Carbohydrate Structure and Function Introduction

Transcript

Hello and welcome to our Institute of Nutritional Endocrinology's presentation on Macronutrients. Today we are going to be talking about *Carbohydrates*, their *structure*, and their *function*. I am Dr. Ritamarie Loscalzo and I have a lot to share with you.

Before we begin let's just say that the presentation is not intended to replace a one-on-one relationship with a qualified healthcare professional and it is certainly not medical advice. It is just a sharing from my knowledge base, my clinical experience, and my research. I am going to encourage you that before making any decisions based upon what I am sharing with you that you verify and bounce it off of your own ideals. And if there is any medical practitioner that you are working with make sure it is consistent and sound advice given your health condition.

The topic of our conversation is actually the macronutrients, those nutrients that we need in large amounts in the body. So far we have discussed water, fat and protein. Today we're going to tackle carbohydrates.

Carbohydrates have had a lot of press over the years with the advent of not only low carb diets, but the paleo diet so we are going to go through and just talk about what really are carbohydrates, the importance of carbohydrates in the diet and in the food chain, and how you can work with your clients to help them to optimize their intake of carbohydrates for their best health.

What we are going to be covering in this presentation is ‘what exactly are carbohydrates?’ We will introduce you to the family members within the carbohydrate family. What are the various and sundry what’s called saccharides in that family. What are the food sources of the carbohydrates, the good, the bad, the ugly, those that you should be encouraging your clients to use, and those that you should be discouraging your clients from incorporating their diet.

We will look at the concept of refined versus whole carbs; how to know which carbohydrates will be best for the individual you are working with. We will talk about therapeutic diets that are related to carbs, and there are a number of them.

I want you to understand what they are and when you might use them with your particular clients.

Finally, we are going to look at how to determine what is needed for each of your clients. Do they need a low carbohydrate intake? Do they need medium? Or are they in a position where they actually need a high carbohydrate intake?

It is very individual and very personalized and I want you to be in a position where you are not working from a set of dogma or "religious" set of rules related to diet, but you are actually looking at each person's individual needs and modifying their dietary intake and making specific recommendations based on those needs.

Let's get started by talking about exactly what are carbohydrates. Here is where we will get a little geeky and go into the actual biochemistry and the molecular structure of carbohydrates, so you get a sense of what they are and how they fit in to the human body and to the diet, and how you can use them with your clients to achieve optimal health and optimal carbohydrate intake. We start at the core of all carbohydrates, is the sugar molecule.

As we look at the sugar we will look at the three types of possible sugar molecules that can start the process going. Each of them is a six-carbon sugar. They are arranged in a particular structure. The one that we are looking at right now is glucose. There are six carbons but only five of those carbons are around the outer ring. One of the atoms in the outer ring is on oxygen. The sixth carbons sits on the carboxylic group off of the leftmost top carbon. We will be looking at these, what they are, and talking about it so you get a full understanding of what makes up a carbohydrate.

To reiterate it is a large molecule that consists of carbon, hydrogen, and oxygen atoms. They are usually in the ratio of hydrogen to oxygen, 2:1. You can see as you go around this carbon ring, you've got attached to each of the carbons two hydrogens, except in the case of the one that has the carboxylic group. When you express it in terms of a sentence structure, you have this carbon and then the number of carbons. That we look at it as H2O, which is actually water and then a number of those.

If we look at the formula that way, glucose is 6 carbons, 12 hydrogens, and 6 oxygens. They are sometimes referred to as hydrates of carbon meaning water attached to a carbon.

Carbon with H2O. It is the carbon that is surrounded by the water basically, so H for the hydrogen, a carbon, then an O and an H.

Carbohydrates are also known as saccharides. A saccharide is another word for sugar. A monosaccharide contains one sugar. A disaccharide contains two sugars. An oligosaccharide, which is a short change of saccharides, contains anywhere from 3 to 9 sugars in general. You may see a little variation in that. Polysaccharides consist of many sugars. Those are more your complex molecules like your starches.

Now let's take a look at the function of carbohydrates. What actually do they do in the body? Are they evil things that they are made out to be by low carbohydrate aficionados, or do they actually have a function in the body? Like everything else the human body is designed with a grand plan and I believe there is actually very good functions for carbohydrates when they are used properly. Carbohydrates are used for energy. Glucose molecules are what goes into the Kreb's cycle which we talked about in cellular metabolism.

Glucose goes in along with oxygen and a number of different nutrients, and that is converted into ATP to make energy for each and every cell into the body. They are also used for fiber for intestinal function. We have a variety of different types of fiber: we've got soluble fiber and insoluble fiber coming from different sources and they are usually from carbohydrate sources. They spare protein for use as energy. Protein can be used for energy. There is something called branched chain amino acids, which we learned in our protein module, and that can be used as energy. But if we are using it as part of the body, if we are using muscle to break down to convert into energy that is not a good thing. When we have carbohydrates that helps to spare the protein for use as energy.

Another function for carbohydrates is as transport for proteins, and other cellular recognition processes. Let's take a look at the different types of carbohydrates that you might find in foods, and help you to guide your clients into choosing the carbohydrates that are going to be best suited for their bodies. Simple carbs are those that provide a quick burst of glucose into the system. They are very easy to absorb and very quick to break down and create sugar in the body.

There are a number of common foods that contain simple carbs. For the most part we want to guide your clients away from the simple carbs into more complex carbs, which are going to be longer chains, and also include things like fiber and other nutrients to help them to be slowly absorbed into the system.

There are possibly times when you need to get some kind of simple carbs into the system. That might be in the case of say, a diabetic who has over taken insulin and their sugar level has dropped way too low and they have started losing cognition and consciousness. Other situations where simple carbs might be effective are for quick bursts of energy when someone needs it say to complete an athletic endeavor. For the most part simple carbs are not desirable and not things that you should recommend that your client takes into their body.

What are some of the simple carbs? The obvious is sugar. We think about sugar being table sugar, which is actually sucrose. It could be fructose. It could even be some of those sugar substitutes that are considered healthier. For example honey, maple syrup, and things like that. There are also particular foods that people eat that may contain sugar. One is candy, which just contains a lot of sugar and nothing else generally. Oftentimes it is some artificial coloring and flavoring and sugar, basically glorified sugar.

There are a lot of drink powders that contain sugar. In addition to the obvious like Kool-Aid and some of the commercial garbage powders that people may want to drink, you've really got to be aware and help your clients to choose properly from the myriad of protein powders and energy drinks that are out there because a lot of them contain simple carbs in the form of various sugars.

You've also got anything that is white flour, white flour anything. Typical are crackers, cookies, pizza crusts, and cereals. These are abounding on the shelves and a lot of them are very deceptive. People need to learn how to read labels to determine what is white and what's not. People are under the misconception that whole grains are a lot more nutritious than white grains when it comes to flour, but in reality white flour is only a little bit worse than whole-grain because of the rate of absorption.

Yes, the whole-grain does have additional nutrients, which makes it better but in general they are still relatively simple in terms of carbohydrates meaning that they get into the cells and turn into glucose relatively quickly. Your job is to teach people how to read the labels so that they can differentiate white flour from something else. An example of that is something that says ‘whole-wheat’ bread. People say okay, it is made with whole wheat and whole-grain goodness.

When you actually read the label you will find that the very first ingredient might be wheat flour or rice flour.

If it says wheat flour or rice flour without the word whole-grain or brown rice, then that is going to be a simple carbohydrates, a white flour products, which is completely devoid of the nutrients other than the sugar for the starch which gets quickly broken down into sugar.

This is where you can really educate people as to how to read labels. In general, I recommend people mostly stay away from flour products even if they are whole-grain, but there are situations where they can be made more nutritious and the absorption slowed down.

White rice or white anything, and again there are so many gluten-free products on the market that are loaded with white rice and people just think they are healthy. Again reading labels is important, and when you are reading a muffin for example and it says rice flour, that is a refined carb, which is a simple carb. That is not a whole grain and it is completely devoid of all the nutrients that are in the brand and the germ of the grain.

The last on the list of simple carbohydrates would be flour products. Flour products are all around and especially in the advent of so many people going gluten-free, there are a lot of flour products that are gluten-free flour products that people think are naturally a healthy alternative, but in fact they are just loaded with simple carbs. Just as a quick aside, when we take a grain, which is a complex carbohydrate loaded with strings of simple sugars bonded together, plus fiber, plus vitamins and minerals, we have a complex product.

When we take away the bran and the germ, most of the nutrition is gone. You start with maybe 20 different nutrients in this complex carbs in the form of a whole-grain and you get it down to maybe three or four. Then the food manufacturers will fortify meaning they just add some synthetic vitamins and minerals to the product. So you take this whole-grain and you strip it away of all of its nutrition, and then you add some synthetics back.

This is not health food, by the way. This is not health food in spite of the fact that it may be fortified and they say it contains all of these nutrients. This is probably stuff you already know about but it serves to be reiterated because I see a lot of people who eat a purported healthy diet who are including a lot of the simple carbs and they are not even realizing that these are problematic.

When we look at complex carbs there is a number of products that come to mind. Let's take a look at what those are. Legumes. These are the bean family and that includes things like garbanzo beans, kidney beans, and soybeans.

These are complex carbs – the sugars isolated from the complex molecules very slowly because of the presence of a lot of other nutrients in there, vitamins, minerals, and in the case of legumes, a fair amount of protein and some a little bit of fat, but not a whole lot. You can see the process of taking a legume and turning it into sugar, is going to be much more slow and gradual than the process of turning sugar or flour into the sugar.

Whole-grains are complex carbs. While they tend to be more quickly absorbed and broken down into sugar than legumes, for some people, certain whole grains, especially the non-gluten whole grains like millet, quinoa, teff, and amaranth, can actually be good additions to their diet but you are going to have to identify for each person what that is. You can easily do that.

We will be talking about this later in the presentation, by having your client get a glucometer, a glucose meter, and measuring how quickly their sugar goes up after the consumption of particular foods and food groups. We recommend you do that with people who you suspect have at difficulty with sugar regulation.

Nuts and seeds have complex carbs. They do not have as much carbohydrate as say, legumes and grains. Nuts and seeds do indeed have carbohydrates. Nuts and seeds tend to be a lot higher in fat, which will extremely slow down the absorption of those carbs. So where you might be able to take a food that has 5 grams of carbohydrate that is in a legume form or whole-grain form versus a nut or seed, or a portion of nuts or seeds that might have 5 grams of carbohydrates, the absorption is going to be very, very different because of the fat which is going to slow that down.

Vegetables are complex carbohydrates. We do not think of them as carb foods, like the green leafy vegetables and low starch vegetables, but they indeed have complex carbs. They have a lot of fiber and a lot of cellulose and a lot of vitamins and minerals. That actually slows down the absorption of sugar into the bloodstream and also facilitates the movement of the sugars from the bloodstream into the cells where they get converted into glucose.

I will take an aside to say that when you are juicing vegetables and you remove the fiber you make the sugars much more readily available. For some people, even vegetable juices without the fiber can raise their blood sugar relatively rapidly. In any case it is a really good idea to test. Sometimes vegetable juices can be slowed down by the addition of soluble fibers like Chia seeds and ground flax seeds or something like that to slow that down.

Another carbohydrate-containing food that is considered a complex carbohydrate is fruit. Fruit, while much more quickly absorbed and converted into sugar than are legumes, grains, seeds, or vegetables, fruits actually contain a lot of vitamins and some minerals and a lot of fiber that slows the absorption down. Again, we are talking whole fruit versus fruit juice, which is very quickly absorbed and turns into sugar right away, and is not recommended except, in very rare circumstances.

Also fruit purées: if you make a smoothie and it is purely fruit and not a lot of greens to slow it down, then again we are getting into more of a very rapidly absorbed complex carb. Even though it is considered complex because it has the nutrients, it actually is treated more like a simple sugar in the body.

Tubers and root vegetables, these are higher in sugars than are the the non-starchy vegetables like your greens, but they are very complex in that there is a lot of fiber and a lot of cellulose which is going to slow the absorption down. What we find if there is a big difference between the rate of absorption of the sugar in root vegetables between cooked and raw. In the raw state the sugars are very firmly attached to the fibers and are much more difficult to break apart by the body and requires enzymatic action, whereas the heat actually breaks down some of those fibers and makes the sugars much more readily available.

If you start to do some glucose testing with your clients you are going to find out that they may be able to take raw carrots in and have their glucose go up only a little bit and very slowly, whereas if they eat cooked carrots the sugar can go up very rapidly. Again, juicing the root vegetables, which is a very common practice among "health food circles," is not a good idea for people with blood sugar issues, and should not necessarily be drunk alone without some of the extra fiber. That is, again, something you will have to determine for each and every person.