Danny Lennon: Andrew, welcome to the podcast. How are you my man?

Andrew Jagim: I am doing well. How are you?

Danny Lennon: I am very good. I am looking forward to an interesting discussion here about a topic that often carries a lot of questions from both athletes, nutritionists, coaches and like and so hopefully we'll dig into the weeds on some of the more important things for people to know. Before we get to any of that, I'm intrigued to ask you a bit more about your background. So, we can obviously take this from a few angles. Before I get into the current work now, maybe bring us through a bit of your background academically kind of undergrad, post-grad work, areas of interest for you, and some of the main things that may give people some context for this discussion?

Andrew Jagim: Sure. I grew up being a athlete and always was trying to look for different training and nutritional strategies that I could implement in my own life to just make me a better athlete and that just naturally led me towards the supplement realm, and that's kind of how I initially got interested in this field was just like of my own personal interest in the topic of supplements and nutrition in just kind of in that space. So, that's kind of how I transitioned into choosing the major when I went through my different studies. So, I did undergraduate degree in exercise science University of North Dakota, and then went onto do my Masters in what was kind of referred to as a Human Performance Degree. I did that at University of Wisconsin, and then ultimately did my doctoral work

at Texas A&M University and that's where I was really exposed to a lot of higher level research that revolved around different nutritional and supplement strategies that can improve performance, improve health and just how that kind of fit into a bigger picture and that's where I really got a taste and a kind of liking to doing a lot of the work that I am doing now today. At the time I worked under Dr. Richard Kreider and I kind of continue to collaborate with him a bit to this day. So, I attribute a lot of my success to kind of coming out of that lab and there are a lot of colleagues that I work with and kind of fellow classmates to this day that have come out of that lab. Actually my current position at Lindenwood University is with someone who also worked under Dr. Kreider in the Exercise and Sport Nutrition Lab, so it's kind of exciting to come full circle and I'll be working with some of the former students that have come out of that lab.

Danny Lennon: Yeah. And I think for many of our sports nutrition fanatics when it comes to reading research will definitely have known that name, as you mentioned. Are the any particular experiences or lessons that come to mind now and they may know, particularly given insight to some of the things you learned under Dr. Kreider or just being in that lab, is there anything that springs to mind, like I say either a bit lesson or particular event or experience that you remember that particularly is impactful?

Andrew Jagim: Yeah, that's a great question. I would say the thing that I have kind of learned during my time in that lab and now working as an independent investigator is just some of the challenges that go into doing sport nutrition research projects and certainly supplement projects, and when you may not necessarily be in that type of environment day-to-day and a lot of consumers or readers of the literature always have questions, why don't you look at this or why don't you control for that, yes but what about – you know they have all these kind of 'but' type of questions after the fact, but what they don't necessarily realize is that some of the challenges or costs or logistical issues that actually go into that one setting up an experimental design that in a perfect world the researchers would love to have control for that or looked at a different type of mechanism or whatever it may be but just again from a logistical standpoint or cost effective point or the funder wasn't really interested in that, and they were maybe the driving force behind how that product was investigated and so forth. So, I think that's something that's important for really anyone to understand and appreciate just the challenges that actually go in

to executing some of these studies and just controlling them as best as you can, and then also just accepting some of the limitations that are there, and unfortunately no easy solution to getting around those.

Danny Lennon: Absolutely, and I think that's a really important point when we talk about just the logistics of getting some of this done and I would encourage people who may be haven't looked into it to maybe go and check say, getting a blood panel done for a group of participants who are going to run you for a lot of what they would consider standard testing they might like to see in various different things. And then, you start to get an appreciation of how costs can spiral up pretty quickly if you want these ultimate design studies that we could dream up, so I definitely get you on that. Out of interest, what was your specific focus for your doctoral work then?

Andrew Jagim: So, the majority of my doctoral work we at the time were doing a lot of dietary supplement research, and the topic of interest that I had for my dissertation was looking at novel form of creating that I had come out on the market a few years prior to my time investigating that and was looking at a buffer creating and how that compared to what is usually referred to as a gold standard and that being creating monohydrates. We were looking at some of the differences in bio-availability, and then how it ultimately impacted intramuscular creatine levels, and then any kind of performance or body composition related outcomes and kind of like we had expected going into but we didn't necessarily see any type of superior benefit with that buffer creating. And then, some of our more practical conclusions that we came up with was from a cost perspective creatine monohydrate is still really the way to go and not only is it still kind of held up in regards to the most effective, but certainly the most cost efficient type of creatine supplement available. So, that was some of the work that I had done through my doctoral studies at the time.

Danny Lennon: Super cool. So, if we turn to some of the work you are involved with now what are some of the ongoing projects that you have at the moment?

Andrew Jagim: So, I kind of have multiple arms of research that I tend to get involved with and one of them being kind of my continued work with dietary supplements and I always had a vested interest in looking at either new ingredients or new products that have kind

of come to the market, and just again kind of continually looking at their efficacy both short and long term, and then now I am all starting to look more so at the safety side of things and how people are using these and some of their interests and goals when selecting these types of products. So, that's kind of continue to be the main focus of my research, and then also I have done a lot of work with Chad Kerksick who I work with here at Lindenwood University and the two of us have a vested interest in looking at just kind of energy balance, energy needs, energy availability in an athletic kind of real-world setting. So, kind of mirroring a lot of work that Louise Burke has done in trying to just kind of continually contribute to that body of literature that looks at how different athletes might be more or less susceptible to energy deficiencies, and then how that may impact performance, recovery, health, body composition, metabolism and then just trying to look at kind of bigger picture what's going on in a – for people who are familiar with that literature, you know it's kind of in under the radar pretty prevalent issue where a lot of athletes just don't eat enough based on their training demand. So, it's interesting to get more data to really support that growing issue in sport.

Danny Lennon: Absolutely, and I think is just spoken to when you look at the attention that's now being placed on something like relative energy deficiency in sport and the emerging data or at least trying to coalesce a lot of these previous ideas that we've had around low energy availability and both the metabolic and physiologic cost to athletes of that, so a huge area. When it comes to the dietary supplements specifically and when we're talking about their influence on athletic performance we are obviously are going to get into the realm of pre-workout supplementation as most people will be familiar with and will have seen various products either individual compounds or most often a combination of those as a pre-workout supplement. But maybe most often I don't think people really think of what the goal of taking one is and often times, at least at a certain level, people kind of judge that based on their stimulatory effect and if something stimulates them and amps them up that's seen as, well that's going to be doing something. But there are probably many ways we can look at how can we influence the quality of a workout or session or event based on a compound we take. So, what are some of the different classes of ways that we can target to try and improve performance acutely through any sort of supplement?

Andrew Jagim: Yeah. That's a great question and kind of when we look just look at a dietary supplement in general you can kind of run down the list of hundreds of ingredients that are out there and really kind of narrow it down to probably 10 or 15 that are actually worth any type of value, and offer kind of a substantial ergogenic benefit. And then, from there you can kind of look at well when is the best time to take this, how much of it should I take, should I take in kind of an acute sense to try to improve the actual quality of a single training session or is it best to take it at night, and so there I kind of think it depends on the specific ingredient itself, and then what is the kind of purported mechanism of action and that will help direct you to kind of getting into the timing related questions. But I think that's kind of how pre-workout supplements as a whole has really evolved as they kind of offer a one-stop-shop for a lot of supplement users where they can just take one scoop of this particular product and not have to search around four, five or eight different single ingredients and make sure they are getting enough of the right dosage and that kind of issue and complication. So, from a logistical standpoint again pre-workout supplements offer that nice advantage. The caveat is making sure that they're dosed properly, they have proper ingredient profiles that kind of got into the development of that product, and then making sure that again the user actually knows what they are getting. But I think there is great potential there for a lot of ergogenic value both in an acute and more long term setting. Well, like I said, the catch is that you have to make sure that the product itself is formulated correctly with those efficacious ingredients, and then also looking at the specific dosages themselves.

Danny Lennon: Yeah. So, with that try and give people an idea of what they might be warrant looking out for, at least for them or an athlete they work with, and which types of pre-workout supplements would be useful. Maybe it's of value if we run through individual ingredients, talk about some of those mechanisms that may work, and who might benefit the most and what type of dosages, and then from there people might be able to piece that together into for them what might be the best combination and what type of product. So, the first one that is the most obvious I think for people is going to be caffeine because just about the prevalence of caffeine within pre-workout supplements tends to be, at least compared to other ingredients, very well dosed most of the time because I guess it give quite an immediate benefit or noticeable

benefit I should say to end-user and it's probably cost effective to the company. So, when it comes to caffeine specifically what is again the mechanism of action by which that's working and therefore who and in what context may there be most benefit?

Andrew Jagim: Yeah. Absolutely, I would agree with you there and that caffeine is probably hands down the most popular ingredient that you find in a lot of these pre-workout supplements, and then also as you described it's the one that kind of lends itself to offer the most immediate type of an acute benefit and it's one that I find often a manufacturer and consumer perspective is kind of advantageous to have a product because a consumer can take that, and kind of feel its effects, and kind of 'feel like it's kicked in and it's working' and they maybe energized or kind of amped up prior to a training bout which is more or less what the name pre-workout supplement implies that you would take it before a workout to improve the quality of that training session. So, the specific mechanisms of caffeine itself is it's a adenosine receptor antagonist, so it kind of blocks that compound from normally exerts its action. And then, overall what tends to happen is it acts just kind of a stimulatory agent. There are some other proposed mechanisms within the muscle, but they honestly haven't been well kind of substantiated and investigated in humans yet. So, for the time being most people just kind of think of it as a central nervous system stimulant which still offers some physiological benefits in and off of itself, and I think from a dosing perspective most of the time there's going to be enough kind of caffeine to promote that acute ergogenic type of benefit. A lot of the caffeine literature suggests that about three to six milligrams per kilogram of bodyweight is kind of the ideal dose to look for. So, depending on how big of an athlete or individual they are most pre-workout supplements if you consume kind of a single serving usually contain about 250 to 350 milligrams, so that might put you on the lower end of that range, it might not. So, it kind of all depends on the body size of the individual.

Danny Lennon: Right. And caffeine tends to get, with good reason, very positive discussions because of the amount of literature behind it. The relative cost, effectiveness of caffeine and probably because it's not a problem for most people to consume that amount given habitual intake. But what are some of the potential contexts where maybe caffeine supplementation is contraindicated?

Andrew Jagim: So, there are certain sports or even certain athletes that maybe really sensitive to caffeine and it could even lend itself as an ergolytic type of an agent or it dampens performance whether or not you struggle to kind of gain control or you're too overly excited or nervous, if you think of any kind of skill based or tactical sport where again that might work against you depending on the situation or the context of the sport. And then, I think for individuals who do training later in the day or even into the evening taking high dosages of caffeine can certainly interfere with their ability to fall asleep and kind of recover. So, anyone who again trains in the evenings may want to steer clear of high caffeine containing products just for that reason alone because you wouldn't want it to interrupt sleep and recovery. I know you're big fan of optimizing sleep strategies as well, so I think that's something that people should maybe think twice about and even look for caffeine free types of pre-workout supplements as those are even starting to become little bit more popular in market.

Danny Lennon: Yeah. That's something I've seen where people will if they're getting an all purpose pre-workout they may get a caffeine-free version, and then maybe buy some caffeine pills or powder separately and kind of can tailor depending on the time of they train. When it comes to different forms of caffeine is there anything in particular for people to be aware of, of what may be most effective or useful or just from even a pragmatic perspective anything you'd advice athletes taking isolated caffeine?

Andrew Jagim: Yeah. It looks like just kind of based on my view of different products on the market. Most of them contain caffeine and hydrates which just from kind of personal experience and anecdotal reports that it certainly seems to reach peak levels within the blood lot faster than maybe a caffeine capsule would just because that has to be broken down kind of personally digested before that would enter the blood stream. So, whether that's good, bad or otherwise just kind of know that you're likely to feel the effects of that type of a caffeine dose that much quicker than maybe if you're getting your caffeine sources from something like a capsule or other types of caffeine sources. So, actually one of our grad students right now is doing a caffeine timing study looking at how it impacts resistance training performance and we're collecting blood samples. So we'll have a better idea of how long it does take for those caffeine levels to kind of reach peak levels within the blood, so that we can maybe

provide some more specific timing related suggestions on when you would want to take your caffeine dose in relation to a workout session or a competition or whatever your purpose is for taking it.

Danny Lennon: All right, for sure. Just to kind of switch gears because there are few things I wanted to get through. One particular compound that is seen quite readily in most pre-workout supplements is beta-alanine and this is kind of different to maybe some of the other ingredients in that, at least from what I'm aware of, may not be as essential or maybe not essential at all to actually time close to the workout in the way that caffeine has such an acute impact. So, lots to do with beta-alanine in terms of how that actually exerts a ergogenic effect?

Andrew Jagim: It's not necessarily beta-alanine itself that it has the potential to offer the benefit. It's the fact that supplementing with beta-alanine will increase intramuscular cortisone levels which acts as intramuscular buffering agent. So, kind of theory by enhancing your buffering capacity you would be able to better tolerate high intensity exercise that could maybe prolonged or work bout or again just kind of better tolerate high volume, high intensity type of work. And like you said it doesn't quite offer the same immediacy type of benefit that caffeine could in the regard that you have to supplement with beta-analine over an extended period of time. Lot of the research suggests two, four, six weeks of supplementation before you start to notice those types of performance benefits. I would add though that one of the side effects of beta-analine in some people actually enjoy the side effect is that paresthesia effect. So, for most people who've kind of felt that if they were taking a beta-analine containing products where you get kind of that tingling type of sensation. And again, I am actually someone myself that I kind of like that effect and I know others that also share that opinion, but all do and some again will classify it as a side effect but that's something that it's not necessarily exerting a direct physiological action but some people from a psychological standpoint will perceive that paresthesia and once they feel that kind of mentally they are saying okay this has kicked in, this product is now kind of priming my body and I am ready to train. So, it almost acts as like a surrogate marker of yes I have digested this product, it's entering my blood stream and now I am ready to train. So, I think that's kind of an interesting caveat to beta-analine. In fact, again it's not necessarily doing anything from immediate standpoint other than

maybe just alerting you mentally that the agent is again 'kicked in' a little bit.

Danny Lennon: Sure. And so, based on that buffering capacity what typical sports of type of events are most likely to see the most benefit and which is probably it's not going to do that much for?

Andrew Jagim: I would think any type of anaerobic type of sport whether it's wrestling, MMA, hockey, any kind of intermittent team sport that's going to do a lot of kind of sprinting and maintenance of high output. And then, even from more of a strength and power athlete in a training setting if you're ever doing a lot of high volume or hypertrophy type of work theoretically that would offer a lot of benefits in that type of setting as well.

Danny Lennon: And so, if beta-analine's role here is to increase those blood levels of carnosine a question people may have is well why not just directly supplement with carnosine? Why is the beta-analine the one that is the more popular go-to choice?

Andrew Jagim: Yeah. It seems the way carnosine is kind of digested and the way beta-analine provides kind of the rate limiting component to that synthesis process, the research suggests that beta-analine is more of an effective strategy to increase carnosine levels itself.

Danny Lennon: Very good. And the dose for that you would recommend to be at what level?

Andrew Jagim: While research supports about 4 to 6 grams a day is kind of the ideal dosing amount for beta-analine, and that's an ingredient that I often times see under-dosed in a lot of pre-workout supplements. So, if you're relying on pre-workout along for your beta-analine you may want to consider adding in kind of a standalone product where you're getting some additional beta-analine in throughout the day.

Danny Lennon: Right. To kind of go on a related but slightly different route, some of the products that are out there to essentially try and influence nitric oxide production one of the big ones over the last few years that has garnered quite a lot of discussion and at least the research seems to flip-flop at different stages and at different times has been more equivocal than not is citrulline. So, either people discussing citrulline malate or L-citrulline. From your perspective up-to-date as of now and your reading where do you

kind of conclude on the whole issue of citrulline supplementation, its potential effectiveness and kind of where we are at with that literature right now.

Andrew Jagim: I think there is some ergogenic potential with citrulline as an agent and its ability to kind of promote acute increases in blood flow in nitric oxide or via nitric oxide production. Where or not that necessarily translates to a performance benefit I think is still somewhat unknown and just even that overall underlying question of does increased blood flow again translate to improved performance, at first thought you would certainly think that how could it not, but a lot of the research hasn't kind of definitively supported that hypothesis yet. So, I don't think it's going to cause any harm. It might offer a slight additional benefit, but there is certainly not overwhelming amount of research that support its ability to kind of offer a strong ergogenic value.

Danny Lennon: Right. I think within that it's again a matter of how much they want to dot the Is and cross the Ts and be sure on things. So, within that there has been positive on citrulline, what kind of dosages and timing do we see in relation to its impact on performance?

Andrew Jagim: It looks like about 6 grams a day is kind of the generally recommended dose for citrulline and the timing – that question is still yet to b determined to the best of my knowledge. I would think that somewhere between 30 to 60 minutes prior to a training session would be idea, but again I've never seen that kind of timing related study set up. So, it'd certainly be a good one to pursue as we kind of look at a lot of these nitric oxide modulating compounds of when is the best time to take these, do you have to load them over a series of days to get kind of that purported benefit. I think a lot of that work is still yet to be done.

Danny Lennon: Yeah. Another one of interest, particularly in endurance sport scenes has been the use of beet juice or these kind of concentrated beetroot juice shots or other variations like that. It's been, like I said mainly at least from what I've seen, probably in endurance sport but definitely been used anecdotally by other athletes. What has been your impression of the kind of impact of supplements like that and maybe even bordering into the whole role of dietary nitrates in general?

Andrew Jagim: Yeah, I agee the last 5 to 8 years I've really kind of seen an explosion of a lot of beetroot juice supplementation studies and literature. Certainly a lot revolving around endurance and cycling based sports, but I will say there is kind of certainly an overwhelming majority of positive benefit being seen whether it's increasing aerobic capacity kind of work output during any type of time trial or anything related to that type of an event there seems to be some performance related benefits and not just its ability to enhance blood flow. So, I think beetroot juice could certainly offer an ergogenic ingredient. It doesn't seem to be in a lot of the pre-workout supplements like I would necessarily kind of think until I started looking through lot of ingredient profiles and notice that it really wasn't in there. And one kind of sneaking suspicion that I have is that that might be somewhat intentional from a manufacturer standpoint if they strategically hold out on some of these nitric oxide modulating agents or even other types of efficacious ingredients it may force consumers to buy more of their products, so they'll say we'll take our pre-workout but you also need our NO type of a product, you also need to buy X, Y, and Z or whatever it maybe. So, I think the same thing with creatine we haven't really mentioned that yet, but creatine as most people know is probably the most effective dietary supplement we have from a performance enhancing standpoint. But it's honestly not in a lot of pre-workout supplements or at least not as many as I would think. So, again the only reason I can come up with as to why that maybe is that forces consumers to have to buy more products.

Danny Lennon: All right, yeah. Especially with something like creatine where you can pretty much bank if someone is in a position where they are buying a pre-workout they are probably going to be buying creatine because everyone has probably told them to as well. With the beetroot juice I guess another aspect – I don't know if it's the same in North America, but certainly here to get like even a 70 ml shot could be over €2 or €3 for one 70 ml serving of beetroot juice, which is again for that one particular serving is adding considerable cost if they are going to try and include that in other products.

Andrew Jagim: Yeah. That's a good point too.

Danny Lennon: So, with that again it seems a bit murky on the exact amount of a dose of those nitrates. I've seen some suggestions of somewhere like 0.4 or maybe 0.5 grams of dietary nitrate that one of these

products should contain. Is there anything that you've seen that would differ from that or do we even know right now what an optimal dose of something like this might be?

Andrew Jagim: No. I've seen several types of recommendations but to your last point I still think there's more work that needs to be done to kind of come up with a more conclusive dose, and then certainly timing related protocol to see when the best time is to take that in relation to any kind of a competition or training session.

Danny Lennon: Yeah. One other one that I did have to ask you about Andrew is sodium bicarbonate, which again can work for a few different reasons but varying different people I think based on tolerance. What is, again, mechanism that we see with sodium bicarb and therefore who may benefit the most from that?

Andrew Jagim: So, sodium bicarbonate also acts as a buffering agent within the body, and again similar to beta-analine those individuals who are training at high intensities or any type of anaerobic type of athlete could certainly benefit from that enhanced buffering capacity. And sodium bicarb is one that's been around for actually quite some time and has always shown to be a fairly effective dietary supplement ingredient. The catch has always been the high risk for GI distress when using it. So, I've seen a lot of practical supplementation strategies that are really just targeted at how to reduce the potential for those GI related side effects or I know sometimes just splitting that dose up, taking it throughout the day or consuming it with meals are kind of just general recommendations that I've heard to help minimize that risk of GI distress. But otherwise I've seen it paired with things like creatine, caffeine and actually showed a lot of performance benefits. And that's another ingredient that again I don't necessarily see in a lot of pre-workout supplements despite it's supported within the literature.

Danny Lennon: Yeah. Maybe I guess they're trying to mitigate potential risks if someone doesn't do so well on it blaming them, but in terms of dosages and timing for sodium bicarb what if you typically had as a recommendation for athletes that do choose to use it?

Andrew Jagim: You know I'm not even familiar with kind of the total daily dose off of the top of my head; I'd have to look back in, in the literature to kind of come up with that. The only, I guess, kind of recommendation again that I have heard and I've seen use a lot is

just to split that up as best as you can, and then combining it with food to just help minimize that risk of side effects.

Danny Lennon: Yeah. Typically the idea of starting small and gradually building up is probably a good idea, particularly with this supplement in particular for some of those reasons you mentioned around the GI distress. Are there any other compounds or ingredients that have caught your eye recently that you think there is potential for that maybe we are not quite sure of yet but at least shown some potential that you hold out for in the future as we get more research in?

Andrew Jagim: Yeah. I think another common ingredient that I see in a lot of pre-workout supplements and even in isolation have had somewhat mixed results within literature that again just probably requires more investigation. Taurine is one of them, synephrine some of these other types of cognitive type of ingredients that are often times included in these types of products, and then even kind of continuing along that theme of other types of nootropic agents whether or not they are more performance based or just cognitive enhancers that offer its own kind of potential benefits. I think that line of research is really intriguing to see where that kind of goes in the future direction as people think. Maybe some of these pre-workouts are nootropic agents as a way to improve not necessarily physical performance but maybe mental performance whether it's sitting down at their desk to crank out some work at the office or with the explosion of esports even and looking at different supplements targeted for that type of sport or athlete if we're ready to call them that. But I know that's becoming a lot more popular within the States. I don't know about where you guys are but again I think those types of ingredients are going to be interesting to see where they go in the future.

Danny Lennon: Oh, for sure. And I definitely know of supplements specifically targeted towards gamers which is kind of interesting and incredible to see at the same time. But I think yeah when you start to realize the money that's in esports and I hadn't realized until probably this past year, someone told me some of the figures, then you guys okay you're going to take this super serious.

Andrew Jagim: Absolutely.

Danny Lennon: I definitely see that. We talked about some of the maybe key ingredients that have the most research and probably the best evidence for, at least, from a efficacy standpoint. In terms of then practically people using this and they want to say okay I know generally what compounds I should be on the lookout for and generally kind of what dosage based on what we've said already. When it comes to next steps to make sure they get the best quality product and are doing right by themselves are there any particular things that you would make people aware of when they're choosing a particular supplement to go with?

Andrew Jagim: Yeah. I think one big thing that we haven't really addressed yet and that pre-workout supplements in general seem to be fairly susceptible too is the practice of listing ingredients in a proprietary blend or some type of an energy matrix or kind of compound formula. However, it's referred to on the label, but what that means is they list the ingredients that are in that product but they don't necessarily specify the amount of each ingredient. So, the consumer is somewhat blind when they select that type of product not knowing whether or not they're getting sufficient amounts of each individual ingredient to confer any type of ergogenic benefit. So, you certainly run the risk of kind of being under dosed with a lot of those key ingredients and in that case you are almost wasting your money at that point because you're not getting enough of those ingredients to offer any substantial value. So, when selecting a product that's one of the first things that I'll recommend to people is make sure that you select one that has kind of an open label type of practice, where they disclose all the ingredients, they disclose the specific amounts of each ingredient, so then you kind of go in the list and do you own little fact checking to make sure okay does it have enough beta-analine, does it have enough caffeine, does it have enough of these key ingredients that I am looking for and that I know have been supported within the literature to actually get the value and benefit that they're looking for.

Danny Lennon: Yeah. That's a huge one. And like you say, when you start to see a certain cool sounding name that's kind of trademarked and no mention of the actual dosages of the individual ingredients that's contained within that matrix then it's kind of a red flag. Other things for people in terms of trying to get the best quality supplements or probably more specifically for those who are competitive athletes in drug tested sports, obviously this take on

a whole new level of importance when selecting a supplement. What are your rules of thumb for those types of athletes?

Andrew Jagim: Absolutely. There are different ways to go about this, not only with pre-workouts but just dietary supplements in general. So, you always want to look for a product or brand that follows good manufacturing practices where their facilities and their manufacturing practices have been kind of viewed and certified by an outside authority to ensure that they're doing things correctly and in the right way to just help promote product quality and minimize the risk from any kind of banned ingredients or just unethical practices with where that product is manufactured. And then, you can go one step further and look for products and companies that not only follow those good manufacturing practices but they also have some type of third-party verification when it comes to quality control and there is handful of different organizations; NSF kind of certified for sport or Informed Choice those are types of organizations that have looked at these different products and often times done their own independent testing of them just to make sure there is not any type of banned substances that's found within that product. It kind of puts its stamp of approval on it and ensures that it follows the regulatory lists that a lot of major athletic organizations may have in place for their athletes, so that if you consume or take a product that's NSF certified theoretically you should be fine and not have anything to worry about in terms of taking an ingredient that you are not supposed to. I always encourage athletes to just do their own homework and research and just make sure you stay up-to-date with maybe WADA has updated banned substance list. Usually, they put out a new one every year, so at least double check that in addition to relying on these third-party verifications. But those are certainly good things to look for and good habits to get into when selecting products, and then just kind of keeping up with not only the literature but different oracles or rulings that may come out if a particular brand has been indicated as following some unethical practice whether it's amino spiking or heavy metals are found in their products. There's all kinds of different independent investigations that will come up and kind of highlight some of these products or brands that again are just not following ethical practices and putting out quality types of products.

Danny Lennon: Yeah, totally. So, I echo all of that and I think it's incredibly important and probably not just for athletes that are getting

tested but especially for those athletes because even knowing what compounds you do and don't want within the product and knowing what's on the banned list. Sometimes you can't trust that's actually in the product unless you have something that's, as you said, verified by some of these independent third-parties. So, going with those specific supplements is the way to go for sure. Before I wrap up Andrew, is there anything in terms of future research questions related to pre-workout supplements either in general or any of the individual ingredients we discussed that most interest you or you think would be a nice next step to see addressed or answered within the literature over the coming years?

Andrew Jagim: Yeah. It's a good question. I think one kind of large research question that I still have yet to be seen is really looking at more of the sports specific applications of these types of supplements. We have some kind of more controlled studies within the laboratory setting but not necessarily a lot that have looked at how it influences on the field sport performance types of competition. So, I think that would an interesting avenue to explore with pre-workout supplements and how they can play a role in more team-based other type of sport activities. I think looking at the safety aspect of it is increasingly important because I think these products for whatever reasons are just little bit more susceptible to maybe people abusing them, taking more than they should, or the products themselves being tampered or contaminated with some banned ingredients whether it be kind of stimulant derivatives or anabolic analogs that again are in there and they necessarily shouldn't be. So, looking at a) if they are in there, but then b) if or if not they are included in these products, all these types of dietary supplements safe to consume long-term. I think the longest study that's looked at any kind of safety implication with pre-workout supplements is only 8 weeks. So, certainly extending that beyond, again, a 8-week time period is certainly important to do to make sure they are in fact safe for people to be consuming. And kind of getting back to how people are using these? This is actually one project that we're going or conducing right now is we have an online survey that's looking at how people use pre-workout supplements, how many serving sizes do you ingest, what are your key goals when you're taking these types of products, when do you take them in relation to training, do you take them on off days, what types of ingredients are you looking for when choosing these types of products. So, that's something we're doing right now just to get a better feel for,

again, how these are used within the fitness and sport industry. To see if we can identify any risky behaviors with this or if there's any other types of things that should be looked at with pre-workout supplements just to get a better understanding of how they're used and their potential role in kind of the sport and fitness industries.

Danny Lennon: Awesome. Definitely lots of things to answer and to look to, so I appreciate for that run down. Before I get to very final question for people that are interested in keeping up-to-date with you on the internet where is the best place for them to track you down, keep in contact, and see what you've got going on?

Andrew Jagim: Yeah. My Twitter handle is A.Jagim and the same thing for Instagram, so I'll usually post a lot of different research updates of different work that we're doing within our lab, just other interesting articles and talking points that I tend to come across on social media. So, that's a great place to find me, and then I also co-host my own podcast with some of our friends that are in Wisconsin and we are www.clinicallypressed.com, so that's another place where you can find different episodes that I'd been on and some of the work that we've done in that space too.

Danny Lennon: Sweet. And for everyone listening I will of course link that up in the show notes of this episode and you can go and check that out, and follow Andrew on social media as well. So, that brings us to the final question that I always round the show on and it can be completely distinct from the topic we've discussed today, of course, and it's simply if you could advice people to do one thing each day that would benefit them in any area of their life what would that one thing be?

Andrew Jagim: I would just say find a reason to move. Physical activity and exercise in any form or intensity has so many profound benefits on health performance, and just overall kind of wellbeing that I think it's so important and sometimes something that people take for granted. So, just find a good reason to take some time for yourself, get out there and move, and be active.

Danny Lennon: Awesome. Perfect. Andrew thank you so much for taking the time to do this and for the information you've shared today. I very much appreciate it and thanks for coming on.

Andrew Jagim: Absolutely. Thanks for having me.