

# Paleo Solution - 234

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Robb Wolf: Howdy folks. Robb Wolf here. We are back with another edition of the Paleo Solution podcast. Today I'm very excited to introduce folks and I suspect many of you may already know Dr. Kenneth Ford. Ken is the founder and CEO of the institute for human and machine cognition. He's the editor and coauthor of hundreds of scientific papers and six books. Ken has a really interesting background, pretty high level athletics at one point. I believe Doc, you had spent sometime in the military and then transitioned from kind of a philosophy background into artificial intelligence is that right?

Dr. Ken Ford: That is indeed right. Thank you Robb.

Robb Wolf: Yeah, yeah. Tell folks a little bit more about your background.

Dr. Ken Ford: Well the after college, I was smitten with the music business and I worked in the music business mostly as a promoter and a manager of the Second English Invasion, rock and roll bands and after a period of time there noticed that I was developing some unfortunate personal habits and decided that --

Robb Wolf: I can only imagine [laughs].

Dr. Ken Ford: Decided that I should probably join the navy which came as a shock I'm sure to both the navy and to my friends.

Robb Wolf: This wasn't a court order, this wasn't still at a time where it was like you can go to prison or go into the military. It wasn't one of those things was it?

Dr. Ken Ford: No. This was --

Robb Wolf: Okay.

Dr. Ken Ford: --right after it was just as Vietnam was wrapping up. You know...

Robb Wolf: Okay.

Dr. Ken Ford: So I spent six years in the navy and the navy introduced me to computers very much against my will. At the time computers weren't in common usage. You know, people didn't have computers at home. they filled gymnasiums you know, and they were used by these strange and somewhat geeky guys behind the window that we used to hand your printouts to you. The very last thing I wanted to do was computers but again the navy is not a democracy and they said well this is where your skills lie and this is what you're going to do. And it turned out to be a blessing because as you mentioned I had been a philosophy major in college. I was mostly interested in philosophy of mind. That is how can an organ like a brain or a liver or in general, how can a physical substrate like an organ ever give rise to something like a mind.

And in terms of philosophy the shelves seemed intellectual's shelves seemed relatively bare to me at that time. My philosophy friends will be sad to hear this.

Robb Wolf: [Laughs]

Dr. Ken Ford: But I had just been exposed to computing and there's a wonderful at least an analogy and perhaps more between the computational substrate in the computer and the executing program when analogized to a mind existing on and depending entirely on the substrate of the brain. And this motivated me to get out of the navy quickly. I had other motivations and get a PhD in computer science focusing mostly in artificial intelligence.

Robb Wolf: Interesting. Now what took you into the - now folks listening to the show usually were talking protein, carbs, fat intermittent fasting, athletic training and you may be thinking well what the heck are we talking about computer stuff. But part of your work at the Institute for Human and Machine Cognition and you've done some work with DARPA and the DOD looking at enhancing athletic and cognitive performance in warfighters and that has kind of taken you down to the track of looking at various protocols using ketones and the ketogenic diet to facilitate you know, hopefully some improvements in performance which we'll get to in a bit. But how did you found the institute for

human and machine cognition? What was kind of the driver behind that?

Dr. Ken Ford: Well the motivating thoughts had to do with developing a place that was not burdened by departments. Some wag once said the world has problems and universities have departments.

Robb Wolf: [Laughs]

Dr. Ken Ford: You know, we were all professors at that point and we didn't like - we felt the department - there was so much to love about academia but there was also so much that seemed fundamentally broken. We particularly disliked the departmental structure which presumed to carve the intellectual space at her joints but really couldn't possibly carve it at the joints. Because the exciting work today the real joints are in the boundary space.

**[0:05:23]**

Robb Wolf: Uh-hum.

Dr. Ken Ford: Between the traditional disciplines. We felt it was a real barrier to insight. So a group of us started thinking about what characteristics would a laboratory have that kept what we liked about academia and shed the elements that we didn't like.

Robb Wolf: I know this is an incredibly leading question but would you liken this with you know, so you take this kind of academic approach but then you're actually putting in maybe some elements that you would see in a traditional - I guess maybe not even traditional but maybe a more decentralized business kind of setting where you know little middle management, little upper management just lots of cross pollination and basically Ameristocracy built off of if you want to do hard work then here's the place to do it. I know it's kind of a leading roundabout question but you know, as far as the structure, you know, the academia clearly highly quite hierarchical, very structured, same deal with the military some of the more trendsetting businesses like gortex and stuff like that. Like they tend to have a more decentralized less hierarchical structure and tend to be very mobile and adaptable right? Is that kind of the way you guys structured this?

Dr. Ken Ford: Exactly. In fact the idea was to remove unnecessary management structure and to avoid middle managers. Essentially all great work whether it's art or research I believe is a passion driven process.

Robb Wolf: Uh-hum.

Dr. Ken Ford: And middle managers are often the vacuum cleaners of passion.

Robb Wolf: [Laughs] Yes. They are the gatekeepers to essentially shut that down interestingly and that's a fantastic analogy the vacuum cleaners of passion that's amazing. Ken so you know, a lot of the work that you've done has been in robotics like you've helped participate in these robotic challenges of trying to get these robots up and moving covering a certain distance you know, under varying timeframes or varying conditions and whatnot. Tell folks a little bit about that and then maybe help them to understand how this interest in cognition, robotics and the mind how did that crack a window into an interest in human performance that led you eventually to looking at the ketogenic diet?

Dr. Ken Ford: Okay. So I'll separate those two the DARPA robotics challenge has been a great experience. This is a global challenge where DARPA invites the most accomplished robotics groups in the world to compete on difficult tasks that are drawn from the Fukushima experience. So when one thinks of what happened at Fukushima, you naturally would imagine Japan is **chockablock** with robots --

Robb Wolf: Right.

Dr. Ken Ford: That you would send some robots in early on and sort it out. But that didn't happen and the reason it didn't happen in a nutshell is that the physical built environment we humans build that for us. Right? So everything about the physical built world interior spaces in particular is designed for us. It assumes our forms, it assumes our mobility, our way of moving. It assumes the use of human tools and robots weren't able to do much. So Darpa developed a series of tasks that were Fukushima like tasks like walking over a rubble pile and opening a door or using a human saw, a regular human power tool and cutting out some sheet rock to gain access perhaps to a valve, you know,

those sorts of tasks. Tasks a human workman can do easily and skillfully but that exceeded the ability of any robot. And they did it as a competition to bring out the competitive juices and you know, to have people working day and night for fear of doing badly.

They have three phases of this competition. The first phase was done entirely in simulation and it's how they down selected from some huge number of teams like a hundred or something down to 30 and then eventually down to eight that they funded and provided identical atlas robots to each of the eight teams, identical humanoid robots. The second phase was hardware and that was that homestead motor speedway, a large Nascar truck south of Miami. The idea there it was a big crowd, it's very strange to be in robotics and AI and looking stands to have people shooting your t-shirts up into the cloud.

**[0:10:37]**

Robb Wolf: [Laughs]

Dr. Ken Ford: This is not what academics are used to --

Robb Wolf: Right.

Dr. Ken Ford: And in this case the tasks were physical. You know, it wasn't in simulation and so you have to drive this car like vehicle and walk over these rubble piles and there were two categories, the category those who had atlas robots all identical and the category of those who could bring whatever robot they were able to afford to build. Right? They didn't have to really be humanoid. But the idea of having one group with all identical robots was very clever on DARPA's part because for the first time then robotics became an empirical science and a method that I might use, that we might use here on our robots could be replicated somewhere else because we had the same hardware. It's like previous to that it's like if each of us had different physics and different biology in our world, it will be very hard to replicate a scientific experiment.

Robb Wolf: Right.

Dr. Ken Ford: Impossible in fact. So that's the nature of the challenge and the third leg of the challenge is coming up in about 11 months or so. And that will just be much harder tasks and

the whole game will be ramped up. Now with respect to your second question how does one transition from an interest in artificial intelligence and robotics and all such technical matters to an interest in ketones. Well the transition there is more seamless than one might imagine and it is that IHMC's view as a whole of artificial intelligence isn't the old view right? So the old view of artificial intelligence was that we were endeavoring to build machines, the behavior typically spoken dialogue of which was indistinguishable from human --

Robb Wolf: The Turingg Test

Dr. Ken Ford: Yes. We were trying to build machines that would pass the Turingg test. In the '90s, folks that IHMC, myself, and Pat Hayes and others started to argue strongly against the Turingg test and we drew analogies to alchemy you know, in alchemy the goal was to develop a substance that was indistinguishable from gold. And only when chemistry moved beyond alchemy did we have the advances that we enjoy. In other words mimicking the natural exemplar probably isn't the best way to understand what's going on. So another good analogy is heavier than air flight. You know, for many years what you might regard as AF, artificial flight, thousands of years humans dreamed of flight and you know, you can imagine a Greek professor of aeronautics would call Hercules over to the cliff presuming Hercules has the best power to weight ratio and feather him up and send him off the cliff. When Hercules splats on the bottom, he will say oh bring Achilles over here. Hercules wasn't a good student anyway and he would fashion maybe a beak on Achilles because without understanding the underlying laws of flight we don't know what it is about a bird's construction that accounts for its ability to fly.

And this is where I believe AI had made a wrong turn but through the Turing test. The Turing test is very much akin to that. So at IHMC we don't regard AI systems as artificial intelligence mimicking nature. We view it as amplified intelligence leveraging and extending human cognition. So much of what we did always at the lab had to do with extending the human cognition, trying to develop cognitive orthosis and prosthesis as well as human locomotion. We build exoskeletons and we build perceptual devices. So when it appeared that there was a very interesting in

opportunity to better understand a molecular means for extending human performance it wasn't a philosophical jump for us to have an interest in topics like the microbiome and ketones.

**[0:15:13]**

Robb Wolf:

And what was your first exposure to that? Like when you had this thought of maybe looking at some biological tweaks along this line like where did you even start looking? I'm just curious because you know, my background is in biochemistry, I took a Fortran programming class when I thought I was going to be an engineer and that's the extent of my computer knowledge. So like if I were to have some moment where I would -you know, I was going to ask some deep thought about computing or artificial intelligence, I'm not even sure where I would start with that question, so how did you even formulate the question of okay maybe there's an alternate fuel substrate or I mean how did it get on your radar that ketones and a ketogenic diet could have some sort of therapeutic benefit there? I'm just kind of curious what that process was?

Dr. Ken Ford:

Well in my case it was a product of personal history so as a child I had grand mal seizures. I was epileptic.

Robb Wolf:

Okay, okay.

Dr. Ken Ford:

And I have sort of a scientific frame of mind and did not like the phenobarbital. It made me a zombie --

Robb Wolf:

Right.

Dr. Ken Ford:

--and as an athlete phenobarbital is not your friend.

Robb Wolf:

Right.

Dr. Ken Ford:

And if you're shooting takedowns against a guy on phenobarbital you'll look good.

Robb Wolf:

[Laughs] Even I will look good yeah.

Dr. Ken Ford:

Everyone will look good. So it was clear that I had to find some other approach and I was aware of work at John's Hopkins about children who have refractory epilepsy you know, they don't benefit from drugs and about 70% of

them really reduce or stop their seizures when they're ketogenic. So as - I was aware of this and had tracked this literature. Now as my life went on, for whatever reason and no one really knows these seizures went away. So I quit having seizures as I grew into adulthood and but I still had this background interest. I was serving on some of these advisory boards that the government has for DoD and for other agencies and both on the air force science board and on the defense science board and DARPA at the time was funding research on the development of a ketone ester with NIH. So DARPA had invested about \$10M in development of this ester and I volunteered to - because of my background, I volunteered to be the person that looked into this and --

Robb Wolf: A good organic chemist. I wish they had come looking for me. I could have done it for a lot less than that. [Laughs]

Dr. Ken Ford: It was great fun.

Robb Wolf: [Laughs]

Dr. Ken Ford: It was great fun.

Robb Wolf: Oh that. [Laughs]

Dr. Ken Ford: So that was the bridge right? So I saw what they were doing --

Robb Wolf: Got you --

Dr. Ken Ford: -and then if you think about seizures then you naturally would think well it might help with the seizure problem that maybe divers have you know, and you can just generalize from there.

Robb Wolf: Right. Right. Oh yeah there's just so many extensions from that. It's just -you know, my own experience with all of this stuff like I had tons and tons of health problems, started eating vegan, had all kinds of GI problems, malabsorption issues. My first real foray into this kind of paleo concept interestingly was actually an Atkins book. You know, picked up Dr. Atkin's New Diet Revolution and it was interesting. He actually kind of brushed on things like gut health and gluten intolerance and different things like that but he really built this compelling argument that ketones were

actually quite a friend of the neurological state and neurological functioning which will be very, very counterintuitive but you know, it's interesting even in my biochemistry textbook there were some illusions in there to the - this is back during my undergrad, there was some illusions in there that ketone bodies could actually be very beneficial for cognition. But you know, on the one hand it would say glucose is the only or the preferred fuel substrate but then under these wacky circumstances the heart actually beat more had a more efficient contraction while ketone fueled the brain had certain benefits and this was much earlier than you know, Savory Beach thingy you know, all these other folks' work that we've now been able to benefit from. But the first foray into kind of paleo-esque way of eating was actually a ketogenic diet that I got out of an Atkins' book. I felt amazing.

**[0:20:25]**

It was the first time, I feel like my whole childhood and adolescence I had spent most of my time feeling like my head was stuffed with cotton and I think now what that was was probably some gluten intolerance and definitely some chronic inflammation and hypoglycemia even as a kid and young adult. And then this first time that I got into ketosis it literally was like the you know, just this might somebody had unpacked my head, pulled out all the cotton out and I was actually firing on all cylinders for the first time in my life. It was pretty amazing and I tinkered with a straight ketogenic diet and acyclic ketogenic diet for probably better than ten, eleven years and then eventually got into crossfit and the nature and the demands of doing crossfit being so glycogen demanding or at least the way that I was attempting these ketogenic or acyclic ketogenic diet just wasn't really fueling that activity properly. So I've since then been on this terror trying to figure out how to get back that stable blood sugar level, that euglycemia that this seemed imperturbable. You know, I was just bulletproof with regards to hypoglycemia and cognition and whatnot but if I really tried to get into doing some sort of highly glycogen demanding physical activity you know, I ended up kind of bonking around that. Ken what are some of your thoughts around all that and that's part of what you guys are trying to figure out with this you know, the enhanced war fighter paper that you would published in the Bulletin of Atomic Sciences. What are some of those boundaries that you see as far as like you know, some glycogen needs for you know, burst activity but yet some real benefits with

regards to cognition and maybe even helping mitigate like traumatic brain injury and stuff like that? Like I know that that's a huge - that's a goulash I guess threw on our lap? What do you think about all of that stuff?

Dr. Ken Ford: Let's start with the performance, the physical performance side and then go on to the others.

Robb Wolf: Yeah.

Dr. Ken Ford: So one of the things - and I'll share partly personal experience and partly experience of you know, of the community, of the ketone athletic community. It seems to be highly beneficial for those involved and straightforwardly so for those involved in medium intensity, medium intensity with occasional sprints. You know, like cycling. It seems to be a clear advantage. You know, you have enough gas left because it's glycogen sparing.

Robb Wolf: Uh-hum.

Dr. Ken Ford: So the ketones are burned preferentially and you want to be able to be in position to win this sprint. Otherwise it doesn't matter how well you sprint. And in so sports like rowing and bicycling these sports that involve you know, long periods of maybe 60 to 80% VO2 max with intermittent full-on sprints. It seems very efficacious. Where it's more complicated are in sports like wrestling or you mentioned jujitsu and I think there if I were talking to an athlete that was a serious wrestler I would talk to them about a ketogenic diet for cutting the weight.

Robb Wolf: Uh-hum.

Dr. Ken Ford: You know, as you know, wrestlers have really often brutal weight cuts to make --

Robb Wolf: Right.

Dr. Ken Ford: -- and when they cut this weight under normal circumstances with typical coaching and supervision they suffer greatly and they lose a good bit of hard one muscle mass.

Robb Wolf: Right.

Dr. Ken Ford: And it's often a negative. You know, the poor wrestler will think oh good, I will get down to a smaller weight and have to wrestle and then I don't have to wrestle this beast. I can wrestle a more sensible sized human --

Robb Wolf: Right.

Dr. Ken Ford: And what you find out is yes you got down to that weight and you also lost a big chunk of muscle mass and the tradeoff is quite unclear. When you are cutting weight and you're ketotic, you lose much, much less if any muscle mass. That to me is very interesting. But then once you're at the weight and now you're ready to wrestle that's like your interest in jujitsu, now comes the question is the benefit of glycogen saving or preserving enough to outweigh the lack of glucose that you've had dietetically.

**[0:25:22]**

No one really knows the answer to that because I think it's important that because I think it's highly individual.

Robb Wolf: Right.

Dr. Ken Ford: One of the things I've noticed is that people don't blood test enough so if you're an explosive sport athlete and you're trying to do it ketotic I find my performance is poor if say the workout for that day is one that's glycogen demanding and I go in there and I'm 1 milli molar beta hydroxybutyrate, I'll probably get smoke checked and so I try to roll in if it's that kind of workout two and a half to three and a half mill molar.

Robb Wolf: Which is quite high.

Dr. Ken Ford: Yes. And very few people achieve that and they don't know they haven't achieved it because they're not testing.

Robb Wolf: Got you.

Dr. Ken Ford: And if you test it before like one of your jujitsu periods and Robb you see you're three milli molar, afterward you're going to be down to like 0.8. I mean you'll burn a bunch of that rolling around.

Robb Wolf: Uh-hum. Interesting but it is still and you know, some of that seems to be like and this is getting maybe a little bit out in the weeds but do you think that that really high level

is working more on the central governor side like working more on the brain side or do you think that it's just the - you know, usually the bulk of the ketones are used central nervous system, the muscles can use them to some degree. The heart can use them to a very high degree --

Dr. Ken Ford: And the brain.

Robb Wolf: Yeah the brain but usually the muscles are getting ramped up on you know, fatty acid lipolysis --

Dr. Ken Ford: Right.

Robb Wolf: That's part of the reason why it takes so long to kind of ramp up on this. But do you feel like that just really, really high ketone concentration maybe is supplementing muscular activity too? Like I've always thought that it was just mainly acting on the central governor side but clearly there is some ketone activity that can plug into the muscular level too.

Dr. Ken Ford: Yes and I take a systems view of it in that the system, the human is a completely sort of codependent, more than codependent. You know, it's entirely interdependent and if I'm greatly improving cardiac function and nervous system function which probably involves my ability to recruit the muscles I have that's a win.

Robb Wolf: Uh-hum.

Dr. Ken Ford: So you know, it might not be a win for a person doing one rep max squats right but for somebody like a wrestler that's a win.

Robb Wolf: Right, right.

Dr. Ken Ford: Yeah.

Robb Wolf: Just creating that efficiency and whatnot okay. Ken what do you feel like is the kind of therapeutic potential and we've talked about this a lot on this program but for traumatic brain injury, for possible neuroprotective effect with aging. Like I was very, very excited at a certain period in my life about ketosis and intermittent fasting and whatnot as a potential antiaging adjunct and then I did some reading from Michael Rose and some other folks and they made the

argument that they used this kind of framework the genetic reaction norms that different organisms would kind of determine whether or not calorie restriction, fasting and similar approaches would produce any type of a significant life span improvement. And you know basically their argument was that if you had an organism that allocated lots and lots of its metabolic energy towards producing offspring then if you calorie restricted or fasted these organisms then they tended to live longer whereas even though you know, I'm getting ready to have our second kid and I feel like we allocate a hell of a lot of energy to our offspring. But apparently humans allocate a comparatively much smaller degree of energy to our offspring. And so Rose made this argument that the most severe calorie restriction kind of protocol might add five to six years of life to the human life span whereas just simply exercising tends to add two to three years to the human life span. Like what are your thoughts on the you know, anti-aging effects? Could it be just potentially a compression of mortality even if we don't live necessarily longer? That you rocket right up to 80 or 90 years old and then you've got a two-week decline and you're done versus a multidecade decline? Like is that a potential?

**[0:30:10]**

Dr. Ken Ford:

Well that's certainly a hope and it's something that no one knows with a high degree of certainty but if you look at a wide range of consequences generally associated with the aging process many of them are affected in a positive direction when on a ketogenic diet or when doing calorie restriction. But --

Robb Wolf:

Uh-hum.

Dr. Ken Ford:

--calorie restriction isn't the game for me. I like to eat and I don't want to look like a marathoner. So for me that's off the table and --

Robb Wolf:

Right.

Dr. Ken Ford:

--intermittent fasting has some similar effects though not identical and the - when one is highly ketotic you intermittently fast almost by accident. In other words, it's you're naturally not feeling the need for some more glucose. So one just gets lunch and doesn't realize -you know, you can think about it sometimes or not have breakfast and not think about it. But many of the

interesting - I'll give you an example. So for example IgF1 levels in serum when one is ketotic they substantially go down, about 30% down. And that's a major, major reduction. Those don't usually swing like that. If you're doing a severe calorie restriction the classic form they go down also 30% to 40%. And but when you're ketotic the sensitivity of the receptors both for insulin and not surprisingly insulin like growth factor 1 go up. Also the musculoskeletal IgF1 goes up and growth hormone goes up.

So there is a large correlation between elevated IgF1 and shortened life span right?

Robb Wolf: Right.

Dr. Ken Ford: So IGF1 essentially if it's very low that's a problem for life span. If it's very high that's a problem for life span. I just picked that as one example. Really probably the primary thing that seems to influence everything else is insulin so a ketogenic person insulin goes down drastically as you know and you know, when -I think insulin in some ways is one of the best indicators of general health. If you look at insulin level and percent and amount of lean body mass and taking those two together you get a pretty good, I think a pretty good snapshot. And then and I'm talking about metabolic health here and now as we age, --

Robb Wolf: Right.

Dr. Ken Ford: -- all kinds of neurodegenerative diseases come seen. In many -you know, many folks get bad news when they go to their doctor and they find out oh you're an APOE4 right? But we're not a prisoner of that gene or any other gene. And one of the interesting thing about acetoacetate as well as betahydroxybutyrate is it's turning out that these ketone bodies are not just metabolic agents. They're signaling agents in the body.

Robb Wolf: Uh-hum.

Dr. Ken Ford: And they play a key role on governing epigenetic changes and so I'm actually very interested in ketones and particularly elevated levels of ketones that might be prophylactic with respect to diseases associated with

aging. No one knows but there's more evidence for that than so much else people believe.

Robb Wolf:

Right. And you know, it's interesting if you know, clearly I come into this from kind of this paleo perspective and we have these really interesting examples of like the catabins. We eat a very starch carbohydrate rich diet but they seem to completely sidestep any of the diseases of western civilization and so the food really starts changing and who knows if that's altering gut biome, if it's photoperiod, if it's all of these things. I do know for a fact that my father died at 71, my mother died at 70, cardiovascular disease, type 2 diabetes, autoimmune disease on my mom's side. Mother's grandfather died at 62 from cardiovascular disease. So I'm definitely -and you know, we're understanding I think better and better also that people who are suffering from these metabolic problems their children epigenetically are a bit more wired up to suffer those problems too.

**[0:35:15]**

Dr. Ken Ford:

Absolutely.

Robb Wolf:

And so you know, I've gone all around the map on this story about you know, what's kind of optimum or appropriate intake. Chris Masterjohn had a great presentation for the ancestral health symposium a couple of years back where he made the argument for a high starch intake in humans because of the multiple amylase gene that we carry like compared to a chimpanzee even the lowest amylase gene frequency in humans is something eight times higher than that in chimpanzees and then there are certain human populations that have like 16 and 18 times the amylase gene density and activity. You know, so this stuff gets really interesting to me that you know, that maybe on the one hand these either recent or middle distance adaptations in humans that we started consuming more starch but then is it possible that some of our epigenetic signaling because of changed photoperiod, changed gut biome, and a bunch of these other stories may actually still necessitate at least periods of time in a ketotic or a calorie restricted state to kind of avoid the diseases of western civilization. Like this is stuff that I just noodle on in an ordinate amount of time which is part of the reason why go to jujitsu when somebody is trying to choke you until you poop in your pants then you don't

really think about much else. But what are your -have you followed any of the like amylase gene density and have any thoughts on that from kind of an evolutionary biology perspective?

Dr. Ken Ford: Yeah. I mean the - I am coming at this, you know, my background looking at this is more from the systems, computer science and --

Robb Wolf: Uh-hum.

Dr. Ken Ford: --biochemistry interest. In other words I'm a mechanism of action kind of guy.

Robb Wolf: Right.

Dr. Ken Ford: And we know so much about the mechanism of action associated with the benefits of for example a low insulin level that postulated imagined benefit associated with an adaptation that we might have that's clearly very different than other primates isn't very strong and not appealing enough for me to do anything that elevates my insulin level.

Robb Wolf: Uh-hum.

Dr. Ken Ford: So the - I would myself I regard insulin as a general all-purpose bad guy. But the other thing I wanted to say about that is I think there's huge human variation and I think this variation is super complicated because it's not just genetic variation, you know Alessio Fasano has this wonderful analogy for epigenetic interactions with the human genome and the microbiome. Where our human genome he says it's like a piano and the microbiome is the piano player, that can play some songs but not others. And so maybe some of us analogously the piano player is Ray Charles and for others it might be Elton John.

Robb Wolf: Right.

Dr. Ken Ford: And his point is that we're not the prisoner of our genome and that there's a super complex interaction between the environment and the genome and in his case, he's mostly looking at the microbiome as the transducer of the environment.

Robb Wolf: Interesting.

Dr. Ken Ford: So in my language, I would say genetics loads the gun but the environment which includes the microbiome pulls the trigger.

Robb Wolf: You know, point and we talked about this a little bit yesterday when we roped you into this ill-begotten adventure. You know, there's been a lot of talk about resistant starch and different providing different substrates for the gut biome. What are your thoughts in that regard? Because there definitely seems to be some interesting stuff popping up and you made the point that you know from an evolutionary biology perspective it seemed a little bit dubious. I've seen some of the interesting stuff even in type 1 diabetics where these folks will do a pretty good starch bolus from say like potato starch which is a relatively rich source of resistant starch and then they will do a subsequent large carbohydrate meal like rice or potatoes or something like that. And they appear to get a significantly blunted insulin response from that. Like what can we pull from that or what do you feel like the story is there?

**[0:40:13]**

Dr. Ken Ford: I'm not really sure. You know, as I mentioned yesterday that my emotional response to the recent craze of resistant starch is not very optimistic in that you know, it's odd to understand how this would have come about in evolutionary framework. I mean this isn't food really. It's food for our bugs. It's not food for humans. I think the benefits that people and I'm not denying that people have had benefits but the benefit could well be from the mechanical aspects or the aspect of yes they're feeding the microbiome. And if that's the case I'm interested in feeding the microbiome with food that items that are both food for me and them.

Robb Wolf: Right.

Dr. Ken Ford: And you know, that's the interesting subject though because you know if you look at people that are a long term ketogenic there is evidence that their microbiome is somewhat less diverse and that's not a good thing.

Robb Wolf: Right.

Dr. Ken Ford: And so I think over time we'll learn a lot and that just living life and being alive is a whole collection of choices none of which are ideal and none of which are going to keep us around forever.

Robb Wolf: Right.

Dr. Ken Ford: You sort of page your dollar and make your choice. Right?

Robb Wolf: Right.

Dr. Ken Ford: And so I am not suggesting in any way, shape or form that others should do as I do or that this will turn out to be in any way optimal. It's just given what seems to be before me and give the options, this is a choice that I've made with my eyes open about the potential downsides.

Robb Wolf: Right, right. I guess that's something that is important to remind our self all the time that evolution is the story of kind of cross benefit analysis. You know, you give up a little bit of this and potentially get a little benefit from that. Depending on the nature of your current environment that may actually be a good tradeoff or not. And that's something that I constantly have to remind myself that optimum is really relative to the story that you're talking about you know, right now. Just before we got online together I signed up for this Brazilian jujitsu newsfeed this guy over 40 BJJ and you know, he's a 45-year-old guy who's got a black belt in Brazilian jujitsu and sends some fantastic stuff on older athletes trying to still maintain the grappling lifestyle and he shot a piece from a guy in Brazil who's 65 and still competing at a very, very high level and what this guy does is he tries to maintain as good a fitness as he can maintain. You know, he lifts some weights, he does mobility, he keeps his conditioning at a high level but the way that his game is played out now is that when he's rolling against younger potentially stronger people it's 100% a technical game for him until he just wears these kids out and then he's able. You know, once he feels like then their base attributes have degraded enough due to him acting them just work harder then he's able to take the attributes that he has. He's still at 65 looks like a pretty, pretty like his neck is thick and you know, shoulders way wider than his hips like he definitely does not look like

anybody I would want to face unless I had like a sticker gun or something.

But even with all that you know, clearly age ends up adding up but the cognitive side of it is where he ends up winning because he's just worked to refine his game so it becomes a much lower intensity game for the most part until he can bring that opponent down to a level where his attributes can then plus his technical skillset can end up winning the day.

Dr. Ken Ford: Yeah.

Robb Wolf: But it's pretty interesting.

Dr. Ken Ford: Yeah. That's a great example. You know, people over focus I believe on the grueling and it is very difficulty. You know, physical nature of sports like jujitsu or my sport wrestling and they often forget that you know, we equate athletic talent with how fast one runs but how fast one thinks is a big part of it too.

**[0:45:00]**

Robb Wolf: Right.

Dr. Ken Ford: And I used to continually have to wrestle this terrible brute of a man and the very last thing I wanted to do was roll around on the mat with this guy. So every time I would take him down I would let him up. [Laughs]

Robb Wolf: [Laughs]

Dr. Ken Ford: The first time I did that he looked so shocked he sort of just got up and walked off with his back to me.

Robb Wolf: Right.

Dr. Ken Ford: So I took him down again and let him up again. So every time I traded two for one. Now if we had a weightlifting contest I would lose. If we had a sprinting contest I would lose right? But he wasn't very good at the thinking part.

Robb Wolf: Right. Relying too much on those attributes which again you know, I think there is an argument to be made for effective aging to maintain strength and explosiveness and VO2 max and all that stuff. But there is the reality that that

is going to degrade with time. We try to fight tooth and nail to prevent that but then at the end of the day you've still got a limited reserve that you can work with physically but theoretically our cognitive reserve should be much greater. You know, if we can think about strategic way to balance that stuff out which like you said the two for one, I'll get the takedown points, he'll get the escape points but you're still in that ahead the whole time that's interesting.

Dr. Ken Ford: And you're not subjected to his strongest suite which is -

Robb Wolf: Right.

Dr. Ken Ford: --muscling you around on a mat.

Robb Wolf: Right. Right.

Dr. Ken Ford: Yeah.

Robb Wolf: Interesting. Doc, what else do we need to cover here so that folks understand what you're up to and do you mind? Is it okay when we post the show notes can we post the Scientific American piece and also the Bulletin of the Atomic Sciences?

Dr. Ken Ford: Oh sure.

Robb Wolf: Okay.

Dr. Ken Ford: That would be great. I think you know, on the subject of ketones, this is not a new subject so this is something I wanted to just mention. I had neglected to mention it earlier you know, I was at a meeting with an agency a couple of weeks ago and it was a room full of scientists from the agency all talking excitedly about ketones like this was a new thing right.

Robb Wolf: Right.

Dr. Ken Ford: And like one person wanted to know if they were FDA approved.

Robb Wolf: [Laughs]

Dr. Ken Ford: Yeah I'm making a bunch of them as I sit here.

Robb Wolf: Right.

Dr. Ken Ford: We wouldn't be here as a species without this mechanism. So it's important that we understand this is an old evolutionary adaptation. It's an old very, very old mechanism. I mean they're finding it now in very - what we would regard as primitive animals, manta rays and you know they are almost always ketotic. Their brains have around 3 millimolars. This is a very - it allows them to deal with dieting to great depths. You know, betahydroxybutyrate regulates brain chemistry in many ways particularly use of oxygen.

Robb Wolf: Right.

Dr. Ken Ford: So the point I wanted to make is that this is an old, old capability. It's a gift we have as humans and humans probably didn't live, most humans didn't live all the time ketotic. They were ketotic probably and then maybe the hunting was good and there wasn't refrigeration so we probably had a feast right. We probably ate as much of that up as we could get down and we probably eight in most detail lots of fast but probably enough protein that knocked us out of ketosis through gluconeogenesis.

Robb Wolf: Right.

Dr. Ken Ford: And then in a day or so we're back in. Right? So that was one thing I wanted to say and the other thing is what's exciting right now about ketones is that it's being researched from so many different angles. So you have the Richard Veech's you know, a real pioneer in ketone research and the one at NIH and that led the charge with the DARPA funding to develop the ketone ester that has implications for performance and for TBI and so much for radiation protection and many others.

And then you've got people working in medicine in cancer for example like Adrian Scheck and Colin Champ and --

Robb Wolf: Tom Saffrey.

Dr. Ken Ford: Tom Saffrey. Right. And that whole crew and they're each different Eugene Fine and each have a little different perspective. Dominic Agustino down at the University of South Florida is broadly looking at not just cancer but also

Alzheimer's and in particular looking at the impacts of ketones on navy divers. You know, the rebreather that navy divers sometimes use is a wonderful device in that there are no bubbles but it's problematic in that at relatively modest depths, you have only a short period of time to be at that depth without risking very significant seizure risk. Dom is doing fascinating work with mice that he's able to dive the mice and a barometric facility and dive them with and without the ketones and the mice seize just about when the humans would seize and not with the ketones.

**[0:50:44]**

Robb Wolf: Interesting.

Dr. Ken Ford: So it's exciting time because people are hitting this, people otherwise wouldn't even know each other. You know, they're intellectual backgrounds are different. Are hitting this from Alzheimer's and Parkinson's and cancer and human performance and all these different angles. So it is an interesting time.

Robb Wolf: Ken, you know, there are some folks that argue that because of the ancient nature of this ketotic state and you kind of answered this already that probably the normal human condition was varying in and out of ketosis. You know, for a long time I really subscribe to that but then it's been intriguing to me. It seems like and I don't want to anthropomorphize this but it's the easiest way to say it. But it seems like body tries to get out of ketosis as quickly as it can you know, to your point like if we over consume protein, gluconeogenesis will pull us out. Clearly certain carb level will pull us out and again this is a huge spectrum like we're producing a base level of ketones all the time regardless but what are your thoughts on that? You know, why if this is an advantage state in some ways again from kind of a systems perspective why is the body working so hard to get out of that state or why is it just such an emergency default mode versus trying to motor in that state all the time? You know, I guess one thing that pops into my head is that there is a down regulation of some things like IgF and some growth elements there. It's not just this kind of natural interplay of growth and recycling that you know there's kind of this fractal story that plays out there on the genome?

Dr. Ken Ford: Well no one really knows. You know, there's a hypothetical --

Robb Wolf: As hypothetical as it gets yeah. [Laughs]

Dr. Ken Ford: One doesn't know whether the normal state was to be ketotic with brief interruptions or whether the normal state for much of our evolution was to be glucose dependent as we are now with interruptions when one is ketotic.

Robb Wolf: Right.

Dr. Ken Ford: We really don't know the tradeoff there. But there are some things that we do know and much of what you were taking about has to do with the insulin level.

Robb Wolf: Right.

Dr. Ken Ford: So when the insulin goes up much at all, we bounce out of ketosis and I think that this connects exquisitely in critically to the protection of the brain during periods of low glucose. You know, it's so elegant when you think about the humans go 30, 40 days without food, we couldn't go two days without food, without this mechanism.

Robb Wolf: Right.

Dr. Ken Ford: So it's not something that's sort of a fringe mechanism especially for any animal with a very large brain you know, our brain takes roughly 25% of our energy and is about 2% of the mass. There's no way. That's such a disadvantage to an animal who's primary risk is starvation. You know, so for most of our duration as a species, the way most of us went is we starve to death. You know, with our brains, we've got a very short time to live without glucose, without ketones.

Robb Wolf: Right.

Dr. Ken Ford: So I think that's at the heart of why this switch is so effective. If you are low on glucose, you know, having a nice piece of fruit is a pretty good idea if you're living in the jungle and you've come across some fruit by all means eat it. Like in other words, I don't think there were people thinking about whether they should be ketotic or not.

Robb Wolf: Right, right. Absolutely, absolutely. You know, when I did the Discovery channel I Caveman show, we ended up starving essentially the first ten days. We ate a couple of frogs and we had a bunch of greens but you know, that was really about it. I ended up losing 18 pounds those first 8 days before we killed an elk but after we killed the elk I really, really, really wanted to eat but they had planned on, they did bloodwork before the show, actually at my recommendation and then we were going to do bloodwork at the end of the show.

**[0:55:27]**

And then as we're getting ready, you know, we're cutting up this elk and getting ready to finally eat, I said you know, we really need to do bloodwork now because we've got a group of people that have been starving for eight days essentially and this is actually going to be some really more interesting bloodwork. At least we need multiple data points so we had to hold off on eating another couple of hours so they could get the centrifuges down the hand crank centrifuges and all that. But as they start they had some handheld glucometers and I went into the show already in ketosis because I was pretty sure that we were going to starve given the fact that we were at a like 8500 feet in Colorado, in early spring and there was still like snow on the ground and stuff. Like there was not going to be anything around there to eat. So I had already wrapped my head around the idea that we were going to starve. But the producers were shocked and they checked my blood about six times because I was logging between a 30 and a 33 on my blood glucose level which they thought --

Dr. Ken Ford: Yeah.

Robb Wolf: --the thing was broken. Everybody else was in the 70s which was remarkably low.

Dr. Ken Ford: Yeah.

Robb Wolf: But nobody else had entered the whole thing in a ketogenic state and after they had literally like pricked just about every finger that I had multiple times double checking this finger like okay you really are running around with a blood glucose because they had two physicians on the production team. I said you really are running around with a blood glucose level of 30 which I should have been

unconscious and potentially you know, at death's door at that point so yeah.

Dr. Ken Ford: That is a really cool story. It reminds me of a long time ago George Cahill. He was at Harvard and then Richard Veech was his post doc.

Robb Wolf: Uh-hum.

Dr. Ken Ford: In fact Veech was Krebs's student.

Robb Wolf: Right, right. Right.

Dr. Ken Ford: So Veech was Cahill's post doc and Cahill had this amazing experiment that I'm sure I'll mischaracterize in some way but it's one that you could never do now right?

Robb Wolf: Right.

Dr. Ken Ford: He found 40 relatively obese Harvard students and sequestered them. It was either 30 or 40 I think he was 40 and sequestered them. I mean these people had no choice. I mean they were going to basically starve and he didn't feed them other than water. Originally he said he was not going to feed them I think for 40 days and when asked why, he said well it's in the bible you know, 40 days and 40 nights.

Robb Wolf: [Laughs]

Dr. Ken Ford: Can you imagine taking this to a university IRB now?

Robb Wolf: Yeah.

Dr. Ken Ford: So it gets better. So now these people are uber ketotic, right? Uber, uber ketotic. Probably like you, probably running around into 30s with a glucose level. He ought to be on the floor. They're running on ketones. So then he injects them with insulin and drives their glucose level down in the 20s and lower and videotaped, now videos before video but films them having lucid conversations. What he was demonstrating is the brain running on ketones.

Robb Wolf: Right.

Dr. Ken Ford: That's really you demonstrated that with less drama in some ways and equal impact right? If your glucose was 33 you ought to be flat in your back, were it not for this mechanism. So you've given a good, a really good and compelling personal example because I don't think your hunting was much worse than hunting often was.

Robb Wolf: Right. You know, other than the anthropologist on the show just made the point that at that time of the year, the natives in that area would have been about 5000 feet further down the mount.

Dr. Ken Ford: Right.

Robb Wolf: Where things were actually blooming in the worst mammals. We actually ended up killing an elk. I killed an elk with hand thrown spear an atlatl, but it took us to the eighth day because the first seven days whenever we would go out to hunt, we had a huge camera crew with us and --

Dr. Ken Ford: Well that's not good for hunting.

Robb Wolf: It's not particularly good for hunting and then this day we actually went out and we only had two camera guys and then they put some go pros on us and the two camera guys set up about 800 to 1000 meters outside of where we were and we just used these long range lenses to watch what we were doing and then we were actually successful that day. So we might have been successful earlier than that. If we had been at an elevation that was reasonable for that time of year, we would have had crawdads and you know, --

**[1:00:07]**

Dr. Ken Ford: Yes.

Robb Wolf: --skunk and all kinds of other things but there was literally nothing, nothing moving up in these mountains other than us at this point.

Dr. Ken Ford: Right.

Robb Wolf: But you can easily imagine a scenario in which a group would have had a run of bad luck.

Dr. Ken Ford: Sure.

Robb Wolf: As long as what we did yeah.

Dr. Ken Ford: February in Colorado.

Robb Wolf: Right.

Dr. Ken Ford: You know, when I was in the navy I went to this cold weather survival school in preparation for this other school called Sear school. One of the issues there was what sometime is called rabbit starvation.

Robb Wolf: Uh-hum.

Dr. Ken Ford: Where we're so accustomed to only eating the muscle meat. Basically it was dead of winter in Maine right and you have a knife and you have a parachute and that's it. And so there's nothing you can do, there's nothing much you're going to eat with that alone -

Robb Wolf: Right.

Dr. Ken Ford: --in Maine in February. And so about the only thing we could get were rabbits right. We cut off the parachutes and made these various kinds of ever so clever rabbit traps where you know, we learned that you had to catch the rabbit and then make a big rock for a log fall out of the tree and pull the rabbit off the ground or all the rabbits buddies will eat the rabbit right?

Robb Wolf: [Laughs]

Dr. Ken Ford: So we get these rabbits and at first you know, rabbits don't have much meat but that's all that anyone ate at first. That was not a good idea. [Laughs] So my group made soup out of the rabbit.

Robb Wolf: Uh-hum.

Dr. Ken Ford: And we ate all the parts of the rabbit and especially benefitted from the fat.

Robb Wolf: Right.

Dr. Ken Ford: And so we did a lot better than the folks that were eating just rabbit meat.

Robb Wolf: Right. Which totally - absolutely makes sense, totally makes sense. Well Ken it was fantastic having you on the show. I really appreciate it. I know it was a very short notice for you and you were very gracious in coming on. Where can folks track you down and follow your work?

Dr. Ken Ford: Well a lot of folks could probably enjoy coming to our website. You know, it's [www.IHMC.us](http://www.IHMC.us) like United States. One thing that I think your listeners Robb might enjoy is at the website under outreach, there are a variety of different outreach events but one of them is called the evening lecture series. The evening lecture series is sort of a gift to the community. It's -these are scientific talks mostly but very accessible. They're not -you know, there's not full of equations and things and there's - so for both of the primary locations Pensacola and Ocala there's dozens of these talks and you can just click and it will play the lecture. Hundreds of thousands of people watched some of these lectures and lots of them are people that are from the community that compromised your audience you know, so Loren Cordain and Joel Salatin and you know, Jeff Volek, and Dominique D'Agostino, and Peter Atiya. You know, it's just you know, I'm forgetting lots but there's that a good splattering of speakers on all scientific topics but also you know, a good number of interest I think to your audience.

Robb Wolf: Fantastic. Well we'll definitely get a link to that as well in the show notes.

Dr. Ken Ford: Great.

Robb Wolf: Well Ken it was fantastic having you on. Thanks so much for doing this. Thanks so much for doing this and maybe at some point in the future here we'll rope you back on and we'll do this again.

Dr. Ken Ford: Thanks Robb. It was a good time. I always enjoy your podcast.

Robb Wolf: Thank you. Hopefully you'll enjoy hearing your cellphone on this one. [Laughs]

Dr. Ken Ford: Likely I'll enjoy that.

Robb Wolf: [Laughs] All right Ken, thank you again and we'll talk to you soon.

Dr. Ken Ford: Okay, thanks.

Robb Wolf: Okay. Bye-bye.

Dr. Ken Ford: Bye-bye.

**[1:04:03] End of Audio**