A Special Interview with Steve Farrar

By Dr. Mercola

DM: Dr. Joseph Mercola
SF: Steve Farrar

Introduction:

DM: Welcome everyone. I am Dr. Mercola. Today, we are here with Steve Farrar who has a Masters Degree in Horticulture from the Washington State University. He actually have been studying and working with mushrooms for the last 30 years professionally. Actually, the first 20 years, you were working with gourmet chefs growing them. In the last 10 years, you have actually taken your expertise and applied it to health purposes.

Mushrooms received enormous amount of attention recently especially in gourmet cooking and pharmaceuticals and a whole variety of other areas. I'm wondering if you could share with our audience why you focused your attention in this area.

SF: I have always focused on growing gourmet mushroom species as opposed to the common button mushroom which is also a gourmet item but it's kind of like the white bread of the mushroom world. I tend to focus on wood decaying mushroom species. They have a different biology and definitely a different production methodology.

By virtue of them being primary decomposers, they have some unique nutritional and also health benefits to them. I tended to focus on species like Maitake, Shiitake, Enokitake, oyster mushrooms, brown beech mushrooms, mushrooms that people over the last 20 years were not really that familiar with. In fact many of them didn't recognize it as mushroom. A lot of people see a Maitake mushroom and they say what is it? It's not the common classical shape of a mushroom.

In the United States we eat a lot of mushrooms, somewhere around 900 million pounds a year but 95% of that is all one species, the common button mushroom or its relatives, the Crimini or when Crimini gets big, the Portobello mushroom. These are all basically tertiary decomposing species that require a previously decomposed…

DM: Are there many nutritional benefits or as many for the common button mushrooms that 95% of the people consume or is it a relatively minor component of that species?

SF: No. The common button mushroom is an excellent food. Some people call it a super food. It's high in protein. It has some enzyme components to it. High in B vitamins. High in niacin. Depending on how it's grown, it could be high vitamin D2. It's a very good food. Low in calories. It's an ideal diet food. A very good food for diabetic conditions. So it is an excellent food.

The wood decaying mushrooms are the species that are more popular in Asia and parts of Europe have different flavor components to it and different textures. America is kind of a mycophobic society. Myco being the root word for mycology, the study of mushrooms. We're always a little bit afraid of mushrooms. Are they going to poison us? Are they going to make us high?

Asian traditions, they are more fungus-mushroom loving cultures and so there has been some resistance to that. But basically this gourmet-culinary bent has brought this to the attention. What flowed out of that was the idea that there are these medicinal benefits apart from the nutritional components to it.

DM: Before we focus on the medicinal and nutritional components, I just like you touch on an area that I think most of the people viewing this film really don't fully appreciate and that is the importance of mushrooms in the whole ecological cycle in the environment. You referenced the fact that the ones you're particularly studying are the wood-decaying ones.

From my understanding, they really are an essential part of this whole cycle. If we didn't have mushrooms, we would be in a really sorry shape because they are really foundational to the health of the soil. Obviously the health of the soil is related to the quality of the food that we're consuming. I'm wondering if you could address that for a bit before we go into the other area.

SF: Yes. Mushrooms, they are master recyclers of our world. Without mushrooms decomposing organic material we would have serious problems. The fungal kingdom, the kingdom of fungi, it's an enormous kingdom. The fungi outnumber plants on planet Earth by a factor of 6 to 1. Most people don't realize that.

Estimates of the total number of species of fungi on planet Earth range from maybe 500,000 to 10 million. About one and a half million is pretty much the current estimate. Of that, only 10% have been identified. So there is more unidentified species of fungi than identified at this point.

DM: Why do you think that is? That's a curious fact.

SF: It's hidden. It's in the ground. It's embedded in organic materials and it's difficult to separate out. A lot of the species are actually part of the plants. They are embedded in the leaf surfaces, endophytic species of mushrooms.

All mushrooms are fungi but not all fungi are mushrooms, if that makes sense. There are many other things like slime molds, rust, powdery mildews. Of that 1-1/2 million species of fungi maybe 150,000 are actually mushrooms.

Mushrooms are defined as a fungus that forms a fleshy above ground reproductive structure called the mushroom fruit body. Basically, its function is to release spores and propagate itself to keep the species going. It's generally a relatively short-lived stage of

the mushroom above ground and it fairly quickly decomposes. But mushrooms can be long lived. The vegetative stages live in the ground for decades even centuries in some cases.

DM: Would it be fair to say that we're really only at the beginning of our understanding of the value and the importance and the function of the species if we've only known less than 10% of them. We're at the beginning stages and through the years, we're going to learn more and more especially the value that this can have to our health.

SF: Definitely. I'm continually humbled by my ignorance of what's going on in this incredible complex world of fungi. It's just mind boggling. Even with the well studied species basically nearly every week, they're finding a new bioactive component even in the well-studied species. Maybe it's a polysaccharide, maybe it's an enzyme, a protein, an antioxidant. They are continually finding new things that have profound effects when we consume them as a food or as a dietary supplement.

DM: Would molds actually fall into the fungi – I was thinking one of the first benefits therapeutically that we have identified from fungi or molds would be antibiotics. The very first antibiotic was penicillin which came from a mold.

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If you can just maybe establish the species or the division of the kingdom with mold, fungi and mushrooms – how that breaks down.

SF: Penicillin is a type of fungi that doesn't form a – it's not a mushroom. It's a fungi not a mushroom. It doesn't form a large fruity body. It propagates by different means, by division. They are continually learning more about the evolution of mushrooms. It turns out that animals and humans are more closely related to mushrooms than we are to say plants. Some 460 million years ago we shared a common ancestry. It broke off there.

Mushrooms are much like animals in several ways. They can only digest organic matter that's been made by a plant of some sort. They take in oxygen and give off carbon dioxide. So in many cases, the tissue and the nutritional qualities of mushrooms are more animal-like than they are plant-like – the protein components, the enzyme components. They are closely related to us.

In fact, the fungal infections are one of the worst infections to deal with because most of the tools that we have that deal with infections that is going to kill a fungus is also going to affect us. There are dangerous fungi out there and poisonous ones but more often than not, they are our allies in health; definitely in the health of planet Earth and the ecosystem. They form a vital component of recycling.

DM: Maybe you can explore some of the other interesting facts about mushrooms that most people may not have heard off. You had mentioned earlier that about 10% were

classified and we don't know about the other 90% and they also outnumber us six to one. Because most of these organisms do not incorporate photosynthesis which is the way traditional plants synthesize their energy and produce their material.

Also, maybe if you can talk about some of the largest organisms and how big these fungi can actually grow to.

SF: The mushroom fruit body that we typically think of as being a mushroom is really only the tip of the iceberg of the mushroom plant itself. More than 90% of the biomass and more than 90% of the time it is spent more on the vegetative stage of the mushroom. That's called the mycelia of the mushroom.

The mycelia is a threadlike network of cells that permeate through our environment and through the substrate that they utilize the food whether it be a soil and the roots of a plant or a decomposing tree, or even an animal that has died. They can decompose animal flesh as well.

The major thing about this mycelia is that they have no protective coating. They don't have a skin. There is just a cellular membrane. So they are in immediate contact with their environment. They are in a very competitive environment generally in the soil whether it's composting, rot going on. There are other fungal competitors, bacterial competitors, yeast competitors, insect competitors. They had to develop an incredible arsenal of biochemical weapons to deal with this competitive environment and also to basically digest its substrate.

Mushrooms unlike animals that have a stomach where they can close their food to digest it, mushrooms took another strategy. They exude extracellular enzymes into the environment to liquefy nutrients so they can be absorbed to the cell wall. They have a very powerful arsenal of enzymes with them that also impact our health whenever we consume that form.

Most of the traditional uses of mushrooms had focused on the fruit body of the mushroom, the part that you can see and harvest.

DM: Typically the ones that we eat and consume.

SF: Yes, exactly.

DM: And gourmet chefs would use.

SF: Up until about 50-60 years ago there is really no effective way of getting to that earlier stage of the mushroom, the mycelia stage because how do you separate it from the soil? How do you separate it from the wood?

Basically, technology has come up with a number of different basically fermentation technologies. We used what is called a solid state fermentation where we use an

organic substrate, a grain. We use oats in this case. Basically, it is able to digest that material in an aseptic laboratory controlled environment. We filter the air. We sterilize the material with steam, heat and pressure in an autoclave.

We are able to capture not only the mushroom tissue itself, the mycelial tissue in that substrate but also the extracellular enzymes and also the breakdown products of the oats themselves as they are being fermented, decomposed by the target species that we cultivate.

DM: Interesting. If we can go back a little bit to the mycelium, maybe if you could just comment on the massive size of this mycelium and intermingling with other plants and how that works. I believe that it's the mycelium that if anyone who has ever worked in a garden or turned over some soil with a shovel and the dirt is kind of clumped together and when you try to break it apart it's like connected with all these material. Is that the mycelium that you're referring to?

SF: That's generally the mycelium, yes. Generally, the mycelium is intimately connected with the roots of plants. They are called Mycorrhizal species meaning that they are associated with the root environment. Some of them are actually penetrating the root. It's basically a mutually beneficial relationship.

Initially it was thought that only a few plants have this Mycorrhizal relationship with the beneficial fungal ally. But now they are finding virtually all plants have that in some degree. The health of the soil depends on the fungal component of it.

It can grow to massive amounts. A forest in Oregon – now they regard it as the largest living organism – it covers over 200 acres. It's a species of Armillaria that basically spread from stump to stump that they had identified as originating from one…

DM: 200 miles?

SF: 200 acres.

DM: 200 acres and it's one plant.

SF: Yeah. They could trace it back to – it came from a common mycelial…

DM: 200 acres of mycelium?

SF: Yes.

DM: Mass wise, how big would that be? It's pretty dense isn't it with respect to the number of – I mean, even within one small area it's like miles of mycelia, isn't it?

SF: Yeah. It's starting out there. I'm not sure of the source. It has been repeated so many times but it's supposedly in a cubic centimeter of healthy forest. If you are

somehow able to lay the individual mycelial cells out, in the end it would start some 8 miles or so. So the amount of permeation through our environment, through the soil and everything, it's amazing. It's just mind boggling.

The fact that it can do it without any protective covering. It's just like if we are able to tear our skin off and go roll in the dirt and not get sick. Mushrooms can do that. They have an incredible arsenal of weapons.

DM: I would imagine they require some type of moisture to thrive too. If you went to a more arid environment like the desert, there would be less of the mushrooms?

SF: There are less, yes. There are definitely less. Mushrooms are at least 90% moisture and water to them. Although there are many desert species they developed strategies to deal with the harsh climate. They form resistant structures, Sclerotia that are underground that can survive in dry periods and then very quickly grow during the wet periods. They get around. They do prefer the moisture. Most of the species and most of the unidentified species are in the tropics where there is moisture and warmth and a lot of organic material.

DM: The last 10 years you have really focused your efforts and energies on the health and medicinal properties of mushrooms and bringing them to market for the consumers. I'm wondering if you could expand on those properties that are beneficial from a health perspective as to why would mushrooms be good. You mentioned some of them earlier with the proteins and the other components but more from a medicinal perspective.

SF: I originally focused on growing the fruit bodies. I probably eat a hundred times the average per capita consumption of mushrooms of the average consumer.

DM: You enjoy them.

SF: Because I enjoy them and I grow them so I have access to them. I eat a lot. I eat mushrooms everyday. I have relatively good health but always still I would get at least a case of the flu, a couple of pretty bad colds a year. It wasn't really until I started consuming on a regular basis the mycelial stage of these mushrooms that bring some other functionalities to the party so to speak. I haven't really been sick in 10 years. I can attribute it to that because that was the one thing that changed in my diet.

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The amazing thing about mushrooms is their effect on health it's not just a one directional approach. It's very much multifaceted. They have a profound effect on our immune system and this is mainly by virtue of what are called these long chain polysaccharides particularly beta glucan molecules. There is also alpha glucan molecules that they found affect our immune system and also some of the proteins and enzymes.

They basically affect our immune system. Their host mediated responses meaning that they are not going in like a pharmaceutical medicine and a sledgehammer and forcing our body in a particular way. They interact through our immune system itself by stimulating it and making it ready and efficient.

Other components that add to our health is they are a very good source of antioxidants. Several ones that are common in polyphenols and selenium things that are common in the plant world but also some that are very unique to mushrooms. One is called L-ergothioneine which is just starting to reach into the dietary supplement world and to the healing properties as it's basically a relatively unknown but basically a master antioxidant.

It was identified in the 1950s. It's basically an amino acid that contains sulfur but it's one of the only antioxidants identified so far that actually our cells have a transport system to actively take ergothioneine across the cell membrane into the cell to the points of oxidative stress. It's a very significant antioxidant. It's probably eventually going to be called a vitamin, relatively unknown. It's only been in the past couple of decades – they barely even found ways to quantify it effectively. Mushrooms are an excellent source of this antioxidant. We can only get it from our diet. It's only produced by fungi and certainly soil inhabiting bacteria.

DM: You had mentioned that now commercially there are techniques such as the solid state fermentation as you described that allows you to harvest the mycelia. That wasn't available when you first started experimenting with this for yourself. How does a typical person, if they were in a forest and found these mushrooms and the mycelia underground, is there a way to harvest that or separate it out?

SF: Not so much. You would have to go with the fruit body so to speak.

DM: How did you do it?

SF: By basically doing aseptic sterile cultural techniques.

DM: So even initially when you experimented it was with this aseptic sterile technique. Did you actually go into the soil and separate it out and start eating the mushroom body, the mycelia?

SF: The source of my cultures were fruit bodies that we tissue cultured. That's the original source of it. It's basically making of mycelial – in the mushroom industry, what you plant, the mushroom crop it's called spawn. Basically it's myceliated either sawdust or grain that they used to basically inoculate the bulk substrate that the mushroom is going to use as a food source. Basically, we use that technology.

The difference is we're not using it to then plant into a bulk substrate to harvest a culinary item out of it. We're using that fermented food product as actually the product because it contains the extracellular enzymes for one that's not in the fruit body and

also many of the antimicrobial compounds that the mushroom has and that mycelial stage (indiscernible 23:36) in an environment.

Also, the cell walls are different in the mycelia than it is in the fruit body. They are a little easier to digest; the covalent bonds, the (indiscernible 23:45) bonds are not as difficult to digest and so in terms of accessing these bioactive compounds, it's a better stage to take it from.

DM: You had mentioned that the substrate you used to produce these mycelia are oats. Oats, maybe not everyone is aware of it but they do contain gluten. I would imagine that because of the way that this solid state fermentation works that basically these mycelia are using this food to digest it – most all, maybe all of it is consumed in the process but maybe it's not. I'm wondering if you could address that for anyone who is concerned about consuming these products that there might be some gluten in it.

SF: Sure. Good question. Oats, they don't necessarily contain gluten. They contain some proteins that have some similar effects to gluten. The main concern about it is that they are a grain and they can be contaminated during the harvesting or growing or processing and they could be contaminated with wheat or rye that contain a lot of gluten.

I examined the oats that we get in bulk 50 pound bags and look for stray wheat or rye. It's a very low level of that but beyond that, by virtue of when we autoclave the oats under steam and pressure, it breaks down some of the gluten and then through the course of the 30 days to six months of solid-state fermentation that gluten is metabolized by the mushroom. So we do a gluten test. We basically test for gliadin. We come out undetected. So it's a gluten free food in its finished form.

DM: So anyone who had a concern about this, it's essentially a non-concern because there is really none in the product.

SF: Yes. In the finished product (indiscernible 25:31).

DM: You had mentioned that one of your experimentations with the mycelia is that you noticed that you started to get decreased infections like coughs, colds, and flues despite the fact that it hadn't occurred when you were eating the fruiting body. I'm wondering if you could share with our audience what you have learned since then about the immune enhancing benefits of the mycelia.

SF: Profound effects. The immune system as you well know it's incredibly complex. We're just now beginning to understand the interactions. The main interaction we had talked about is the polysaccharides or basically they are sugars. Sugars somewhat have a bad word now. People are trying to reduce their sugar intake. But these are more essential sugars, complex sugars.

DM: By complex, they have this large number of different connecting bonds so that they're not easily digested and broken down by enzymes in our system and they don't breakdown to simple sugars and raise our blood sugar and insulin levels.

SF: Exactly. They are very complex. There are particular bondings too. Originally, they have thought that most biological information in our bodies came through the protein and DNA and the protein coding. They are finding more and more that most of our communications between our cells and our immune system, our body is more – it's governed by these sugars. These glyconutrients they are called.

The vital information that can be contained in these sugars is astounding. If you combine two amino acids into a dipeptide – there is basically only one way they can bind – two monomers, two sugars, there is 11 different ways that they can combine. So when you take it to a large polysaccharide complex chain molecule, you know, very large molecular weights up to a couple of million Daltons, it's six to seven orders of magnitude greater amount of biological information conveyed in these sugars.

The way they communicate basically is kind of through this receptor sites on our cells. It's described as a lock and a key. That there are receptor sites depending on the physical structure of the polysaccharides, the side branches, and the substitutions on it, they will lock on to certain components of our immune system and activate it much like they would be activated by coming into contact with the bacteria. It's very profound effects and we don't fully understand them. Like I said, I'm continually humbled by my lack of understanding of it. Basically, I understand how complex it is.

Our technique is we think that basically if you provide your body with an array of polysaccharides from several different species of mushrooms essentially providing a very complex diversity of these polysaccharide structures that can activate and bind on to receptor sites, you're going to elicit a very broad based immune response. That really the diversity of it is the strength.

You can get these beta glucans from plants. They are a different structure. They tend to be linear and not as barrel strand, not as well branched. You can also get them from the simpler fungi like yeast. They also have functions on the immune system. But it's really these long chained polysaccharides that are immense complex structures, a lot of times bound with proteins or amino acids or different side chains that have the effect on the immune system.

Our understanding is too primitive at this point to I think to try to isolate them and just pick out the best ones. It's better to provide your body with an array of them. (indiscernible 29:32) to activate the immune system but also provide some of the raw materials for our body to reassemble to the point to do their cellular communication.

DM: I'm interested to know that you actually use the term glyconutrients which is sort of the general term that has been described to these complex polysaccharides. I can recall that my first memory of that was actually from an aloe plant.

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Actually a multilevel marketing company had popularized and produced D-mannose which had some phenomenal benefits and still does. I had never really promoted it because I'm not too interested or enthralled with the multilevel marketing model. But it doesn't diminish the value or the benefit of that product. I'm wondering if you could compare D-mannose to some of these other complex polysaccharides that are produced from the mycelia.

SF: There D-mannose in mushroom species. It's one of their components. It's more or less a simple sugar. Some very active compounds in the mushroom actually have that as some of the side chains. When you're talking about the polysaccharides in mushroom , they talk about beta D glucans basically with what they call 1-3 and 1-6 linkages. That's a lot of kind of biochemical gobbledygook to most people.

But the take home message is that it's the structure of the mushroom that dictates its function – the structure of the polysaccharide and their shapes. There are very complex shapes. They can be triple helixes, very elaborate structures. They are difficult to characterize by our current techniques. They have different affinities for different parts of our immune system from the macrophages to the T helper cells. Everyone has different sort of receptor sites that can be activated by these different structures. Basically, I think providing an array of tools that your body can use.

DM: For the person watching this, for more information, I think you can do is just Google or any search engine you like and type in some of the benefits, immune potential effects of D-mannose or some of these other glyconutrients and you'll see literally just the most amazing stories. The testimonies are really quite profound. We're not going to include that here but they do exist.

I really think that sort of the summary of this is that there are phenomenal outstanding benefits and we've only touched the surface. We don't really even begin to understand how this all works.

Interestingly, the technology to utilize or take advantage of this source of nutrients has only been recently available. Would you say in the last 10 years or so?

SF: No. I would say 40 years. But it's primarily in Asia. It's just now starting to seep into our paradigm.

DM: One of the arguments someone might have because a lot of people follow this and in my viewpoint specifically is that we seek to replicate the dietary patterns of our ancestors. With the premise being that if we are able to reproduce that that we are more likely giving our genes what they were designed to be and optimize that genetic expression to its fullest.

An argument some people might have is that while the technology to harvest this portion of the fungi only existed 40 years, our ancestors didn't do it so why would there be a benefit for us to take this food source when typically our ancestors never had access to it. I wonder if you could address that just from a curiosity perspective. I'm not saying it's right. I'm just curious and to address someone who would be skeptical of this approach.

SF: It's an interesting take. The mycelium is still mushroom tissue. It's still from the same organism. It's like – I don't know what an analogy would be but it's not like it's a new product. You are getting a different part of the organism as opposed to the fruit body. It's like eating…

DM: The roots instead of the actual plant itself that grows above ground.

SF: Exactly yes.

DM: Certainly many like ginger the plant or ginger root. They are two different – it's completely different properties. The root would do some things that the plant wouldn't.

SF: Animals, we make a number of products for animals particularly. We've been very successful with products for thoroughbred race horsing and performance that sort of things. One of the arguments is horses; they don't know how to eat mushrooms, do they? They don't but they do. They are foraging animals and when an animal is out in the pasture eating a plant, it's pulling it up and getting roots and also mycelium with it.

DM: Interesting. So that is a way that they may have actually been consuming it indirectly.

SF: Right. So when we eat animal meat some of those bioactive chemicals come through basically as their diet and there is a fungal component to that, a mycelium component to that because there is – most of these pasture plants are rife with (indiscernible 35:12).

DM: That's a very good answer. I'm wondering if you could expand on that because a really powerful anecdotal testimonial evidence is really how a product performs in animals specifically competitive animals like a thoroughbred racehorse where there is large amounts of revenues that are generated so that really no resources left unturned typically at the highest competitive levels to achieve that fraction of a second in performance.

The reason why it's such a valuable resource or tool to evaluate because there is no placebo effect in animals. It's going to work or it's not going to work. There is no psychological component. It's a (indiscernible 35:54) effect. Results speak for themselves. You're either going to see it or you're not going to see it. I'm very intrigued and interested on your expansion of what you have actually seen using these mycelia in thoroughbred racehorses.

SF: In 2007 we hit a homerun so to speak in that realm. We were able to – a trainer on the East Coast, we were able to get basically his whole stable on a product that we had. It was a blend of mushroom. It contained a lot of the Cordyceps species which is widely recognized as a performance mushroom, enhancing energy production. It had a number of other species and it helped with muscle recovery after strenuous exercise.

Basically, the 2007 Kentucky Derby winner Street Sense was a horse that was on our product. The owner and trainer attributed a lot of the success to that. Interestingly enough, part of what was the performance energy component to it and they should really recover from the exercise, another part of it was basically a behavioral aspect to it. It was totally unexpected on our part.

The trainer said that given this blend of mushroom to the horse it was a different horse as opposed to being – racehorses tend to be very fidgety and very high strung and they can be distracted and what not. It's very difficult to focus their attention. They said once they started along this regimen of a daily dose of this mycelial blend of mushrooms that it's trainability and focus, it was a different animal.

So instead of a lethargic sort of calming effect it was more like an alert focus and the horse is ready to go but it was focused and it was trainable. That combined with the performance aspects, the muscle recovery and the energy generation was enough to they thought make a difference. Since then they have been spokesman of (indiscernible 37:53) for our products.

DM: So because of their experience and the benefits that they have achieved are other stables starting to use this and what percentage of the thoroughbred racing industry is using this would you think?

SF: It's hard to say because a lot of – when a thoroughbred racer finds something that works he doesn't want to spread around yelling too much. They keep it as a secret. We get orders from all over the country. A lot of the dressage horses – we've had some Olympic dressage horse winners and high placers.

It was a hard sell in some respects because mushrooms for a horse? It just seems counterintuitive. You wouldn't ordinarily think it. But basically, like you said there is no psychological effect either they see an effect or they don't. It also tended to be a venue, help us segue to get into the human market because a lot of these racehorses they don't want to give everything until they tried it themselves. They try it themselves, they feel the effect on themselves, they give it to the horses, see the effect on the horses and they were sold. They're on an autoship program from the get go. That sort of thing.

DM: Have you seen any benefits in competitive athletes, in human athletes or any actual stories that are similar to winning the Kentucky Derby?

SF: Yes. We're getting more and more into that. It's very difficult now because everybody is so afraid of doping in the sports industry.

DM: It could end your career.

SF: Exactly. Even if it was unintentional, an accidental thing. For awhile they are worried about while these mushrooms are so complex so many different things in them, how do I know it's going to be something I'm going to test positive for it. We're working on that. In the horse racing world as well, that is an issue as well. They check for the horses. We did through the Hong Kong Racing Association – we were passed through their very stringent regulations and said it was approved.

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Although there are steroid-like compounds in the mushroom, they're not the ones that they are tested for.

DM: They're not synthetic anabolic steroids that are going to have really serious adverse consequences in the long term.

SF: These are in the natural form with all the cofactors and enzymes associated with it. It's not an isolate or a concentrate. It's an entirely different action, like you said, these concentrate anabolic steroids. They definitely have profound effects on animals as well with dogs and cats particularly elderly dogs, you know, their joints starts to go. Their hips start to go. We've had a number of people say they start feeding the animals a daily dose of this and they're like a puppy again.

DM: I'm curious if you'd had any feedback with respect to the dosing and the cycling because in some supplements it's more like a food and you need to take it everyday and others you need to pulse it or cycle it because you can develop a tolerance to some of the benefits. I'm wondering if you have seen any of that with this product.

SF: Excellent question. In traditional Chinese medicine which is basically the source of our knowledge of mushrooms. It's basically been recently borne out by the scientific inquirer saying that yeah this did work for this conditions and this is their mode of action.

In Chinese medicine these mushrooms are regarded as tonics and tonics being something that has a beneficial effect across several systems of your body. It's a non-specific effect, kind of a general beneficial effect. The effects do not decline over time. There are no toxicities or resistance builds up to them. You basically take what you need and leave the rest. If you take a massive dose of these mycelial products, you're not going to overdose on them. Your body will take what it needs out of it. You can't overdose.

Typically when we have people starting on on these products for the first seven to ten days we recommend a double dose of it kind of to load your system and thereafter a

moderate dose of one to a couple of grams a day. It's all that's needed. When you're talking about the isolates of mushrooms, the active ingredients, you're talking about milligram dosages. If you're talking about the raw whole food…

DM: Whole food equivalent essentially.

SF: Anywhere from 1 gram up to 30 grams for very severe cases of cancer cases. People are taking relatively massive doses of it and have had phenomenal effects. Typically, 1 to 2 grams is enough as a tonic effect taken on a daily basis. Generally a couple of times a day more or less on an empty stomach. You can't take it with food in conjunction say with a smoothie or a light meal. This is in contrast to a lot of herbal products.

Echinacea is one that's used for an immune function. That's one that really there are some toxic (indiscernible 42:55). You should only take it when you're sick, while you're sick and when you're recovering because otherwise there are some toxic aspects. Not so with these medicinal mushrooms. One of the most famous ones Reishi, the Chinese call it the mushroom of immortality. They take it every single day.

DM: The devil is in the details frequently so let's go into the details because that will help people understand how to identify a better product if they are interested in obtaining some of the benefits that we just discussed.

Actually, before we get into the devil and the details why don't we just hit another basic area but it's somewhat related to that in that there is a difference between a concentrate, a mycelial concentrate that you mentioned versus a whole food process. With the whole food, you're going to get aspects – I'm wondering if you could comment on this – that serves as a prebiotic.

Because one of our basic premises and really one of my foundational beliefs is that most our health is related to the health of our gut. Even eating sugar – yes it has some negative biochemical effects but really one of the primary ways is that its most significant effect on us is it disturbs the gut flora. It causes the growth of the anaerobes, the pathogenic fungi, the yeast, that shouldn't be there and it really doesn't nurse the growth of the beneficial bacteria.

I'm wondering if you could explain to our viewers how the whole mushroom unlike the concentrate actually serves as a prebiotic to improve the beneficial bacterial growth and to minimize the pathogenic bacteria.

SF: Good question. Typically, most extracts or concentrates of mushrooms are what are called hot water extracts where they take either the mushroom mycelia or fruit body and they boil it for an extended period of time like six-seven hours to extract these long chain polysaccharides. That generally involves a precipitation with ethanol or methanol to get it out of solution, to be able to collect it. What you get basically is a concentrated

form of these beta glucans. But the enzymes, the proteins, the amino acids, the dietary fiber, mostly the antioxidants, they are either denatured, destroyed or simply discarded.

While you do get a very concentrated amount of these – generally, they also try to purify it to get them down to a minimum of variation then they can standardize it. When they do the research they limit the number of variables and they can come up with a good research paper and then it segues into basically you're going into a pharmaceutical sort of licensed drug. Not to say that those aren't valuable products. In extreme cases of advanced cancer, tumors, all sorts of things, that is a very appropriate thing.

DM: It could save your life.

SF: It can save your life. Particularly as a complimentary therapy. It's generally how they are used not so much on their own although some people choose to do that but a lot of times they are in relation to chemotherapy and radiation therapy for cancers. They provide some synergetic aspects and also lessen the side effects.

If you're in a reasonable state of health and you're looking to maintain that health and optimize your health, I really think more of the raw stage of the mushroom. Basically, it's a tool chest of chemicals that you can introduce to your body. Basically, it's participatory healing. That's one of the phrases that mushrooms in the (indiscernible 46:47) these are host mediated responses meaning that it interacts with our system as opposed to having direct effects.

There are direct antimicrobial, antiviral, antibacterial effects to some of these (indiscernible 46:49) as well because that is part of their arsenal when they are competing in that world of rotten and decomposition in the natural world. Primarily the overriding effects to our immune system are these host mediated response potentiation of our existing strategies to deal with infections and what not.

So when we consume these full whole food products, a big component of it when you talk about digestive health is dietary fibers. There are some very unique structures to these fungal dietary fibers that function basically as prebiotic platforms for the growth of the probiotic organisms in our gut. Mushrooms they are high in dietary fibers and in the mycelium. And in addition, when we grow it on a grain and oat, it brings its own functionalities to the process as well.

DM: There may be some confusion to our viewers in that you mentioned dietary fiber. From my understanding there is a pretty radical difference between the fiber from a mycelium and the fiber from a plant. It has to do with the surface serving as a better platform for the growth of probiotics. I'm wondering if you could expand on that.

SF: That's kind of a new area of research. They are sort of looking at it. There has only been a couple of research papers that had looked at that but they did find some unique aspects to that. Particularly when you think dietary fibers you think from the plant world like psyllium and things like that. I think adding a fungal dietary fiber to your diet there

are some definite benefits to that added as well from the botanical sources of the dietary fibers.

Mushrooms, their cell wall is made up of chitin one of the most abundant – next to cellulose, I think the most abundant natural thing.

DM: I think it serves as the exoskeletons for insects, doesn't it?

SF: Exactly. The exoskeletons of insects and of shellfish and what not. Basically, it's a sugar. It's a polysaccharide sugar but the bonds are difficult to break. In our products we grind to a very find particle size which facilitates the digestion of that.

That's one of the arguments for the use of extracts to get polysaccharides. You can assimilate more of them by extracting that from the chitinous cell wall. It's still available to chitin in the cell wall. It's only a part of the cell wall. There is also the cytoplasm where there are beta glucans in the cytoplasm. Unless you're in a severe medical condition and you need a concentrated and isolate, I think it's better letting your body decide what it needs and participate in the healing.

[----- 50:00 -----]

DM: Another important reason why we really want to go for the whole food rather than the concentrate for most cases. I'm curious as to percentage wise because I certainly have no idea. Of the mushroom products that are out there and available for individuals, what percentages are these isolates versus the whole food concentrate?

SF: Good question.

DM: Just a rough ballpark. Is it half? Is the minority, the majority?

SF: I would say maybe – at least the ones that are marketed that have a big scientific backing to it and a large marketing to it, they tend to focus on stuff that they can proprietary sort of preparations of it. If you take in a natural mushroom, you know, anybody can grow that mushroom basically so there is less proprietary (indiscernible 51:33) property

DM: So there are some marketing benefits. What your guess is the majority of mushroom products available to the individual is going to be the isolates.

SF: Yes. At this point.

DM: It's really more like a drug. Even though it's a natural drug, far less side effects and almost all beneficial, it's still a drug. I'm a strong believer in a food based approach, whole food base especially. That's why people can use as an example, an analogy, branch chain amino acids which are very powerful and useful especially for building muscles when you're doing strength training exercises.

I'm not too thrilled with using isolated branch chain amino acids. I think they should be obtained from food sources because then you get the whole balance then you prevent the risk of developing complications from having them in abnormal ratios. So similarly, I think it just makes all the sense in the world to go for a whole food concentrate versus an isolate.

So if you're interested in mushroom products the strong recommendation is why don't you look at least the 1/3 or even less of the products are whole food and kind of forget about the isolates because that's where it's going to be.

Let's take another step forward. Another differentiating factor that people can use to find out a higher quality source would be looking into the details of the solid state fermentation that you referenced which has been available for about 40 years. You mentioned that your company uses this fermentation with organic oats. Can you relate to how the rest of the industry or most other producers use it and I think they use sawdust or what is being used? I am unclear on that. Just educate as to the differentiating factors here.

SF: Sawdust is used in commercial mushroom production as an inoculant to grow a crop basically.

DM: The mycelium.

SF: The mycelium to inoculate. Typically the producers of mycelial product for dietary supplements use rice as a substrate. I think that kind of evolved out of – most of this evolved out of Asia where obviously there is a lot of rice there. These mushrooms are in nature by large wood decaying mushrooms. Their bread and butter so to speak is cellulose, lignins, very difficult. They are sugars but in very resistant structural forms.

DM: There are not a lot of those in rice.

SF: Not a lot of those in rice. It's starch, carbohydrates, some protein. We chose oats with the whole intact because the whole has some cellulose and lignins in it with the carbohydrates and the starches embedded inside in the protein. The mushroom has to express more of its metabolic enzymatic pathways to access the easier to digest materials. So we found we get a more balanced, diverse product.

Mushrooms they are kind of conservative. They have a big arsenal of biochemical metabolic pathways in their hip pocket that they really only bring to play when they need to. Because who knows what they are going to encounter in their environment whether it's a pathogen, a toxin associated with their food source. They have to have a lot of tools to deal with it.

DM: I think it's like all life forms including humans. We're all pretty fundamentally lazy. We don't want to exert anymore effort and energy than we have to.

SF: Right. There is conservation of energy.

DM: Most of us with the intelligence recognize that we need to do that if we're going to stay healthy in the long term. It's an intellectual expression. But for primitive life forms, they're not going to be doing that unless they are forced to.

It's interesting that you made that decision. I think it's really easy for people to understand that. How could you possibly have something healthy produced from an organism if you don't give it all the proper food that is required just like for us? So you gave it some of this essential substrates that it was designed to have so it can express more of what it was put to.

Could you differentiate for us the percentages in the industry of how many are using sawdust versus the traditional Asian rice versus the oats?

SF: Another differentiator is the number of products and companies that are doing fruit body based products versus the mycelial stage. Sawdust nobody is using too much. A lot of the products out there – as opposed to solid state fermentation are done in what is called submerged fermentation where they take these giant bioreactors, stainless steel. They fill it with a liquid nutrient broth so to speak generally chemical synthetic in nature. They sterilize it. They introduce aseptically a culture and then with agitation and bubbling, they basically grow these globs of mushroom tissue in these bioreactors that they are later able to separate out.

A large amount of the product coming out of China is done in these bioreactors and they are submerged fermentation. I think a solid substrate is a better substrate for mushrooms to grow on. It's more their natural sort of thing. There are spaces for air.

DM: So you can grow the mycelia in there too, in these liquid ones?

SF: Yes. That's what they do, they grow the mycelia.

DM: I'm trying to understand, help our viewers understand what percentage of manufacturers are using this liquid versus the more natural whole food approach?

SF: I would say half maybe.

DM: So half?

SF: That's out of the top of my head.

DM: So it's about 50/50.

SF: Yeah.

DM: You haven't done a comprehensive analysis of the industry but about. I mean there is a fair number of people who are using this. That's another tool or question that people could have when they are looking for these products is to make sure that it's a whole food based one. You're probably more than likely even though rice isn't ideal, it's probably better than these liquid ones.

SF: Yes.

DM: So the submerged technology. Solid state fermentation is superior to submerged technology in growing the mycelia.

SF: Yes. Particularly if you're looking for a complex matrix of nutrition and bioactive compounds. The submerged fermentation tends to be the companies that are focused on getting isolates out of it. That tends to be where they're looking at individual active compounds that they can extract which is their preferred methodology.

DM: Which is the 70%. Most of these, many of these products that are using the submerged technology probably are using the isolates versus the whole food approach.

SF: Correct.

DM: Because it makes more sense. It's more economical.

SF: It's really more complicated to separate their item of interest.

DM: And it's more of a drug based approach anyway which there are some benefit to that clearly but if you want a comprehensive beneficial effect it would seem far more valuable to take the whole food approach.

SF: Yeah.

DM: So within the whole food approach, what percentage are using the rice versus the oats?

SF: There are few other grains that some people use. Some use rice, some use millet, some use milo.

DM: Those are all better than rice more than likely if they use the whole grain.

SF: There is some aspects to the rice that are intriguing particularly enzymes and breakdown products of it. They have identified some bioactive compounds. I think if much attention and research was done with oats they would find similar sort of things.

DM: But the bulk of the science was done in Asia.

SF: Exactly.

DM: That's where most of the research is done.

SF: Exactly. They grow very strongly on the oats. Oats bring some things of their own too. There is beta glucans in oats as well that are more of a linear structure that have an impact on our immune system that carries through despite the fermentation and they bring some additional L-ergothioneine and antioxidant to the product. Oats basically have better nutrition than rice as well. If you look at the amount of protein and B vitamins. Nutritionally, oats are superior to rice.

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DM: So you could have used any of these grains yourself. But you picked those for that very specific reason because you could use rye or some of these other grains but you chose oats for the reasons you just mentioned.

SF: Yes.

DM: Another point of differentiation in addition to finding isolates versus whole foods, submerged technology versus solid state fermentation, and then the type of substrate that is being used in solid state would be what they are actually using in the product. The two broad options are the whole fruiting body what we typically think of eating mushrooms when we think of mushrooms versus the mycelium. What percentage of the products are using the whole fruiting body versus the mycelium?

SF: I would say a little more weighted on the fruit body end of things. It's primarily again from I think the Asian influence of it. Research wise, looking into the effects of these mushroom things, if you do a Google search on Pub Med and look at medicinal qualities of mushroom fruit bodies versus the mycelium, you get more hits on the mycelium end of it. There is more research directly with the mycelial stage of the mushroom by far than the fruit body stage.

DM: It's just because that's where the benefits are or this is the emerging area of evidence or because of the way it started in Asia?

SF: There is a couple of reasons for it. One is that growing the mycelial stage of the mushroom it's easier to standardize it and keep it contained. When you take it to the fruit body stage basically you have to open it up more to the environment and there is more variation. Between individual mushrooms and clumping material, some of them come out very big, some small. A lot of times they'll pick successive flushes of the mushroom. So depending on which harvest of the mushroom (indiscernible 1:02:06) fruit body. There is a lot of variation that comes into effect.

Also, it's opened to the air to airborne contaminants both biological and industrial contaminants. It's much more difficult to control the product when you're taking it to the fruit body stage. That's one aspect of it. And particularly now with the rampant pollution

and even more recently the fear of radioactive (indiscernible 1:02:35) might have fallen into the air, have been able to contain it, grow it in the laboratory with filtered air in a filtered bioreactor. Basically you can ensure that it's not contaminated either biologically or with heavy metals. That's a really big factor to consider with mushrooms because they can bioaccumulate both beneficial minerals and also toxic metals. If there is ever a case made for consuming the organic product, mushrooms are at the top of that list. You want to try to find an organic mushroom if possible.

DM: Some of the commercial producers don't have organic mushrooms?

SF: Correct. They're not certified.

DM: That's another factor that you can look at.

SF: Yes.

DM: I'm wondering with respect to – it would seem if someone was viewing this whole video they would probably easily reach a conclusion that there is more than likely some benefits to consuming the mycelial stage of the mushrooms grown to the way that we just discussed.

If one is making that commitment, I'm wondering if you can comment on the synergy, again, kind of focusing on the whole food component of consuming the fruiting body in addition to the mycelial stage. If so, what are some of the recommendations you might have for someone choosing a whole food healthy organic mushroom fruiting body?

SF: Again, trying to find one that was organically reduced because of the factors of possibly heavy metal contamination. The common button mushroom is an excellent source of nutrition. It doesn't have the sexiness of these relatively new gourmet species to the American consciousness but it's an excellent food source.

Maitake is a very excellent mushroom for people to try. It is produced right next to our facility in Southern California. There is a place that produces organic Maitake mushrooms that's an excellent mushroom. There is a king trumpet mushroom out there that is also an excellent mushroom, excellent (indiscernible 1:04:54) mushroom. They should expand their repertoire of mushrooms that they are trying. Shiitake is an excellent one. It's well known.

DM: Is there a place where one would purchase these? Does your typical grocery store have them or are there specialty shops that one would frequent? Where can you find a good source?

SF: The national chain stores are starting to carry more and more species of them particularly now since they have developed some new technologies for packaging these mushrooms. A lot of these mushrooms the problem was particularly the Maitake is it didn't hold up (indiscernible 1:05:22). It's a very fragile leafy sort of species that doesn't

hold up well to shipping. A lot of times by the time it got to the store, it's a crumbled bunch of pieces. Now they have developed this basically modified air packaging where they put it into an enclosed bag that protects it and builds up the carbon dioxide so essentially its metabolism shuts down and you open it up and it's fresh and beautiful. It also provides some protection against mechanical damage.

Now in terms for dietary supplement products people should expand not – many of these culinary mushrooms have medicinal effects. There are also many non-culinary mushrooms you would never think of cooking for dinner that have very profound medicinal effects. These mushrooms are either very bitter or they are very hard or very woody. You just can't eat them as a culinary item but by virtue of their biology and the compounds they contain that they are very valuable additions to our diet.

Things like the Reishi mushroom, the Cordyceps mushroom, turkey tail, there is a lot of non-coloring mushrooms that they should look to incorporating because you really can't eat it in the fruit body stage. You can but you do it basically as a tea, as a hot water extract. You can eat the mycelial stage and get some of the benefits with all the compliment enzymes and proteins that would be denatured by a hot water processing.

DM: So there area additional benefits for eating the fruiting body that you wouldn't get from eating the mycelial stage?

SF: And vice versa. There are some compounds that have higher concentration in the fruit bodies. There are some that are in higher concentration in the mycelium. Combining the two stages I would recommend it. That should be a good portion of our diet.

DM: How would one consume a non-culinary mushroom?

SF: Basically in a powdered form either in a pill…

DM: So you buy it as a supplement.

SF: Buy it as a supplement or as an extract, as an isolate, isolated components or they are sometimes available in tea bags where you brew a tea out of them. We like to do it as a food that you would add it to either the smoothie. I drink my mushrooms with my coffee in the morning. I mix it in. It's not totally soluble but it gives me a good way to start the morning.

DM: Does the higher temperature that you might encounter in boiling water tend to denature some of the beneficial constituents?

SF: Yes and no. The proteins and enzymes yes but it also tends to make some of the polysaccharides more available. It's a balance. Moderate amount of heat it can be recommended. The fruit bodies particularly they should not really can be consumed

raw. It's better to eat the fruit bodies in a cooked stage. There are some sensitivities to them and basically it just makes them more digestible.

DM: Are there any other tips for cooking mushrooms that you might have or preparing them so they are more edible or tasty?

SF: Just to eat more of them. They are so versatile. You can eat them in anything. People when they think mushroom, they think steak and mushrooms. In the United States our annual per capita consumption of mushrooms is a little about 4 lbs a years. In parts of China and Japan it's 20, 25, 30 lbs. Even Canada has twice the consumption of mushrooms that we have. Mushrooms should be a bigger part of our diet.

DM: We are mycophobic.

SF: We are mycophobic. We need to be mycophillic. We need to be mushroom lovers. They are our allies and nothing to be afraid of.

DM: Terrific. I thank you for expanding our knowledge on this important health resource. Are there any other closing comments you would like to leave our viewers with?

SF: I think I touched on a lot of stuff. I would like to expand more but I think I'm going bore people.

DM: One of the things that we can talk on about actually is sort of maybe the hidden elephant or the obvious elephant in the room would be the issue of the magic mushrooms, the ones with psychoactive elements to them. I wonder if you can comment on that.

SF: As a mushroom grower, I get that all the time. When they say you grow mushrooms they always assume I'm growing magic mushrooms for some reason. Mushrooms are magic not for the reasons a lot of people think.

[----- 1:10:00 ------]

The psychoactive mushrooms, the Psilocybin species and related species they have been pretty much demonized for at least four decades. It's only recently that researchers have had access to start working with it again. They found that they are very useful in the treatment addictive behaviors, posttraumatic stress disorder, cluster headaches, migraine headaches, and combined with therapies.

The (indiscernible 1:10:26) thing to me about it was that how they can have such profound effects on our cognitive and perception yet so far there is no neurotoxic effects to it. It's kind of (indiscernible 1:10:39) the way when we consume it not for their psychoactive effects but for their other physiological effects, profound effects to our

system without any of the contraindications or the negative side effects. That still amazes me. If something can be powerful but have no downside to it. Basically they are not finding the (indiscernible 1:10:56) that's why they use them as tonics everyday.

DM: But for the most part the typical person is not going to be purchasing this in their grocery store and have it widely available because it is an illegal substance.

SF: Yes. They are an illegal substance and I don't recommend to use them but under therapeutic guidance and in a controlled setting particularly like end-of-life counseling people have been in stage 4 cancer that are afraid of dying that they have basically profound experiences and they come to peace with their situation in their life. It's been a great boom to many people suffering from conditions. Mushrooms, they are an underappreciated kingdom of life.

DM: There are appropriate uses for narcotics. There is no question and certainly in severe pain or in end stage disease, terminal diseases. We want to make life comfortable in the transition as peaceful as possible. This would seem a useful tool.

But with respect for those of us who are still alive and not having to struggle with that at this point, it seems there is enormous value for the mushroom specifically the mycelia. If someone is interested in that, we just sort of summarize the approach that would seem to be useful would be to look for a whole food concentrate or the mycelia versus the fruiting body although the fruiting body is beneficial and it could be used synergistically. But if you had to choose one or the other, more than likely certainly most of the research supports the mycelial stage.

And the whole food concentrate versus the isolates and then within the methods of producing them, you want to make sure you're not using the submerged technology which is typically a bunch of synthetic isolates and not really ideal nutrition for production versus the solid state fermentation. And within the solid state fermentation it seems to use a natural substrate like oats as opposed to rice. I think that sort of summarizes it.

You should do your homework. There is a lot of companies out there. You're just certainly one of them and I'm sure there are others. If you use those guiding principles and you have the knowledge, the skills, the understanding to make an intelligent informed choice because (indiscernible 1:13:18) information is not really easy to acquire. Really, there is only a few people who understand all the details so that you can really make a knowledgeable informed choice.

I thank you for providing us with this knowledge, this information, the wisdom that you have acquired over three decades to achieve that level of expertise and use that to help us really push ourselves to a higher level of health and wellness so we can have more tools to help us take control of our health.

SF: I appreciate the opportunity to talk about mushrooms. I really appreciate this opportunity.

DM: Thank you.