

Presenter: Dr Christopher Thompson - 2016

Title: *Deficiency to excess: It's all about the dosage - (12:07)*

<i>Time</i>	<i>Dialogue</i>
0:09 00:32	Giddy folks. How are you going? My name is Chris. I'm a physical chemist by trade. So I did my PhD in spectroscopy. Looking at lots of small molecules from the atmosphere and some astrophysical molecules but I'm also a really passionate educator of chemistry. So I was going to talk to you about something that is very close to my heart, and I think it is very close to everyone's heart and that is food and the chemistry of food. And what we will talk about today is cupcakes. Something nice and simple. Something we all like to eat. Let's go back a step. OK we are bombarded with messages in the media about the kinds of things that we should and shouldn't be eating. We should be eating more of this. We should be eating less of that and a lot of that is not based on good science. But even the experts disagree on a lot of the key points.
01:01 01:31	So what I want to take you through today with a cupcake as my subject is the basic chemistry of food. Ok what are the atoms and the molecules, the chemicals and they are chemicals. There're natural but they are still chemicals. What are the chemicals that we are putting into our mouths to sustain us? So my thesis that I am going to prosecute is that "We cannot live on cupcakes alone". There's a biblical line yeah? Man cannot live on bread alone. So I'm just giving my own personal spin on it. So let's talk about it in terms of energy. OK so we consume food for a number of reasons but one of the predominant reasons is to energise our systems. So here we've got a scale of zero to one hundred % and the Australian dietary guidelines which tell us how much food we should be eating and the different types of food. The different types of chemicals.
01:56 02:30	So if we break that down the biggest contributor is carbohydrates . It's about 60% of the food that we should be eating should be carbohydrates. The next 30% of the energy we get from food comes from fats and oils, often what we call lipids . Now that might seem like a lot in the first instance but bear in mind that fat or fat molecules have gram for gram almost twice as much energy as say carbohydrates. So what we are really saying is you should probably be eating six times as much in terms of mass of carbohydrate than you should be eating of fats and oils. We've got protein making up the last 10%. So protein comes from all manner of sources. We often think of protein as meat but it is much more than meat. It comes from vegetable sources as well.
02:43 03:19	So let's break down the cupcake and testy out my thesis on whether or not we could live on cupcakes alone. Let's start with carbohydrates. In my cupcake recipe we are running at about 70%. 70% of that energy you would get from eating the cupcake is coming from the carbohydrates. Now I know what you are thinking. What sort of carbohydrates? Yeah? The elephant in the room here is that there are all sorts of different types of carbohydrates and some potentially worse for our health than others. So carbohydrates are typically broken down into complex carbohydrates. We are talking about starch, cellulose, dietary fibre. We also have the sugars. So with the sugars we've got glucose, fructose and sucrose. That's just to name a few but they are probably the three main sugars that we are consuming in our diet. Now it's the sugars that we need to keep an eye on. It probably should be limited to about 15% of the energy needs.

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03:50 04:22	This molecule here is sucrose and you would be pretty familiar with this. This is the stuff you sprinkle on your cork flakes. Actually this molecule is composed of one glucose molecule and one fructose molecule put together. So how much sucrose is in my cupcake? It's running at about 50%. OK. So it's not looking good in the first instance. This is really important. Sucrose has very clear links to the obesity epidemic which in itself has very strong links to type two diabetes. It's very strongly linked to tooth decay and there are more tenuous links to heart disease and cancer. OK. So we absolutely have to be limiting the amount of sucrose we have in our diet. With one caveat about sucrose. It gets a lot of bad press but bear in mind we get it from nature. We get it from sugar beet. It's the predominant sugar in pineapples and pears. Ok, it's completely natural. We just have to limit how much we consume.
04:49 05:21	So fats and oils. Before sugar was the bad boy on the street, it was dietary fat that was getting all of the bad press and absolutely we should be limiting how much fat we consume as well and the Australian dietary guidelines – about 30% of our diet. So in this case you can see an example of a fat molecule here and in my cupcake recipe it's about 30% of the energy content which is consistent with what we should be having in our diet. So perhaps it's not so bad here? Perhaps? There are different sorts of fats and oils. In fact the two terms fat and oil are the same types of molecules. We call the fats the solid variation. So at 25 degrees, room temperature, if you have a molecule like this and it's a solid we call it a fat. You guys would be familiar with olive oil and vegetable oil? At room temperature it's a liquid. We call those the oils but they are the same types of molecules.
05:47 06:29	They do have structural differences though and you will have probably heard of saturated fats and unsaturated fats. This is the example here of a saturated fat. Now they recommend that you keep your fat consumption, of fats and oils limit to 10% saturated fats. The rest should be unsaturated or polyunsaturated fats. So what about my cupcake recipe? It's got a good dose of butter in it. Yeah, (<i>smiles</i>) butter - solid. About 50% saturated fat. OK so probably not a good sign and this is of course why some people replace butter with things like margarine because it has a higher degree of unsaturated and polyunsaturated fats. And I should like to mention again there is a caveat here. Fats and oils and other sorts of lipids – phosphor lipids, thinking egg yolk is about one third a phosphor lipid. Still a kind of non-polar molecule. What we call a lipid and very important for health.
06:47 07:08	The sterols such as cholesterol, we don't want to higher cholesterol but some cholesterol is absolutely essential for the health of the cells in our body. So it is really important that we do get some fats and oils and so called lipids into our diet. Ok so the remainder must be protein. In my cupcake recipe this final macronutrient of protein is running at about 3.5%. Now we mentioned before that for protein a lot of people think meat. They instantly think meat – that's where I get my protein. There is no meat in my cupcake recipe you will be pleased to hear. OK so where is the protein coming from? It's coming from the wheat flour and the molecules you can see hear is a Gliadin . Gliadin is one of many proteins you get from wheat flour. It's one of the predominant proteins.
07:33 07:58	You have possibly heard of Gluten? A lot of people are intolerant to gluten. So gliadin is one of the two main proteins in Gluten. You can see in this case here that this molecule has many, many atoms in it. So we saw sugar has in the order of about 40 atoms. The fat molecule is getting near to a hundred atoms. Protein molecules you are starting to talk about thousands and thousands of atoms at a time. The other key difference is in contrast to carbohydrates and fats, which have hydrogen, carbon and oxygen; in this case protein also has nitrogen. So it's through protein that our body gets its nitrogen. These molecules are so big that it's not typical that we look at them in that ball and stick kind of picture. We often use these so called ribbon diagrams.

<i>Time</i>	<i>Dialogue</i>
08:24	Now this shows the linear chain of amino acids that proteins are made from. So proteins are really long strings of molecules that we can break down into amino acids. In fact if you zoom in we can see these nice little structures, these little spirals in there and that's where this chain of amino acids sometimes spirals in upon its self with all that secondary structure. This structure is really important for the biological properties that many proteins have. A protein is not just for energy of course. Proteins make up all sorts of biochemical or contribute to biochemical processes. Think enzymes and so on. So many of these molecules are incredibly important for good health.
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09:10	So over 99% of the energy that we put into our bodies is from food types that consist of just 5 elements from the 118 elements available to us in the periodic table. So OK what about the rest? There are a whole bunch of elements that are absolutely essential for good health. Think iron. Iron is at the heart of haemoglobin and really important for pour blood obviously. Zinc, the second most abundant micronutrient as we call these things. Really important in metabolism and processes like that. Calcium really important for bone density. Iodine – 30% of the world's population is deficient in iodine. And it is attributed to a lot of brain disease and brain damage in infants and young children particularly in third world countries.
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10:04	You know New Zealand actually has low levels of iodine as well so they add something like 50mg of iodine per kilogram to table salt. So when you sprinkle table salt on things you are actually getting iodine which is really essential for good health for things like thyroid and so on. How about in the first world, sodium? If anything have too much. Yeah - this talk was titled deficiency to excess. There are a lot of things that we are consuming in excess particularly in the first world and sodium is one of those things. Cobalt – It's the metal at the heart of vitamin B12. This is just eight further elements from the periodic table so there is still a lot that I haven't even mentioned here many of which are important for good health.
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10:27	You probably didn't need me to tell you that a diet of cupcakes alone is probably not a good idea. OK, but yet we yearn for these diets. So you read the popular press. They're constantly talking about these absurd diets – the Adkin's diet . The low carbohydrate, high fat diet is one of the latest ones. The raw Vegan diet – yet we are yearning for these diets, but I put it to you, it's not that complicated. We know what sort of molecules, atoms, micronutrient and macronutrients we should be putting into our body and if you can follow a recipe and bake a cupcake – I put it to you, you can come up with a recipe for the diet you should be consuming. There is no perfect diet. There are all sorts of different variations, but it is basic chemistry people what you should be putting into your body.
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11:36	But I've got some good news for you though, in case you thought I've just ruined cupcakes for you? The amount of energy in one cupcake – in the daily diet about 8700 kilojoules. One cupcake probably about a thousand so I recommend one cupcake every now and then is probably OK.
11:55	Thanks a lot.