Transcript of “How to Quantify Fatigue Like Never Before with Rick Green and John Kalns”

Bulletproof Radio podcast #5

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Dave: Today's cool fact of the day is that the antibodies in your body that attack wheat gliadin one of the proteins from wheat, also happen to attack your heart tissue, so much when you see claims like heart-healthy whole grains, whether you are an entrepreneur or whether you are a performance athlete, it doesn't really matter, grains are not a part of being healthy cognitively or healthy from a cardiac perspective or just healthy in general.

You are listening to episode 5 of Bulletproof Radio. This is Dave from the Bulletproof executive blog talking about how you can upgrade your mind, your body and your life to levels you never thought possible. Today, we have a great interview with Rick Green and John from Hyperion Biotechnology. These guys have created a unique test that is the first of its kind to accurately measure fatigue. It actually measures salivary peptides to determine exactly how fatigued or tired you are, whether it is from some kind of athletic training or just from emotional or other forms of physical stress which could even include like job stress or relationship stress.

These are the kinds of stress that make you not bulletproof. This can even come from venture capital fundraising stress. It doesn't matter where it's from but if you can measure your body to know what's going on, it is really cool. This is a brand new test and we are really excited to be able to share this new tool for self-quantification with you.

Co-host: Now we are going to move on to our exclusive interview with Rick Green and John the inventors of the something called the Fatigue Biomarker Test, which we're going to talk about today. So guys, thank you so much for coming on the interview.

Rick: Yeah, it is great to be here.

Co-host: Before we get into this very deeply, what is the Fatigue Biomarker and how did you all discover this technology and get into it?

Rick: Well, the story goes like this. We had this idea that there was a real deficit in understanding how to make things better for soldiers that were being deployed to Iraq and Afghanistan after the war on terror got started. What was ultimately happening was a lot of folks were having to pull pretty long duty cycles and not only that, they had to haul around huge amounts of weight. One soldier who is deployed now, [inaudible 00:02:36] they had literally 120 pounds of gear that they are

carrying including weapons and ammunition and water and a whole bunch of things going on. It's very stressful.

They often are up for very long periods of time and the question came up: "How far can you push guys before they crack?" and you get into some real problems in terms of completing the operation. The bottom line is you don't want people to get hurt and killed if you can avoid it. War is a messy business, no doubt about it. The army came out with an idea. They said, "Okay, are there ways that we can assess fatigue?" because we know fatigue is a dangerous source of accidents and problems that we get into. Lots of things that happen are related to fatigue, so we need better ways of measuring fatigue so we can minimize it on the battlefield and basically use soldiers more effectively to accomplish the task that they have to do.

We looked at that as an opportunity. We're very interested in that idea. We see that it is something that really is unanswered in the private sector, too. There is a big demand for ways of measuring fatigue in the private sectors that you probably can think about. We got a grant for $850,000 from the army to develop the Fatigue Biomarkers and long story short, we wanted to look at saliva because that is something that you can sample easily. You don't have to stick someone in the arm and get a blood sample or do anything like that. Capturing a urine sample is kind of naïve sort of, but it has some logistic problems too. Saliva seems like a really good way to go on this.

Second thing is we're thinking that a lot of metabolic events are really probably what we're going to be looking at and those metabolic events are often expressed as changes in removal of short little bits of enzymes that are related to metabolism. Our idea was that these short little bits that are cut off of the big enzymes are going to wind up in the blood and ultimately in the saliva and if we can measure those things and measure metabolic events, such as transition to burning lipids and the events that we will be able to detect with our marker technology. We went into it with no assumptions about what we're going to find.

What we did was, we just got people on treadmill. We worked with the University of Montana on this. What they is put people on treadmill, cycle ergometers for eight hours and we got saliva samples at various times. At the end of the eight hours, they were all very tired and these are really healthy people. These are recreational cyclists, they are folks in very, very good shape; they're very young, and they look a lot like the military population except they might actually be in better shape than a lot of the guys over there in Iraq. Long story short, we compared the composition of saliva, we focused on the low molecular weight component, we focused mainly on peptides.

We took a sample of saliva from one of these guys before they started their endurance exercise and at the end of the eight-hour period and compared the compositions using liquid chromatography, mass spectroscopy, and some bioinformatics tools that we invented here. Finally, we identified a number of things that were sure enough related to physical performance capability and a couple of those peptides, we actually had them synthesized, we filed patent on them now, so it's very hot stuff. The bottom line is when you're fatigued, some of these peptides are reduced in their abundance by a thousand to ten thousand fold.

They're high initially and they're present in relatively large amounts in your saliva. As you get really, really fatigued, they virtually disappear. We have essentially a yes/no marker for fatigue. This is related specifically to physical fatigue and the ability to perform physical exercise. We are very excited by this. One application that we have used this is in training of special operation force. One of the issues in special operations is that guys get out of basic training, they're in good shape, and they're really, really motivated typically, but even despite all that, about 50% to 80% of the folks that go into special operations training never ever make it through. They fail in the first of what's called the indoctrination session. This is a fairly rigorous training cycle.

One of the things we thought about was, if the guys are coming in fatigued, could we project who was going to fail and who was going to complete? Lo and behold, our fatigue biomarkers did a very good job of predicting who's going to fail or complete. In terms of military operations, that is important because you can reduce the number of failures by judiciously selecting the folks to go into the Special Forces training cycle and to become Special Forces operators. Another important example there is that if you have fatigue detected with our markers, you can go to these guys and say, "Look, you're fatigued, let's find out why, and let's make you less fatigued." That's the really exciting part where we can start applying different types of intervention, changes in training, changes in sleep, changes in diet, to essentially make a very fit person even better. And I guess that is long-winded but short answer to what we think is a fascinating and ultimately a very beneficial technology.

Co-host: Yeah, that sounds great. How long have people known about the relationship between salivary peptides and stress? Is this something you all just discovered?

Rick: Yeah, this is something that we discovered and I alluded to this idea that our original hypothesis was that we're going to see some small fragments from enzymes that are related to energy utilization. What we found though was something that was more exciting in a way and a little bit surprising. Mainly, the peptides that we

found are fragments of a larger protein that is expressed only by the salivary glands and what we found out was that the abundance of these fractions is really controlled by the physical fatigue state and other types of state, which I cannot get into because of patent issues that are pending right now.
The salivary gland links up both to the dural endocrine system, immune system and the brain itself, so we know that those linkages exist and lo and behold, as you get more fatigued, the behavior of the salivary gland as an exocrine functioning gland actually changes in a very profound and significant way that we can measure by looking at the composition of saliva.
Co-host: Could this test possibly predict mental fatigue and maybe immune system depression and those kinds of things as well?
Rick: Well, I think you chap on a very hot area now. I just have to say that I have to be very careful. I really can't comment on that because … I'll just say this. We have a number of different research programs that are in the works right now. We have a number of different collaborators in the federal government and I think there is a real opportunity to understand how the composition of saliva is linked to all types of different physical phenomenon. I know I'm being cagey deliberately because again I don't want to say public disclosure of things that could jeopardize patentability of some of our technology coming online.
Co-host: Fair enough, sounds good. So, how do you go about measuring these peptides? How is the test performed? Does somebody spit in a little tube and mail it to you or how is it done?
Rick: That's exactly right. What you do is, we will send you a 15 ml centrifuge tube, and 15 ml of saliva is about 2 tablespoons of saliva. It will take you about three to five, maybe six minutes to accumulate that much. You spit in the tube, seal it up, put it back in the mailer and send it to us. One other thing that we know about our physical fatigue peptide is that they are relatively stable and so sending by regular US mail is just fine. They come to us, we get the saliva, we do a bunch of proprietary processing to clean up and refine it, get to the biomarker, and then we apply a technology that is called liquid chromatography and mass spectroscopy and what that enables us to do is just separate all the different components of saliva after our preliminary test.
There is about five to ten thousand different chemical components there and so we separate them out using chromatography and then we use a very precise detector, which is a mass spectrometer and that tells us not only the abundance of the compounds of interest, but also their chemical identity. This is really the cutting edge way that many analyses are measured in clinical laboratories and this is really

state-of-the-art right here. It's not cheap, but it is the definitive way of doing this type of assessment.

Co-host: Do you see any opportunities in the future for doing a home testing kit, so you wouldn't have to mail it in?
Rick: Yeah. One thing I was going to mention, [inaudible 00:13:00]. If you want, you can go to fatiguebiomarker.com and order the test. It's $55 for a single test and there are instructions for collection.
Co-host: In the future do you ever think, maybe there could be something almost like a pregnancy test, where you spit into a little a spot and it will tell you on a graded scale what your fatigue marker are?
Rick: Absolutely. One of the great things there is that we have worked with some companies to actually define the components of the type of test and we have talked to a number of companies. The trick here is, to make a pregnancy test what you need is a molecule which will recognize and bind to your molecule of interest with very high affinity. Specifically, for all of these, what are called, point-of-care tests like this, you raise up antibodies immune response, collecting antibodies [inaudible 00:14:04] detection platform. It does two things for you. One – it can shorten the times to get a test completed from literally days or week, which is what we're looking at right now, to perhaps as short as an hour or even half-an-hour.
There is another technology that is coming online that can make this almost real-time, where you can get test results essentially in thirty minutes, maybe two minutes even. We're going down that road and we hope to have something like that in maybe another year or two.
Co-host: Well, it sounds great. Let's say I took the test and my fatigue biomarkers were high, but my salivary peptides were low, how do you know whether I'm actually fatigued or not? What kind of standard are you comparing it to for reference?
Rick: Yeah, it's a great question. This is part of the very interesting philosophical issue that I think surrounds the whole idea of fatigue. What is fatigue? How do you define it? I think there are a lot of questions about that. What we've tied it to in terms of this are different types of outcome measures. For example, when we did the cycle ergometer testing, we were looking at the ability of folks to maintain a standard mechanical output let's say on the cycle ergometer. Can they pedal at the same rate all the time? That's one way of assessing it. If you get more fatigued, you can't maintain a steady rate of energy output like that. As you well know, you get a little choppy and your performance becomes a little bit less consistent.

Another thing that we did was to ask about their, what is called, a POM score. This is an assessment of how one perceives their exertional output and how difficult the task is. There is really extensive literature on use of these types of measures. There is essentially a visual analog set on a scale of 1-20 was this really hard, the hardest thing you ever did or maybe it is not such a hard thing at all? We were tracking using this measurement scale over time and linking that to the biomarker. Essentially as folks got more tired, there was a correlation between the fatigue that they express and the levels of the biomarkers. Now, the question obviously becomes why don't you just ask people how fatigued they are?

Where you get into problems there is that their perception of fatigue is altogether something different than the actual fatigue status and the actual capability of the individual. And as you well know, there are a lot of factors that play into how one does in a race or in any kind of athletic competition and then there are a lot of factors that go into that and physical fatigue is only one of them. We hope that this would be a positive feedback where folks would get this information back and say, "Well, look, I am not as fatigued as I thought I was," or "I'm really fatigued according to the Biomarker test, but guess what – I am not doing as bad as I could be". There's a lot of ways of spinning this, and ultimately what you use the information for is to make yourself a better more capable athlete and a better person I think ultimately and that is where we're going.

Finally, the really complex outcome was success in the Special Forces guys, predicting who will succeed and who will fail. I'll tell you Special Forces training is very complex, it is not just an athletic challenge. There're a lot of mental challenges there, too. In fact, the mental challenges are probably more significant. When we found out our biomarkers could predict success or failure, we're very excited because this really validates the whole claim that we're predicting something which is very useful in life in general, not just in terms of physical performance though of course the physical performance is really where this thing is linked. Again a complicated issue is fatigue. I think we don't even have a good language of talking about it yet, but I think our technology will certainly enable that discussion to go forward.

Co-host: When you we're testing the people who were going into Special Forces training, what kind of accuracy does this test have, what percentage of the Special Forces people who had high levels of fatigue ended up failing?

Rick: Well, it's a statistic distribution. I can tell you this, if your marker comes in suggesting fatigue, let's say at a level of 0.1, which is very fatigued, your chances of failing are about 90%. If you come in at a level of 1 or above, this suggesting that

you are not very fatigued at all your chances of succeeding are about 80-90%. Now, folks that fall in the middle of that range, which is maybe about 30-50% of the folks there, their likelihood is a little bit mixed. You can't make such profound conclusions about it, so again there are trends there. If you're on the low end of the high part of the scale, you're more likely fatigued than if you are in the lower end, but there are some absolute cutoffs here that really I think would be useful in determining definitively "Wow you are really fatigued or hey, you're doing pretty good and your body is good off than you are ever going to be in terms of your physical capability."

Co-host: Yeah, it's amazing. What is the scale for how fatigued somebody is? You said 0.1 to 1? Have you ever had somebody who was more than 1 or so what is the scale graded on?

Rick: Well, the way we look at the scale, this is the kind of feedback that we will get back for somebody who actually takes the test is, if your level is above 1, you're essentially in pretty good shape and you're probably doing the right thing. There is probably some room for improvement and this is something we just honestly we need more data. I'm a scientist and I'm always a little cautious to make too many conclusions. I think the higher you are, and we did measure some people as high as a 100. I'm not exactly sure what that means, but if you're above 1, you're in pretty good shape.

Now if you're between the range of 1 and 0.1, you are somebody that could be improved but you are showing evidence of fatigue and there are probable interventions or changes that you can do in your life that would probably improve your fatigue score and probably improve your physical capabilities. Now if you're below 0.1, that suggests that you're really fatigued, that you have some real issues that needs to be addressed for you to come up anywhere near to where you should be, and that is the person who you want to reach out to and say, "Look, find out where your life is, find out what your training is about, find out about your personal life, think about it introspectively and we invite you to make some changes and measure the fatigue biomarker after you make those changes and see if it improves." That's the great thing about this, and over time this allows people to get better over time and improve their own physical performance capabilities. That was really exciting.

Co-host: Yeah, it is. There are a lot of other measures for fatigue I know depressed heart rate is one measure, your general mood, your performance and workouts, your blood lactate, all sorts of other measurements, what makes this better or worse than those? What kind of advantages does this Fatigue Biomarker test have over the standard measures of fatigue?

Rick: Right, it's a really good question. I think what plagues a lot of things like lactate, cortisol, and some of the heart measures that have been around for a very long time, is that they are highly variable and they are dependent on a lot of different factors that come into play. Ultimately, when we did some of our testing here, we did measure things like salivary cortisol, and we did measure lactate and when we stood them up against our marker, the thing that really comes out is that the variability for our marker is much, much smaller than it is for some of these other measures and what that means is that we're seeing things decline for example by a thousand to ten thousand fold.

When you see changes occurring in cortisol you're lucky if you're seeing something that is maybe between two fold, three fold, four fold. Lactate spike – again, you can see a pretty significant increase in lactate, but the variability even within a single individual is so large and so, we see with our marker that is essentially an off-on switch and within a population of people, again we see very tighter distributions here, and that's the main advantage. The heart rate measures like what you can get out a Polar monitor or other type of things, yeah, they're useful, but again they are susceptible to a lot of different inputs and the software, I would argue, you don't know exactly what you're getting out of it and there are also a lot of things that can affect heart rate variability or R-R interval measures.

Ironically, we are working in [half passes of 00:24:07] technology to use R-R interval measured with a chest strap and the results are interesting, but we don't see a really great relationship there to physical performance, not as good as what we have with our markers.

Co-host: Are there any factors that could affect the test? As you said, it is a salivary peptide test, so it seems like if you ate something before the test it might throw it of, is that true?

Rick: That is a great point and in fact, when we did our initial exploration studies with the University of Montana, one of the things that the exercise physiologists that we were working with was interested about carbohydrate loading taking place four hours into this endurance test and exercise physiologists, as you know, are very interested in different ways of tweaking things to make people perform better. What we found out was that intermediate meal of carbohydrate had no more effect than feeding of a placebo. The answer is, we don't think food has a great effect on this. Carbohydrate loading doesn't seem to have a big effect on this.

Hydration is one of the things that comes to mind. When you're dehydrated, especially after a long endurance event, our test actually measures two peptides and one of them is something that we use to normalize for the effect of dehydration.

Actually we're not measuring just dehydration when we measure the peptide, we are actually normalizing the dehydration event and so, our test is even more accurate than it otherwise would be. I hope that answers the question, but it is a complicated issue and what we really invite people to explore, again not all the people are the same and some interventions will really be more effective than others and things.

Co-host: Yeah, that was perfect. Is this meant to provide an overview of stress in someone's life accounting for numerous factors or is it more of something you might use after a workout and then send it in and see exactly how fatigued you really were during the workout?

Rick: Well, this is a very interesting question. When we discovered this thing, again we were looking for dramatic changes in composition that were associated with relatively acute short-term endurance exercise. That's what we were looking for. Now, whether that folks that were undergoing short-term bout of exercise acutely stressed or seeing stressors in their life overall, I don't know, I think the answer is probably not to a great degree. However, this is the really cool part I think, is that when you look at the Special Forces guys that were coming in and we were measuring a single saliva sample at the outset of the training regime. They go through a 12-week training regime, the Special Forces guys that we looked at. A single saliva sample before they started training indicated whether or not they were going to fall out during that 12-week period. Now that would suggest to me that we are looking at more simply the acute phase performance characteristic of an individual. I think when we observe a low level of the marker, we're looking at something which tells greater about the totality of the individual's performance capabilities. I think that totality is influenced to a great extent by emotional stressors, psychological stressors, immunological stress, and the whole galaxy of different things that could predict whether or not someone is going to succeed during the Special Forces training. I think the answer is yes, but we need more data and I think that is the bottom line and we're working on that right now.

Co-host: As people begin to take this test, are you like accumulating a large body of data that you can draw on to look at these kinds of things?

Rick: Yeah, absolutely. That's what makes this really cool, I think. Over time, we hope to accumulate a lot of data on people, both from controlled studies and studies that are relatively uncontrolled. I think we're just potentially going and we hope of course to go through something, which is kind of viral where people are talking and discussing among themselves about what they did and how it affected their Biomarker level. You can imagine that a lot of folks are going to start sharing

information about supplements, and I think this really talks to the whole supplement industry because people know that something winding up at a MuscleMag with some celebrity making an endorsement doesn't necessarily mean that the supplement's applications are safe, right?

This is the way that people are going to answer for themselves – does this supplement really help me objectively or not? Placebo effect can be profound with regards to the supplement use and really for any kind of intervention, whether you're going with a new trainer, new foot gear whatever it is, you tend to believe that that stuff will work – this is not meant to degrade that, but to enable you to really understand objectively whether the interventions that you are doing are really effective for you or not. The results might be surprising and we hope that the community shares through Hyperion this information and the users share it among themselves.

I think once the discussion gets going, it's going to revolutionize the supplement and really athletic pursuits overall. I think it's going to be absolutely revolutionary.

Co-host: This is great. You often hear like one of the factors for selecting supplements should be whether you really feel a difference or not, but often times, you're not going to feel a difference. They might be very subtle, but you still want to know it's working and this seems like it would be a perfect way to actually make sure you're getting what your money's worth. That sounds absolutely amazing.

Rick: I think a really good and well-studied analog to this is the use of depression medication. Why bring that up is that depression medications, when they do the big controlled studies by the pharmaceutical companies, about 40% of the people that are treated with the placebo show significant positive benefits from taking the placebo, and that's a big, big deal. In fact, the drugs often show just a minimal improvement over placebo. There's been a lot written about that lately and I think folks that use supplements ought to take that to heart. If you have a positive outlook that could make all the difference in the world, but still it may not really be having any demonstrable real effect on your body.

Co-host: Let's say there is somebody who is not an athlete, but they are just hard working like mom or something like that, like a soccer mom who's working really hard trying to get her kids all over the place, could she use something like this to try and quantify the amount of stressors in her life so, basically any person could actually get an objective marker for their stress?

Rick: I think that is the really exciting part that this marker really could be a great benefit and give people some pause and think about what they are doing in their lives. I think there are so many people that are pushing themselves so hard and they

have so many different things going on – they have got the kids, they have got the job, they have got things to pick out and do at home, they have got activities, they are spending two hours a day on the road – I mean, it is absolutely endless. I think this kind of states that, "Hey, look, take a rest. Think about what you're eating. Here it is in black and white, here's the result. Are you on the right path? Could your life be better?" This is the enabling technology that we really need for this stuff.

Co-host: Absolutely. I couldn't agree more. It's often hard for teachers and other people in any job to come in and really say, "We're being overworked," and the person hearing it would say, "What do you mean?" There is no real objective measure for overworked and so, this might be useful for somebody who's trying to explain to somebody else how far they're really pushing themselves and they can show them with numbers: "I'm like this fatigued, I need to take a break." So, that might be useful for that.

Rick: Well, there are a lot of professions and boy where the stakes are really high and I think stakes are really high for teachers too. I think you're absolutely right. Would you want a position with super fatigue operating on you, I think the answer is no. And so yeah, there are a lot of applications out there and there is a lot of interest in the technology.

Co-host: Interns, they made something like 70% more drastic medical mistakes when they hadn't had sleep for 18 hours or some period like that. This test seems like it would be a perfect marker to really show how much it was affecting people.

Rick: Yeah, you bet, and that's where you get so much excitement. I went to the American Association of Clinical Chemistry meeting and actually, I had a lot of physicians come up to me and ask that question specifically about medical residents saying, "Hey, we really need to talk about this." I think you hit the nail on the head. That is the really big one.

Co-host: When somebody orders the test, what happens? Can you take us through the process of what it's like to get this test done on yourself?

Rick: First comes the money. We have a credit card-enabled website. What you do is basically punch in your credit card information, secure website, www.fatiguebiomarker.com and then what we will do is we will send you a sample collection kit, which is just brutally simple. It will have some collection tubes in it with some very simple instructions. Don't brush your teeth, don't drink a lot of water right before taking the test and then spit in the tube until you get the required amount, seal it up, and put it back in the mailer and drop it in the mailbox. It's really that simple.

Then what we do is, again, we do some fancy chemical preparation of the saliva, we really clean it up and separate it and then we stick it in our LC-MS (Liquid Chromatography-Mass Spectroscopy) machine and we get a readout. Now, that readout will give you the concentration of your fatigue biomarkers and we will express that to let you know in terms of our population and knowledge, where you fall. Again, 1 and above is good; 1 to 0.1 – well, you've got probably some of the issues that are addressable; or less than 0.1, which means that you're really fatigued and you really have got to take care of what your life is all about. And, then from there we have some suggestions.

We suggest on the website that you could actually run your own, what is the called, crossover study, where, for example, if you are doing a ten-mile run, you take a sample before the ten-mile run, after the ten-mile run, and then you do it, let's say a few days later, but let's say you are some supplement that you hope will make you better and less fatigued. Well, you repeat, take the supplement, measure your biomarker before the run, and then after the run. What we will do is give you a detailed assessment of how your fatigue level was affected by the supplement, and again that's where we see a lot of value. I forgot what's the cost of that one is, but it is highly discounted. I think actually for those four tests, I think its $110 or something like that. If you order a little bit more, you get a lot more value back as well.

Co-host: How does somebody see their test results? Are they mailed to them in an email or Snail mail or is it on the website? How does that work?

Rick: Well, we would email it to somebody and again, it would be a nice PDF form. I think it would be very descriptive to tell you about the technology, tell you about the interpretation of the results. We have put a fairly distinct document and something that would not be overly technical, though again, we invite people to really think about what it is that they are doing. We like that kind of technical discussion. In fact, we would really like to talk to people about their ideas of what they would want to be measured and we're willing to work with them to define a testing regime that really makes sense and answers the questions that they want answered. There is more than one way to skin the cat I think. We really look forward to working with people on this.

Co-host: How long does it take for the test to get completed once somebody sends in their saliva sample?

Rick: Well, we can turn around the test in about a week; depends on the workflow, maybe as little as just a few days, depending again. This is a fancy test. No two ways

about it. It's expensive. It's time consuming but the results are really, really, we believe revolutionary. We're looking at about a week.
Co-host: If for whatever reason, there was a mistake on the test, would the person get a new one?
John: Absolutely. No questions asked.
Co-host: If somebody wanted to learn more about this technology, where can they go?
John: Well, one good source is www.fatiguebiomarker.com and also we have more information I need to check up on what the website is about but, once you order the test, we will give you some more information about the test. There are some published studies out. There is one article in military medicine that I can send to you and we will be happy to have that distributed, though we have to be mindful of publication rights and that kind of good stuff. We have another couple of publications coming that are coming out in the peer reviewed Scientific Literature as well that talk about the utilization of the test. It is more common, it's really a scientific thing that we've got here and it's not smoking mirrors or celebrity endorsements and that is what makes our product so different.
Co-host: Great. I'd love to get those studies and I'll definitely publish those in the show notes too, so people can look at them and see for themselves and thank you so much for doing the interview. That was great.
Dave: If you enjoyed this, there are several things you can do to help out. One is, just leave us a positive ranking on iTunes. That really, really helps other people find our content and makes us feel motivated to keep doing this. If you want to learn more about biohacking, you can also follow us on Twitter and check out the blog at bulletproofexec.com. You can find links to everything we talked about today in the show notes at bulletproofexec.com.

What We Cover

1. Everything you need to know about fatigue biomarkers.
2. How to quantify fatigue by measuring salivary peptides.
3. Why the military needed an accurate measurement for fatigue (and how you can benefit).
4. The future possibilities of being able to objectively measure fatigue.
5. How you can have your fatigue levels measured through an at home test kit.

6. Why salivary peptide testing is superior to other forms of fatigue measurement like heart rate and blood lactate.
7. How to use fatigue biomarker testing to avoid overtraining and measure your progress in workouts.
8. How anyone can use this test to see how much stress is in their life.
9. A walk-through of the entire testing process.

Links From The Show

FatigueBiomarker.com

Hyperion Biotechnology

Food & Supplements

Kerrygold Grass-Fed Butter

Alderspring Ranch Grass-Fed Meats

Upgraded™ Glutathione

Upgraded™ Whey Protein

Medium Chain Triglyceride (MCT) Oil

Probiotic Ultra Blend

Hydrolyzed Collagen Protein

Vitamin C

Listener Q & A

1. How do you eat a Bulletproof Diet and save money?
2. Should you modify the Bulletproof Diet for type-2 diabetics?
3. How do you eat Bulletproof at a restaurant?

4. How do the carbs in plantains and bananas compare?
5. Can you eat a Bulletproof Diet and still have enough glycogen for workouts?
6. Should you cut calories and have cheat days?
7. Is decaf coffee toxic?

Biohacker Report (latest studies & research)

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Listener Questions

Caiterin

This whole diet looks extremely tempting-- I did the Blood Type diet in high school (type O, so somewhat similar to this), and that was the only time I ever lost weight, despite playing sports and working out. I'm just concerned with the cost of organic food. As a college student, I have to worry about feeding myself on as little money as I can manage. How harmful would it be to follow the Bulletproof Diet with nonorganic vegetables and non grass fed beef? Ideally I would stick to the healthier stuff, but don't have the resources to do it.

Don

Great read. First time learning about the bullet proof diet. Graphs are very helpful. Any modifications in your regime for those of us with type 2 diabetes ? (Xylitol?)

Dave

What do you do when you are traveling to follow the diet? How do you go out to a restaurant to eat?

Chuck

Are the carbs in a plantain the same as a banana or more like a sweet potato?

Kent

1. What about the other concern about glycogen stores for athletic performance?

2. Also, if your goal is to lose fat as quickly as possible, is it still best to eat this way and not worry about creating a caloric deficit? It seems like long term your thyroid function might match any healthy food intake you have, but over periods of a few weeks to a few months it would be much more effective to use a low calorie week / cheat day type of approach.

Zingbo

Great stuff. Since i'm naturally jittery - Is decaf ok or is that toxic somehow?

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Some background research for this post may have been conducted by Bulletproof staff researchers.