



Fructose in the diet – health aspects of sugar consumption

The interview with Prof. Dr. Janin Henkel-Oberländer from the University of Bayreuth is about fructose in the diet. Fructose is considered in the context of various other sugars and health aspects of sugar consumption are highlighted.

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KUestions is a video podcast format produced by the Akademie für Neue Medien (Bildungswerk) e.V. and the University of Bayreuth for the project Ernährungsradar. Experts are interviewed on various topics in the context of nutrition and report on the current state of research. The interview was conducted by Matthias Will from the Akademie für Neue Medien (Bildungswerk) e.V. and Clara Marx a Master's student of Lebensmittel- und Gesundheitswissenschaften (Food and Health Sciences) at the University of Bayreuth.

Recommended literature on the topic

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English translation of the German interview transcript

Matthias Will: Dear listeners, welcome to the start of our interview series as part of the Ernährungsradar project. Two project partners, the University of Bayreuth and the Akademie für Neue Medien in Kulmbach, have joined forces to shed light on various nutritional topics with renowned experts. We, that's Matthias Will. I'm from the Akademie für Neue Medien.

Clara Marx: And I'm Clara Marx from the University of Bayreuth, studying Lebensmittel- und Gesundheitswissenschaften (Food and Health Sciences).

Matthias Will: The focus today is on fructose. And our interview guest is Janin Henkel-Oberländer. She is Professor of Biochemistry of Nutrition at the University of Bayreuth campus in Kulmbach. Welcome, Mrs Henkel-Oberländer.

Prof Henkel-Oberländer: Thank you very much.

Matthias Will: Professor Henkel-Oberländer, which sugar is better: fructose or normal sugar, i.e. household sugar?

Prof Henkel-Oberländer: It's not that easy to say. Perhaps we should first briefly clarify what normal sugar is? Because I don't think that's always clear and the terms get mixed up. Sugars are carbohydrates. Carbohydrates include complex carbohydrates, which also include starch, for example, which are polysaccharides. And then we have mono- and disaccharides, which consist of one or two building components, and of these individual building components there are basically exactly three. Glucose, fructose, i.e. fruit sugar, and galactose. These also occur freely in food, but in small quantities. They are usually contained in the disaccharide form, i.e. always two building components together. And if, for example, you have a glucose building component and a galactose building component, the result is lactose, which is the milk sugar that makes milk sweet. When two glucose molecules combine, we have dextrose, the grape sugar. And when a glucose and a fructose molecule combine, we have sucrose, the household sugar, which you now call normal sugar. Accordingly, there are chemical differences. But what is also different is the sweetening power. This sucrose, i.e. normal household sugar, granulated sugar, has a sweetening power of 1, which is the normal value, the starting point. Glucose alone, i.e. when it is broken down, has a sweetening power of 0.6 to 0.7, i.e. it is less sweet than household sugar. Fructose, however, is twice as sweet as glucose at 1.2 to 1.8, which means that fructose is sweeter than glucose. This has a natural effect on food.

Matthias Will: Where is fructose actually found?

Prof Henkel-Oberländer: As the name suggests, in fruit, so a lot in fruit, but also in vegetables in smaller quantities. In honey. Honey has a lot of fructose. I think these are sources that are known. But what is underestimated as a source of fructose are processed products such as confectionery and soft drinks, because you can make a sweet syrup from this fructose, which is very often used in industry.

Clara Marx: And how much fructose is healthy?

Prof Henkel-Oberländer: Fructose in itself is a source of energy, just like glucose. And the German Nutrition Society recommends that we should get 50% of our daily energy from carbohydrates, but only a fifth of this, i.e. 10% in total, from sugars, i.e. glucose, fructose etc., i.e. this includes all sugars. And this 10% is about 50 grams. That's 12 teaspoons spread over the day, so it's not that much. In these quantities, the fructose is metabolised quite normally in the cells of the intestinal mucosa and is used to produce energy, which means that there is actually no hazard.

Clara Marx: Okay. And if you now say it's not that much. If I eat fruit every day, which types of fruit contain particularly high levels of fructose so that I can be aware of this.

Prof Henkel-Oberländer: Apples and pears are very high in fructose, although it always depends on the variety and the degree of ripeness. Bananas and grapes are also considered to be very high in fructose, but this is not actually critical if you consume the fruit as a whole. So you have to think of the degree of ripeness as the sugar, i.e. sucrose, in the fruit being broken down as the fruit ripens. And accordingly, ripe fruit is simply sweeter because the fructose is then freely available and it simply tastes sweeter. This is why, for example, dried fruits such as sultanas or dried figs and dates are very high in fructose because they are very ripe. And honey with a 40% fructose content is also very high in fructose. But I would say that these are the main sources of fruit.

Matthias Will: So that means you have to be a bit careful and you can't safely eat just any fruit.

Prof Henkel-Oberländer: You can, if you eat the fruit as a whole. For example, if you eat an apple and consume a whole apple, then you are satisfied. You don't eat five apples in a row. This means that the amount of fructose you consume with one apple, even if it is a sweet and very ripe apple, is considered harmless in the constellation with all other ingredients, with the water content. You don't need to worry about that. And I also believe that you can't eat kilograms of grapes, so in my opinion you can or must not necessarily pay attention to the types of fruit, but should eat fruit and vegetables, regardless of the fructose content.

Clara Marx: Yes, you've just mentioned processing, that fruit should be eaten whole. What about smoothies, which are very popular among young people in particular?

Prof Henkel-Oberländer: That is precisely the point that I also exclude from consumption. Smoothies and fruit juices in themselves are more questionable because you always think you're doing something good for your child by consuming apple juice, even if it's good 100% pressed apple juice. You have to imagine, as I said before, that a large apple has about 10 grams of fructose, so that would be a fifth of my daily sugar intake. But it also has a lot of fibre, for example, which also has a satiating effect and keeps our intestinal flora in check and keeps it busy so that the fructose can't have any harmful effects there. And I feel satisfied after an apple. If I drink a glass of apple juice, about 200 millilitres, a small apple juice, I take in 14 grams of fructose, much more than I take in with an apple, and I'm not full afterwards. In other words, I could also drink 2 to 3 glasses and then I would have a critical amount of fructose because the juice alone has no fibre. This means that the microorganisms in my gut are directly exposed to large quantities of fructose, which is harmful again. And it's similar with smoothies. They still have fibre, because I usually process the fruit and vegetables completely, including fibre, but there are simply quantities of fruit in a small smoothie that I would never manage to eat in one go. And after a smoothie like that, I don't think we're satisfied.

Matthias Will: Professor Henkel-Oberländer, is there a guideline as to how much fructose per meal is harmful?

Prof Henkel-Oberländer: There is no such gramme amount. The critical point is whether the fructose arrives in the intestine on its own or as part of a complex meal. In other words, if I eat a mixed meal or a fruit salad, this is not a problem because there are simply many other components, the digestive system has to work normally and the fructose is broken down and simply converted into energy. However, if I treat myself to 3 smoothies and a biscuit, then it can become more difficult because I simply don't have this complex food and because the intestinal cells are then overwhelmed with these large amounts of fructose. This is because the intestinal cells actually act as a protective barrier and simply break the fructose down into individual components. These are then available in the blood and give our body energy. This means that the fructose itself does not enter the bloodstream, it is already broken down beforehand in the intestinal cells. However, if large quantities of fructose alone are present, for example after soft drinks, smoothies and so on, then this protective barrier is somewhat removed. And then the fructose also gets into the body, into the blood, where the liver is the target organ, which can also absorb fructose. Most other cells are unable to do this. And the liver also processes this fructose, i.e. the corresponding cells in the liver, and converts it into energy. However, if there is already too much energy, i.e. if I have a correspondingly high amount of sugar or glucose, then this is converted unregulated into the formation of fatty acids. This means that I simply convert the fructose into fats and store them in the liver. And this of course has consequences for liver function, which then leads to fatty liver disease and is of course very harmful in the long term.

Clara Marx: We've been talking about fruit all this time, but we said at the beginning that many processed products also contain fructose. What makes fructose so attractive to the food industry?

Prof Henkel-Oberländer: I sometimes ask myself the same question. The product that is processed here is called high-fructose corn syrup, or HFCS, and this is a very frequently used sweetener. It is available in various combinations, i.e. 90% fructose and 10% glucose or 55% and 45%. It's very cheap to produce, it's made from maize starch, then split into fructose and glucose, it's very sweet and has very good chemical properties. So it is hygroscopic, it is used as a humectant and is therefore always popular in the confectionery processing industry.

Matthias Will: The food industry likes to use the term fructose because it sounds better to consumers. Is that actually misleading?

Prof Henkel-Oberländer: No, not really, fructose is the chemically unambiguous term. Fructose is not always equated with fruit sugar, or fruit sugar could also mean sucrose, so in my view fructose is rather clearer than fruit sugar and I don't think it has much to do with misleading consumers.

Clara Marx: If you want to eat as little fructose as possible, especially in ready-made products, does it help to look at the list of ingredients, because it probably has different names there?

Prof Henkel-Oberländer: This fructose-glucose syrup is stated in the list of ingredients. Unfortunately, you can't see it in the nutritional information, where it is already broken down into carbohydrates, including sugar. But you rarely find out exactly what fructose is. But the syrup, at least if it is present in large quantities, has to be declared.

Clara Marx: Okay, but then still look at the nutritional values to see how much sugar is in the product?

Prof Henkel-Oberländer: Exactly, especially with products like muesli, ready-made muesli mixes, cornflakes etc., they contain more sugar than you might think.

Matthias Will: I'd like to talk a bit more about health aspects. There are claims circulating that fructose damages the intestinal flora and could promote cancer, is that true, Professor Henkel-Oberländer?

Prof Henkel-Oberländer: Yes, that is a very relevant scenario. I already mentioned liver damage when fructose is ingested in high quantities - so we're talking about soft drinks and so on, the sweetened, non-complex products that we consume. When these enter the gut in large quantities, a large proportion of the fructose is also metabolised by the microorganisms in our gut, i.e. mainly bacteria. As a result, the composition of the various bacteria in our intestinal flora changes in a negative direction, i.e. certain species grow larger and species that are actually beneficial for us decline. The composition also changes. And intermediate products are formed that damage the intestinal cells, in particular the proteins that are between the cells and seal the intestinal mucosa. In other words, the proteins that prevent what is in the intestine from entering the bloodstream. And these proteins are damaged or their formation is reduced by fructose. This means that our intestinal barrier is no longer really fully functional and that bacteria or components of bacteria can enter the blood and we are simply exposed to a permanent inflammatory reaction or at least the risk of this is higher. And it is precisely this damage that naturally also leads to increased growth of cancer cells. So an association has been found between fructose consumption and the risk of intestinal cancer. But in general, the metabolism in the various tissues is negatively affected.

Clara Marx: And now another health aspect. Intolerances are a recurring theme these days. How do you recognise a fructose intolerance?

Prof Henkel-Oberländer: There are two enzyme defects that lead to problems with fructose consumption. This is more of a fructose resistance. Both are very rare. One is a defect in an enzyme that metabolises this fructose first, with a rate of over 1 in 100,000. This defect only has the effect that large amounts of fructose simply cannot be absorbed into the cells and that it then remains in the intestine. This then leads to diarrhoea, simply because a lot of water remains in the intestine. If at least some of the fructose is absorbed, it remains in the blood and is then excreted in the urine. You would only notice this if there were high concentrations in the urine or if you had diarrhoea or a rumbling stomach after eating large amounts of fruit. However, this has no serious effects. However, there is another defect that is more common among newborns (1 in 20,000). An enzyme in the fructose metabolism in the liver is defect, which leads to the accumulation of a metabolite in the entire fructose metabolism in the liver, so that it can no longer produce energy. In other words, this leads to massive liver damage and therefore the fructose must be completely eliminated from the diet.

Clara Marx: We have just briefly mentioned fructose metabolism. It used to be said that fructose is particularly valuable for diabetics because it is metabolised independently of insulin, is that true?

Prof. Henkel-Oberländer: The formulation is the other way round, i.e. the metabolism of fructose is promoted by insulin because insulin regulates glucose and lipid metabolism and fructose enters these metabolic pathways. This means that if I have a high insulin level and consume a lot of fructose, then I metabolise fructose better in all these metabolic pathways. What you mean is that, unlike glucose, fructose does not lead to the release of insulin. And this is actually the case, because the beta cells in the pancreas that produce insulin do not react to fructose. This means that when I consume fructose, I do not secrete insulin and that is the problem for diabetics. That's why it used to be advertised as a substitute or replacement for glucose. Nowadays, however, this has been abandoned because fructose has these harmful effects. This means that there are other substitutes, substitutes that are much more suitable and have fewer bad side effects compared to fructose.

Matthias Will: If you could summarise again, what are the 3 most important tips for a healthy approach to fructose?

Prof. Henkel-Oberländer: I would summarise it by saying to consume fruit and vegetables in whole fruit, so fruit juices and smoothies are the exception rather than the rule. In any case, avoid sweetened drinks, soft drinks that are enriched with this fructose-glucose syrup. And simply eat consciously and colourfully.

Matthias Will: Professor Henkel-Oberländer, I'd like to finish with a little imagination. Federal Minister of Food Cem Özdemir recently complained that Germans were eating too unhealthily and he explicitly mentioned sugar. Imagine you were invited to a nutrition summit with him. What would be your central demand to the Minister of Nutrition?

Prof Henkel-Oberländer: I would spontaneously think of 3 points. One would be to limit the amount of fructose syrup added to food, introduce a maximum limit and declare it accordingly. And, of course, educating the public - we're still not as far along as we could be. Here too, many people simply don't realise what they are actually doing when they consume fruit juices and smoothies. However, my main point would be to stop using attractive advertising, especially for children's products. They are becoming more and more colourful, cooler and cooler and many people don't realise that the ingredients are harmful. As a mother, you think to yourself, I'm doing something good for my child if I eat or buy this or that child-approved product and give it to the child. And I think that's another big point that many people don't realise. Of course, education also comes into play here and I think we should work more restrictively in the area of advertising and availability, including in schools.

Matthias Will: Well, I can see that the Federal Minister of Nutrition still has a lot to do during his term of office. Professor Henkel-Oberländer, thank you very much for the interview. Nice of you to be here.

Prof Henkel-Oberländer: Thank you very much, I really enjoyed it.

Clara Marx: Yes, thank you again from me too.