking of being a recent interest, you recently published a study titled "Soy consumption, but not dairy consumption is inversely associated with fatty acid desaturase activity in young adults". So in plain layman's terms, eating more soy food products, is decreasing your ability to create more of the long chain polyunsaturated fatty acids or LCPFAS. And we kind of already alluded to more about why you say that. Do you initially expect that kind of outcome?

Melissa Gonzalez-Soto  8:43
As I mentioned, there's maybe a couple of studies from the 80s. What they actually like gave mice soy protein, or casein. And they did see a decrease on the activity of this enzyme. So we were expecting that but because this is not an intervention at all, we just had data from 10 years ago. We didn't know how that would translate in humans, which was actually kind of like the main interest because I guess we're working the opposite way people would usually do. You would pretty much do an animal study and then go to humans but we are working from humans to animals. So yeah, I guess I hoped to see those same that I that I read about on the animal studies. But I was kind of surprised when we did see that there were lower levels of omega 6 fatty acids as well as the estimates because you cannot measure the activity from this type of data. We just estimated with ratios. So pretty much you divide the precursor as David mentioned, For example, for omega 6 would be linoleic acid and to the product, which would be arachidonic acid. So, you divide that and you can estimate the activity of the enzymes involved in this pathway. So of course, you cannot compare it directly to this animal studies where they actually measured the activity.

Michael Lim  10:17
So you kind of mentioned it briefly before, but in terms of relating casein to dairy diets, but can you briefly describe like casein is and why is it used as a proxy?

Melissa Gonzalez-Soto  10:26
There are two types of protein in dairy. I guess most people can identify whey because that's the supplement that most athletes or whoever goes to the gym drinks. Though there is casein and whey in dairy. So those are the two types of proteins present there. So in this old study
they were only using casein. And I believe that's because the child diets, that's how you call just a control diet for mice. The source of protein that they use is casein. So everyone uses this as a control protein just to feed the mice. But we actually wanted to see the entire profile of dairy in those diets. So we were interested in both casein and whey.

Michael Lim  11:26
Back into your study. There are several factors that can influence fatty acid levels in the body. For example, like age and diet, and your focus of your study was well on the diet of consuming either soy or dairy products. And so in the end your implications for the study was looking at the impacts of not only omega 6 and omega 3 levels. Basically, mentioned before, using these ratios of your precursors and your end products determine your relative activity of the possible enzymes used to speed the process of creating more fatty acids. Do you anything you'd like to clarify about that description of your study?

Melissa Gonzalez-Soto  11:59
You mentioned that the enzyme speed up this process is just the enzymes that are in charge of producing those fatty acids. So you start with the essential fatty acids, alpha linolenic acid and linoleic acid, omega 3 and Omega 6, and those enzymes are the responsible ones for converting them into LCPUFAs, which are the long chain end products of those precursors.

Michael Lim  12:25
So in your study, you separated, essentially, it's into two different segments. Your first segments looking at if the either drink dairy milk, soy milk, both or none. And then later on you separate by servings of dairy and soy over the course of a month. Out of curiosity, I was reading through your methods, and you decided that if someone had consumed one serving of milk or soy products, so the equivalent of eight ounces, which roughly the weight of two to three apples, or 240 milliliters, so about a cup of milk. So why just one single serving for an entire month?

Melissa Gonzalez-Soto  12:59
Yeah, that's a very good question. Because actually, it came up with my committee.

David Mutch  13:04
It's almost like you were in the thesis examination because this is a question that's coming back to Melissa.

Melissa Gonzalez-Soto  13:11
Yeah, it's giving me PTSD. Yeah, no, that's, that's a great question. So because there's really no literature on how dairy or soy impact this pathway, we really didn't know how much of each would make a difference. So basically, what we wanted was, whoever was consuming either soy milk or milk would be included in those groups.
Yeah, it was one of the challenges, right? Because how do you define intake? Some people might have very sporadic intake and some people might have very consistent intake. So consistent intake, you know, if you have a bowl of cereal every day, you know you're having milk or some beverage. With that, it's very easy to quantify that right? But, it's challenging if people are having very sporadic consumption. The food frequency questionnaires, or the diaries that are used for measuring food intake, it's a well sort of certified validated questionnaire that exists and many people use these. And so you know, you kind of asked about why the 240 mls or eight ounces why that particular number is for that particular number is simply because the questionnaire would use that as their definition of what a serving size is. So that means a participant would be looking at this because you know, if you're if you're asked a question, how much milk do you drink today? Like in a day, how do you quantify that it's pretty challenging, right? But if you give it in relation to about a cup would be one serving, then somebody can say all right, okay, I had about a cup with my cereal this morning and maybe I had a splash with my coffee and boom, that's all I had. So you can quantify that a little bit more easily because you can kind of perceive what that means is a quantity.

Michael Lim 14:56
You later on determine that can see me so products, either alone or in combination. with dairy products was lowering overall omega 6 LCPUFA levels and decreasing desaturase activity. So in other words, there seem to be decreased ability for the body create LCPUFAs is at least in the omega 6 kind of strain. For our listeners, can you describe what this might mean for overall health and what can be done for people who have these lower omega 6 levels to mediate those effects,

Melissa Gonzalez-Soto 15:22
I would be a little bit more concerned about omega 3 than omega 6. So as a background, try and see it as something that's happening at the same time from both sides. So both omega 3 and omega 6 share the same and enzymes. So, at the end, if you're affecting one of those enzymes, you're affecting both pathways.

Michael Lim 15:44
Right? Because it's converted from one to the other?

Melissa Gonzalez-Soto 15:47
Yes, so even though we saw differences in omega 6 comparing to omega 3 in the analysis we did, we also saw differences in the estimated activity of the enzyme. So that would mean that it at the end of the day, it can affect both sides. But as David mentioned, we do not consume a lot of omega 3 from the diet. So, it means that your body is relying on that endogenous synthesis. As for omega 6, you're actually consuming a lot because the Western diet is mainly omega 6, and not a lot of omega 3's. Not a lot of fish. Whereas there's a lot of vegetable oils, which have omega 6. So maybe a little bit of reduction in those enzymes won't really affect you and the like talking about omega 6's, because you're getting most of them from the diet. So you're covered in that sense. But if you're not getting enough omega 3 from the diet and besides that you're adding something that's slowing down that pathway or making it less efficient because it's
actually a very inefficient pathway. So making it on top of that more inefficient and also not consuming it from the diet, then can result in lower levels of omega 3 which are usually associated with a higher risk of diseases such as cardiovascular disease, neurological disorders, and non-alcoholic fatty liver disease. If they’re concerned about how much omega 3 they’re getting from the diet, or how much they should be getting, I would say talk to your dietician or health care professional and maybe come up with a way of increasing the sources of omega 3 in the diet. Or if, for example, you're vegan and you cannot eat fish or you're vegetarian, you can always get a supplement.

**Michael Lim 17:42**
I think that will make our listeners very happy to know that they don't have to worry about Oh, no. Should I take soy or regular milk today?

**Melissa Gonzalez-Soto 17:49**
Yeah, yeah, that's one of the things that we were like really talking about that. It's hard when you find things like this, because you don't want people to think, "Oh, this is bad. I'm not gonna eat it for the rest of my life". It's more of seeing it as okay, like, this has all the consequences that we maybe didn't know in the past. But hey, what can we do about it?

**David Mutch 18:12**
Yeah, it's about moderation.

**Michael Lim 18:15**
I feel like that's the key health message like moderation for everything.

**David Mutch 18:19**
Yeah, absolutely.

**Melissa Gonzalez-Soto 18:20**
Absolutely. Yeah.

**Michael Lim 18:22**
I'm sorry, the huffing and hardlining in your study here. But you also acknowledge that the conditions repetitions were relatively similar. So they're all healthy, early 20s to late 20 year olds, would you like to see similar results in other groups of people say younger individuals, like children or older like, say, middle age to like, retired age.

**Melissa Gonzalez-Soto 18:42**
Now I'm thinking about like, the non nutritional perspective, and all those factors that affect the pathway. And I believe there's not a lot of studies looking at the saturation activity. So the activity of the enzymes compared within across the board with the age. But I read about levels of omega 3's like specific ones, so EPA and DHA being positively associated with age. The only thing that I would note as that usually in women, I believe, from like 40 to 60. There's lower omega 3 levels in the body probably because of estrogen levels. So if we were very specific, I
would say that if we took a group of 40 to 60 years old, of course, women I would see, I would expect to see the decrease in their desaturation activity, also with soy. But it's probably more of the estrogen level, About the saturation activity, I wouldn't be so sure how it would change in different age groups.

Michael Lim  19:54
Some more work needs to be done. It's what you're saying. So, I think that you made a very good use of a terrible time in everyone's lives during Covid, to get a really interesting study out there. So what was your favorite part of doing this entire study on omega 6's and omega 3's and different diets?

Melissa Gonzalez-Soto  20:15
Yeah, I think my favorite part was because I actually started an animal study. So we got mice, and we gave them soy protein, and dairy or skim milk as a source of dairy. And I got to start, I guess, like the first batch of mice that we got, and then Covid hit. So that's when I stopped. So it was really fun to see everything that I was expecting to see in that animal study, just looking up the database and saying, "Okay, there's something here like it's actually happening in humans". So, I think my favorite part was when I told David like, okay, like, I think I see something, I think this is gonna work.

Michael Lim  20:58
David, do you have a favorite part?

Melissa Gonzalez-Soto  21:00
Well, my favorite part was when Melissa came to me and said, I think I found the same thing we were hoping to see in mice. There's nothing better than that. Really. I mean, like you said, talk, talk about taking a tough situation when research was shut down. And but Melissa definitely made the best of a tough situation. And she was able to pivot to this human analysis. But I asked the exact same question and, you know, that's what you always hope for is you hope that it's going to show something in humans. That's obviously is where we would really like to see things. And the fact that we did see statistically significant results that aligned with our hypotheses and our goals with the animal work, and also aligned with what was shown in the late 80s, early 90s. In this in these sort of in vitro studies that were done a long time ago. That's exciting. That for me, it's not always the case where things align quite as nicely as that.

Michael Lim  21:57
I hadn’t really thought about it, but this study is 10 years old. Do you think there's been a much larger shift towards soy consumption since then. So if we did the study now, would you see, like a large soy demographic? And what would that mean do you think?

Melissa Gonzalez-Soto  22:13
I would think so maybe I'm not sure about soy, I know, it's the one that's the dominant one in the market. And also, it's been out there for so long. But I feel like right now, it's very popular,
just like plant-based alternatives, overall, almond milk, oatmeal. So other types of plant beverages. I would say a lot of people are just switching from dairy to plant-based diet.

David Mutch  22:40
And that in itself would be really interesting area of research, because nobody's has looked at these other kinds of beverages, plant-based beverages, and their impact on fatty acid profiles and desaturase activity. So this in itself could be a really neat project to actually do to build on this work would be to actually go and explore more broadly, the various kinds of plant based beverages out there.

Michael Lim  23:06
So that's enough questions for me. We have a couple questions from social media, I'm going to ask you. Our first question is, are there noticeable nutritional differences between non dairy milks? If yes, which one is the best? And is that even close to what dairy milk provides?

David Mutch  23:24
Well, that's a good question. Yeah, that's a good question. So definitely, I mean, you know, definitely all of these different plan-based beverages are going to have a different profile of amino acids, they're going to have a different profile of micronutrients. Some of these things are addressed because a lot of these beverages are fortified with for example, vitamin D, and calcium, because that's essentially what you're trying to, you know, what you get for milk, if you're removed milk, then you need to get those things from another beverage. So often those things are fortified. But they're all produced differently, for sure. And they're going to have a different macronutrient/micronutrient profile. And again, I mean, is that a problem per se? Not really, if you're because you're probably not just consuming this plant-based milk all the time. If you were only eating and drinking that and that was all you had in your diet, then yeah, I'd say that there'd be probably some cause for concern. But again, if people are having a moderated balanced diet, and that's just one part of your diet, then there's no there's no need to be concerned because you're getting the profile that you need from other things as well.

Melissa Gonzalez-Soto  24:38
I would add that also it depends on what you're looking for in a beverage if you want a very low calorie one, then maybe, and maybe don't quote me on this, but I don't know how many calories oat milk has compared to dairy but I believe it's just like, oh, blended with water. So, it shouldn't be that much. Whereas soy milk actually has a very high concentrated protein, almost as dairy, I believe it's like eight grams per cup, which is pretty comparable to milk. So I would say if you're looking for a high protein beverage, then maybe for you soy beverage would be the best. But someone else might not be interested in that. And they just want a low calorie beverage. So I would definitely say it depends on the person and what they're looking for.

Michael Lim  25:27
Right? I wasn't even thinking about the differences in terms of calories, like cholesterol, what actual amount of like nutrients like proteins in it. But clearly, this requires a lot more research.
There's no simple answer. And our second question is, what makes lactose so special? Is it needed in our diets? And if it is, then why do people become lactose intolerant?

**David Mutch 25:49**
Well, so lactose intolerance is very much linked to this gene that codes for an enzyme known as lactase. And so that's an enzyme that's that's produced in our intestinal tract that's used to break down lactose into a simpler sugar that can then be absorbed by our body. And so it is well known that there's a certain genetic basis to this. So certain ethnic groups in the world, they are going to have a higher prevalence of lactose intolerance compared to others. And as people age, the effect efficacy of that enzyme lactase is actually going to be reduced. So it becomes harder to digest down lactose. Lactose provides you with some simple monosaccharides. You know, you could get those monosaccharides from other sources. That is not really is not really the thing that we need. It's just a sugar. Our body needs sugar. We need sugar to survive and to provide us with energy. So lactose represents a source of energy that can be used by the body, but doesn't mean it's the only source or that it offers something particularly unique. It's just providing certain simple sugars and a more complex form. Lactose is just a more complex form.

**Michael Lim 27:11**
Before we end for today, do you have any final comments you want to make like your work? And if there's only one thing their listeners take away from our chat, what do you hope that it is,

**Melissa Gonzalez-Soto 27:20**
Maybe I would make a point of not focusing if something is good or bad, and just giving this like bad reputation to certain foods, just because they might have other effects in the body that we might not be aware of.

**David Mutch 27:36**
Yeah, and I would just add to that, that it's this is my motto, really, when it comes to eating is that everything in moderation is okay, right. You can have the healthiest things in your diet that you think are that are healthy, that are great. But if you have too much of even those things, you're going to end up having issues. So you really do need to think about balance and moderation. And that's really that makes it even more fun. That way too. If you're worried about everything that goes into your body, it often makes fun and makes eating not a pleasurable experience. And I and I think there's a lot of really wonderful, delicious foods out there. And we don't really want to deprive ourselves if we don't have to. And so to enjoy them and think about the big picture.

**Michael Lim 28:19**
If it goes back to that old thing, the dose makes the poison. So, you know, as long as you don't having too much of it, then it'll be fine.

**David Mutch 28:27**
Very, very, very good quote. That's very, very true. Yeah. And then my final point that I just would like to say is, of course, this work, just to give out an acknowledgement to the funders for this work. So, we were fortunate to be funded by the Dairy Farmers of Canada for not only this, well, really the mouse study that's ongoing now, but also then this human work that was that we're able to pivot to during Covid. So, I definitely want to give acknowledgement to our funders.

Michael Lim  28:56
And so that officially brings us to the end of today's podcast. A big thanks again to our guest, Dr. Dave as much and Melissa Gonzalez-Soto for joining us today. GryphonCAST is brought to you by your host, me Michael Lim with editing assistance from Ian Smith. If you help me to learn more about science topics, please check out Scribe research highlights that's scribe S-C-R-I-B-E research highlights on the University of Guelph website at uoguelph.ca or you can follow us on social media @UofgCBS. You can find us Instagram, Twitter and Facebook. Music in the podcast comes from Upbeat. There'll be details on the show notes. And until next time please stay curious.