Basics of Wine Tasting: Flavour, Taste and Mouthfeel

CORY: I'm Cory, and on behalf of Global Connections I would like to welcome you to our webinar today on wine country evaluation-- flavor, taste and mouthfeel. Please feel free to use the chat box for any questions or comments throughout the presentation, and if you have any trouble hearing or seeing any aspect of the presentation, please feel free to send me a message in the chat box. That's what I'm here for-- to help you guys out. So I will now pass the microphone over to Dr. Ross and she will-- [INAUDIBLE] for you.

CAROLYN ROSS: Hi everybody. My name's Carolyn Ross. I'm an associate professor here at the School of Food Science for WSU. I've been here nine years, and this is the third webinar in a series of three. The first webinar we looked at appearance of wine, talked about how to evaluate it, some basic background concepts to keep in mind when you're thinking about wine sensory evaluations. In the webinar I talked about aroma, how those are perceived, different types of aromas, got a little bit into off aromas as well. And today it's our final webinar. It's continuing with the theme of the basics of wine tasting-- flavor, taste, and mouthfeel. And so I'm going to cover all those things today. So after today you should have a lot of new knowledge to go forward in the world with.

Outline of what I'm going to talk about today. We're going to first of all talk about taste properties. So different tastes and what kind of aspects they have within wine. Then I'm going to talk about factors affecting taste, and factors within the wine that affect our perception, and also factors within ourselves-- the genetic differences that we may have. I'm going to talk about flavors.

And then we're going to get into mouthfeel. So what does the wine feel like in the mouth? And so maybe that's not a term you may not be familiar with, but I sorry you've heard of aspects of it. It's basically the texture of the wine-- what it feels like.

Then I'm going to talk about wine finish and some research that we've done in that area, and then finally finish it up by talking about wine faults. And so that'll kind of finish up in wine faults in the context of flavor and mouthfeel-- not in aroma. We covered that in webinar two.

So moving on. In-mouth impressions. This is just an introduction of what we're going to talk about today. There are a number of ways of looking at the product once it's in the mouth. There's looking at the taste of that particular wine. And in wine we look at acidity, sweetness, and bitterness. We tend not to look at saltiness, although it may be an issue depending on where the wine is from, so you could look at saltiness. There's also umami, which is that kind of meaty or brothy notes, and we don't look at that as well. That could be a flavor that you get, and you'll learn throughout this webinar the difference between taste and flavor, but it's generally not a taste that you perceive.

So we look at those tastes, and those are receptors that are located on our tongue. So that's where we're perceiving those different tastes. Tactily, those are receptors that are randomly scattered throughout the oral cavity, and so we pick out tactile or mouthfeel in-mouth impressions all over our mouth.

And that's viscosity-- the thickness of something. texture-- it could be gassiness, whether it's effervescence-- so if you think of the sparkling wine. And then hotness-- it could be in terms of temperature. It would be more cold versus room temperature when we're talking about wine, or hotness in terms of alcohol concentration. So if something's very high in alcohol concentration you could call it hot or burning.

We do have two sets of chemo receptors in the mouth. Our taste we perceive on those receptor neurons, which are located on our tongue. And then mouthfeel we have these free nerve endings that are randomly scattered throughout the oral cavity. And so when we talk about the technique used to evaluate wines, that's you really want to swish it around and swirl it around. It's to get to both of those different types of chemo receptors. All of these things combine to produce flavor.

So you've got your taste, you've got your mouthfeel, and then you've got your flavors, and those are all kind of built in together. So what's going on with the wine once it's in your mouth. There's a lot to take in, but we're going to start by looking at basic taste.

So I did mention we're not going to focus on salty when we talk about wine, but it is on the chart, and what it shows is the sensitivity along the tongue. So along the bottom axis, we have the edge of the tongue-- the location. And then we've got the sensitivity along the other axis.

So this is keeping in mind that there are-- if you take in something that's very, very sweet, you're going to feel it all over your tongue. It's not just that you're going to feel it at the tip of the tongue, which is what this chart is showing. So if you look at the figure, we have sweetness, and you tend to feel that more at the tip of your tongue, and it tends to decrease in sensitivity as you go along the tongue and get to the back, whereas bitterness has sort of the opposite relationship. It starts off-- you're maybe not picking up as much at the front of the tongue, but then you're picking up more as you get further back. And that then translates to reaction time-- how long it takes us to detect something.

That's not to say that you would not feel bitterness at the front of your tongue if something was extremely bitter. Your sensitivity is just a little bit lower.

So there was a diagram years ago that had just discrete sections of the tongue that were responsible for specific compounds. That's not the way it works. Your tongue is dynamic. It picks up all of those compounds. It's just there are certain locations of more or less sensitivity.

But what this is suggesting is that reaction times vary based on the compound. So for sweetness, our reaction time is about 0.4 s. So if you take in something-- a wine-- red wine--

you might notice immediately that hey, this is pretty sweet. And you noticed that before. Maybe you noticed woah, now it's salty. But it just doesn't hit you right away because of the concentration of those particular tastebuds or taste receptors.

We kind of noticed bitterness later on, so it can take up to a to develop. So it could the after you swallow the wine, or after you spit the wine out, then you think, wow, that was really bitter. You may not have noticed it straight away.

And that's something to keep in mind when you're doing these evaluations. You can tell or you can use that information to discern and tell the difference between sourness and bitterness. Sourness we tend to feel along the sides of our tongue, and it tends to develop more quickly than bitterness, which is generally at the back of the tongue, and it tends to be more lingering. So you can use that information to help you figure out which kind of compounds you're detecting.

Now, looking at vocabulary, with sweetness we have a few more terms then say with bitterness. With sweetness in white wine it can range from bone dry through dry, all the way up to very sweet. And that's because there's just more of a range of sweetness levels that you're going to see in white wine.

And there's also-- I've noticed from the labels on Riesling, especially-- it gives you some information about how sweet this wine is. So whether it's medium dry, or whether it's dry, or whether it's sweet-- and so you have that information when you're making the decision. So if you're looking for just a dry Riesling without a lot of sweetness, then you'll want to find one that says dry on the label.

Red we range from bone dry up to medium sweet. It doesn't have the same range of sweetness levels as white wine does. In bitterness, as I mentioned, it's more prominent in the wine finish. So not just-- so you wouldn't pick it up when the wine in your mouth, but maybe after you've expectorated the wine, or after you've swallowed the wines, you really kind of figure out or then it kind of strikes you-- wow, that was really bitter.

And then sourness-- it can also be called acidity. Some people call it tartness. But some vocabulary here-- green, tart, crisp, and then you start getting into the more of the sweet like flabby or flat, and cloying or too sweet. And as far as sourness and sweetness goes, there is a balance there is that we have. So if you've got a sweet wine, you wouldn't expect it-- you know, when you know it's a sweet wine, it's an ice wine, it's a late harvest wine-- you expect it to be quite sweet. You don't necessarily-- you don't have the expectation that's going to be like a table wine. So if you were-- a lot of it is about expectation. You may not have a balance in some of those wines, which is OK as long as that's what the wine style is dictating.

So for sweetness, again you may have an ice wine that's very, very sweet, and maybe just not a lot of sourness, but it's not meant to have that; whereas for table wine you'd want more of balance.

OK, so now I talked a little bit about this initially, but the action of tasting is very active. So you want to take in about 10 milliliters of wine, which is about a third of an ounce, or even half an ounce-- so a good sized mouthful. You want to move the wine around to the different parts of the town. So you really want to slosh it around. Sounds like you're almost gargling with it. And what we're doing there is we're trying to access it to the different parts of the tongue and of the whole palate so that you're able to perceive those flavors and a mouthfeel and taste that we talked about. So you really want to slosh it around-- almost gargle with it-- and then if you can suck in air simultaneously, what you're doing there is you're releasing some of those volatile compounds that are captured.

So it takes a little bit of practice. It's also very loud if you do it, so maybe try and practice in private first, and then apply it. As far as how long you want to leave it in your mouth, what we do for our wine tastings is we suggest a residence time of about 10 seconds, meaning that leaving it in your mouth and really swishing it around for about 10 s is good. It's also a long time. It's longer than you would normally leave a wine in your mouth, so you certainly don't have to leave it in your mouth that long. If it's also very bitter or a very astringent wine, you probably don't want to leave it in your mouth for that long. But just try it with that 10 residence time just to get a feel for how long that really is.

OK. So factors affecting taste perception. So there's a lot of things that affect how we perceive taste. And there are differences, which we'll talk about in a moment, but there are also chemical aspects. So what is going on in the wine itself?

So you may have something called suppression, and that's where one compound suppresses the perception of another. So if you have a really high, sour, very, very acidic wine, it can suppress our suppression of sweetness, so you may not have a balance there.

Enhancement. So certain compounds can enhance certain properties, and we'll talk about this when we talk about alcohol. But alcohol concentration can enhance the perception of certain things, and decrease and suppress the perception of other things. So it's not just the compound itself, and not just the concentration of that particular compound itself that is affecting the wine, but it's how it interacts with the other things that are also found in the wine.

And that's a big part of my research that I do now-- is that I look at the interaction of the matrix. I look at ethanol, I look at tannins, I look at the sugars, I look at other things that are in the wine, and how those all interact together.

And then we may-- also some of our compounds may have more than one sensory quality. So for example, tannins-- they can be bitter and they can be astringent, and so then they can get a little bit confusing there. Glucose, which is sweet-- it can be sweet, but it can also be a little bit acidic if it's at low concentrations. And same with alcohol. At low concentrations it can be a little bit sweet, but it can also provide that burning that we talked about.

So some of these compounds-- it's not just simply they're just loaning one particular parameter to the wine. It could be that they're inferring-- conferring several properties to the wine. So again, it's very complicated.

Now, for individual differences, we're all different, so we perceive things differently. And so I'm going to spend a couple of slides talking about that-- why you may be different than someone else, or how you are different within yourself. You may not be consistent. Maybe you're sensitive to one thing, but not something else. And so we'll talk about individual differences.

This is a slide showing individual sensitivities. So along the bottom we have-- they're just initials, so those are subject's names. And then along the other axis, we have the sensitivity levels. And what I wanted to show here is that how some things are more or less sensitive to certain compounds.

So if you look at GC, which is the first initial, that person is quite sensitive to sourness, but you know, not as sensitive to other things, like saltiness. And so there's going to be a lot of variation. Just because you're sensitive to one compound doesn't mean you're sensitive to everything.

It could be that you're just used to that compound-- that there's been some familiarity. You've maybe grown up consuming that compound, and so you've become used to it, and so you're familiar with it, so you're more sensitive to it. Or maybe if you work in a lab or you work in a particular restaurant, you may become used to a particular compound. So that can be learned sensitivity.

So there is sort of a genetic difference, which we'll talk about next. There's also sort of a learned sensitivity. Also over time you can become desensitized to some things. So if you really like spicy things-- really, really, like them-- and you continue to have them, over time, you can become desensitized. I mean that does take a little while though.

So there are changes that are genetic-- or there are differences because of genetics. There are also differences because of what we consume and what we have as habit.

And so this next side talks about being a supertaster. So this is actually a genetic difference that we have. So supertasters show a taste blindness to 6-n-propylthiouracil so or PROP. And this is discovered in the 1920s by Dr. Fox, and he was working in a lab working with this particular compound, and doing some synthesis, and someone else came into the lab, and he just couldn't believe how-- because it was airborne at that point-- and so ingested it, and couldn't believe how bitter it was-- he didn't detect anything. This is Dr. Fox. So being a good scientist, he actually tried it-- he actually put it in his mouth-- and didn't perceive anything. So he thought, well, that's kind of interesting.

And then he went off to one of the conferences and brought this compound with him-- actually no, it was a different compound. The initial compound that he worked with was found to be

carcinogenic, so he moved on to the propylthiouracil. But the initial compound-- PTC-- it was the same story-- that some people were sensitive, some people not.

But off we went to this conference. He brought this PTC compound with him. He gave it to a whole group of his peers, and then he was able to segregate the population to people who thought it was unbelievably bitter, people who thought it was bitter but not off the scale bitter, and then some people who couldn't perceive it at all. And so that's where they got into this research about supertasters.

So the PTC compounds was found to be carcinogenic, they were able to identify another compound that they could use, which is the propylthiouracil, or PROP. So this is the compound that they use now when they're talking about supertasters, if you've ever seen them talk about that on the news.

This tasting ability to taste this particular compound it's produced by a dominant allele-- capital T. So if your receptors, which are a little ts-- they're non-tasters. They're not able to perceive this compound. So if you give them a cup of the compound and dissolved in solution, they are going to have it as a 0 or a 1 on a 15 centimeter-- on a line scale. They're not going to find it intense, if they detect it at all.

We have tasters, which is one dominant and recessive gene. And so they can detect that it's bitter, but they don't say it's the most bitter thing that they've ever had. And then we've got the two dominant alleles, which are supertasters, and they would characterize this as the most bitter thing they have ever had. And so the scale is quite something. It ranges from nothing to the most bitter thing I've ever had.

And so it's quite interesting to see people who-- you can tell the supertasters when I'm doing this in a group, because they just spit it out. You can see it on their face. But the non tasters-- nothing. It's very interesting.

So they found that you can divide the population into these three groups. About 50% of us are tasters, 25% are super tasters, and 25% are non-tasters. And this is for this specific compound. So just because you're not sensitive to this specific compound, there are many other bitterness receptors, and you could be sensitive to another bitter compound.

So I just did this recently with a wine tasting panel. I had one woman who was an extreme non-taster for the PROP compound, but that didn't mean that she couldn't pick out quinine sulfate, which is another bitter compound. So it just depends. There are different compounds that we have sensitivity to, but this is the compound that I've identified that genetic component with.

There are also physical tasters between-- sorry, physical differences between tasters and non-tasters. So PROP tasters have a higher number of taste pores per papillae. They have an increased density of taste buds. So there are physiological differences between non-tasters and supertasters. So we've got this PROP testing which does give you that information about

whether you're a taster or a non-taster, but I just wanted to also say that anatomical differences may be a better indicator of that.

So the PROP tasting is easy enough to do. We do it at all of our panels and with groups, because it's something that's pretty easy to do. You taste two solutions and you evaluate the intensity of them. But anatomical differences do sort of confirm that information.

With all of our panels we do collect this information, because it can give us information about how people are evaluating the intensity of things. So if we find that one of our trained panelists is really having a hard time with astringency, for example, or bitterness, and we can look back and say, OK, wow, they're a non-taster, so that explains something.

Now there are gender differences. More women tend to be supertasters. And this superiority may decrease with age. The component of being a supertaster-- because it's genetic-- it's always present. It's not going to go away. But the sensitivity can vary.

And they have studies that show a relationship between bitterness sensitivity and taster status, and supertasters found glucosinolate containing vegetables 60% more bitter. So that's broccoli and Brussels sprouts and those types of compounds that are found in different vegetables. They've done a lot of metastudies on this where they've looked at two choices associated with whether you're a supertaster or non-taster.

And they've also found that the women supertasters tend to be thinner because they're not as sensitive-- they're too sensitive to fat and sugar. It's just too much for them, so they don't consume that much. They've also found that people who have chronic-- who have difficulties with chronic consumption of alcohol tend to be non-tasters because they are not as sensitive to alcohol as those who are tasters and supertasters.

So the next slide I'm going to show is a specific study that looked at wine and PROP sensitivity. This was in red wine. And yeah, there were 25 people and they were screened and classified as non-tasters, tasters, and supertasters. And then they were given a commercial red wine, and they rated the astringency, bitterness, and acidity of those wines. And they wanted to compare the three groups to each other. And so the next slide shows this.

So we've got our bitterness, astringency, and acidity along the bottom are attributes, and then we have perceived intensity. So that's how intense that particular group found it. We have the non-taster group, which is the open square, and then the supertaster, which is the dark colored square, and then the taster group which is in between the middle. And what we see is that for bitterness, different letters represent significant differences from each other, or real differences that are outside of chance.

So what we see for bitterness is that the non-tasters found that wine to be significantly less bitter than did the tasters and supertasters, but there was no difference between the taster and supertaster group. We see the same trends for astringency and for acidity.

So what this suggests is that there are big differences between non-tasters, supertasters, and tasters, but within tasters and supertasters-- not much of a difference. Not significantly. And so this was for a commercial red wine that was evaluated.

So you may find yourself in that non-taster category, and if you look, you still see that people who are non-tasters are still detecting bitterness, astringency, acidity. It's not like they're not able to perceive it-- they're just finding it as less intense than did the supertasters.

So moving from taste we're going to talk about flavor now, and this is defined as the impression perceived by the chemical senses from something that's in the mouth. So it includes aromatics. It includes those orthonasal compounds that we talked about in webinar two. Those are the ones that come straight up your nose. The retronasal compounds-- those are the compounds that are released from the wine once it's in the mouth. So they also get to the olfactory epithelium which is up here. They just get by a different route. So they kind of come over the back. And so if you've got a cold, that area is clogged up and you're not able to perceive flavors because those aromas are able to get to that olfactory epithelium.

It also includes taste-- the sweet, sour, and bitter-- and then chemical feeling factors which are all the mouthfeel that we're going to be spending quite awhile talking about. So flavor is an interaction of all of those things together. It's quite complicated.

And this is another wheel. I've got a few wheels to show you in this lecture today-- or webinar. So this is the wine flavor wheel. It was developed for the Niagara College. On the innermost component-- very similar to what you see for the wine aroma wheel. It has one less spoke, though. So the innermost part are the most general terms, and then you work your way out to more specific terms.

So you can see if you smell-- if the wine is in the mouth and you think, wow, this is fruity-- you can go to the fruity spoke, and then from there it spokes out to a lot of specific attributes that you can decide if that's what you're talking about or not. Or you can just leave it as fruity.

This wheel also has a number of the flavors that may be associated with the wine. It can be useful. It can also encourage you to look for those particular aromas or flavors and find them, which is especially problematic if they're not there. So if you're smelling a Riesling and you look down here at the Riesling and think, wow, is there lime? Sure there's lime. Whereas you may not have picked it up otherwise.

So that's something to keep in mind with these. It does provide some information and it does help you look for certain things, but then you have to remember this is helping you look for certain things. So it may cause a bias and may cause you to find a particular attribute that you may not have otherwise found.

So now we're going to talk about mouthfeel. These are those tactile impressions you get from the wind once it's in the mouth. So if you look at it, it's even texture. These are sensations that

are activated by those free nerve endings that are scattered throughout the oral cavity. So these trigeminal fibers, they surround the taste buds and are randomly distributed.

So that's why you really want to-- when you take in the wine, really swish it around; really gurgle with it, because it will change the sensory perception that you get from the wine. And we'll talk about that in the next two slides, but it's quite complicated. There's a lot to kind of keep in mind for mouthfeel. It used to be more simplified, and now they've got a red wine mouthfeel wheel, a white wine mouthfeel wheel. There's a lot of specific terms. A lot of specific how-tos as far as evaluation as well.

So these are some mouthfeel terms that you'll be seeing. Viscosity-- thin or thick. So viscosity in most simple terms-- think of water versus a milkshake. How thick something is in the mouth. If you compare a table wine to a dessert wine, there's going to be a difference in how thick it feels.

There's a ceiling on the soft tissue in the mouth. So smoothness, if something's velvety, kind of a little bit fuzzy, if it's coarse-- so if you start getting-- it's got more particulates in it; and then it's gritty. So those are some different terms that you can think of when you're looking at how does this feel in my mouth.

Carbonation related. So if you're not having a sparkling wine, you wouldn't be using these terms-- hopefully. Unless it's flawed. Others-- bubbly, there's tingly, there's spritz-- so kind of how it feels in the mouth.

And then you've got body, which is the weight of the wine in the mouth. How it kind of feels on your tongue. So others-- heavy, or watery, light, full, rich. All these terms.

And then chemical effects. So we've got things like astringency, which is that drying, puckering mouthfeel. So to me it feels like my teeth are wearing little socks. It feels very, very dry and kind of fuzzy.

You've got burning, which is that ethanol, and then you may have something sharp, which may be associated more with sourness.

Afterfeel-- how long something lasts in the mouth after you're finished. You can also call it finish. And then temperature. So whether it's cool or whether it's warm. So if you have a white wine that's served directly out of the refrigerator versus a white wine served at room temperature, it's going to have different properties. It's going feel different in the mouth.

Now, the next figure that you're going to see is the mouthfeel wheel. This was developed by Dr. Gawel in 2000. It was developed out of Australia. And so what you see here is this is the red wine-- well, mouthfeel wheel, but more specifically for red wine mouthfeel because it does have an astringency spoke and a feel.

So if you can look at the innermost part, it talks about astringency, and then it also-- the feel we might call those more tactile sensations. So astringency is very complicated. It's not just drying. You can look out from astringency and go to drying, and then within drying you can choose numbing, parching, dry. There are a lot of other attributes within that.

And the way they developed this wheel was actually to give people different fabrics that they felt in their fingers while they were trying the wine, and trying to relate what they're feeling between their fingers with the fabric versus what they're feeling in their mouth. And so that's how some of these terms like furry, velvet, suede, silk, shammy-- those all came about with fabrics. So the panels were feeling fabrics.

And I do this with some of my sensory testing. It's very difficult to do-- to translate what you're feeling between your fingers fabric wise and tactily, and what you're feeling in your mouth. But that's how the wheel was developed. But it does give you a lot of terms you can see. So there's a lot of additional vocabulary here beyond just what I've gone over. You know, I've given up some broad terms, but this is a lot more specific vocabulary if you really want to get into describing mouthfeel and being very, very precise.

Now this next one-- it's a different-- the mouthfeel wheel was developed in Australia. This is information that's coming out of ICV, which is the Institut Cooperatif du Vin, so it's out of France. The Cooperative Wine Institute. This is their protocol for mouthfeel evaluation. So it's a little bit different from the previous wheel, but it does give you different information. It's a different way of evaluating it, and if it sort of speaks to you and you relate better to this, then whatever works for you.

So with this mouthfeel evaluation, it's very specific. So I'm going to go over a few of the specifics just to illustrate how very fine this is, and how they're trying to get away from the variation that's caused by how people manipulate the sample in their mouth.

So you put 10 samples into your mouth-- 10 millimiters into your mouth-- and there are six descriptors. So there's volume, there's acidity, there's tannins, there's astringency, dryness, and bitterness, and each of those are evaluated at a particular time point. So volume is defined as the intensity of the tactile pressure of the wine on the tongue or the lips. It's assessed within three seconds after putting the wine in the mouth.

The acidity is assessed on the rear half of the tongue, and it's within three seconds after evaluating volume. And then you've got tannin, and that's two seconds after you evaluate the acidity, so you run the tongue along the palate from the front to the back and see how much it kind of scrapes-- so how much friction you generate by moving your tongue from the front to the back. So the more friction you generate, the higher intensity of tannin you might be able to say that that wine has.

Astringency is two seconds after tannin, and this is running the upper lip twice-- or sorry, running the tongue twice against the upper incisor. And then we've got dryness, which was two

seconds after astringency, and it tells you how to manipulate your tongue from front to back. And again, you're looking at how much friction you've generated. Very similar to tannin, but it's a little bit later in the process. And then bitterness is two seconds following dryness.

So this is very, very specific, and it does take a-- as far as seconds go, you're counting seconds and evaluating these different mouthfeel components. If you're doing this, you may not be able to simultaneously evaluate other things like some of those more complicated flavors, because you're focusing on evaluating the mouthfeel.

But that's how specific it can get in how-- they're trying to control how you manipulate the sample once it's in your mouth, because that can generate a lot of variation as far as intensity of tannin. If you don't manipulate the sample the same way-- if you don't move your tongue in the same way as somebody else next to you, they may get a different intensity. So that's just a way of standardizing.

Now, just some general notes about astringency. It can be confused with bitterness because of the location or how it takes us longer generally to feel astringency than other things. It tends to come out the same time as bitterness, so it takes longer to develop. And what happens is is these astringent compounds-- these polymeric compounds-- they bind precipitate our salivary proteins with tannins.

So we have a certain amount of salivary proteins. A certain amount of saliva-- a certain amount of spit that's just rattling around in our mouth. And so when we first have our first sip of red wine, those compounds bind with the saliva that's already present. And so you're OK. It doesn't seem that intense. You either swallow it or spit out the wine.

As you continue to consume the wine, you basically start running out of saliva. You start running out of salivary protein, and then you get the binding of these compounds with your teeth, and your tongue-- with other things in your mouth. Not with the saliva, because you have less saliva that's present in the mouth.

So you do get rid of the saliva-- again, you only have a certain amount in there-- and you get increased friction. It can be slow to develop, but it is a dynamic process, meaning that-- and in the previous slide where we talked about 10 seconds, waiting two seconds, waiting three seconds, you can see that it is a dynamic process that changes over time. What you perceive initially is maybe not what you're going to see after 10 seconds or after 15 seconds.

Intensity and duration does increase the with repeat sampling. Again, it's a function of the saliva. You're sort of running low-- running out of saliva. So the wine that you have at sip one and what you perceive as astringency may not be the same level of astringency you perceive at sip six. And we did research on that and clearly showed how intensity-- especially in high tannin wines-- how that intensity of the astringency increases with repeated sampling.

Positive descriptors you may have heard associated with astringency-- soft, round, or mature. Negative descriptors might be hard, green, young, persistent, chalky. So if you think back to the mouthfeel wheel, those are some of the spokes that you may see.

There's also an effective salivary flow rate. So how much saliva you generate. So now we have another source of individual differences that may contribute to how much we perceive our astringency.

So this side shows that. The next slide. We've got a time zero. Along the bottom axis we have time after administration of stimulus. So at time zero, each person was given either distilled water, TAN-- so you've got tannin-- just tannin. If you move up to the right hand side, we've tannin plus ethanol-- EtOH is ethanol. We have tannin plus sucrose. In the middle we've got pinot noir, so we actually have a commercial wine. And then at the very top we've got tannin plus tartaric acid plus sucrose.

So we have tannin which confers astringency, tartaric acid, which is sour, and sucrose which is sweet. So we have each of those stimuli which are administered at time zero, and then what they do is they measure the saliva weight at one minute and after two minutes to see how saliva flow varies with what you're given.

So what we can see here is that when you're given distilled water, you have a pretty low-- you know, you can see what the base level of saliva weight is-- maybe about 2.5 grams. As you're given different compounds, you generate more saliva. So if we look at the tannin plus tartaric acid plus sucrose, now you've generated 1.5 grams saliva. so that's quite a bit of saliva.

So it does vary with what you're given. And so if you've got a wine that's really heavy or really high in astringency-- really high in sucrose-- then you may generate more saliva than another wine that does not have the same parameters.

Of course there are differences in our saliva flow rates individually. So how much saliva we produce varies from individual to individual, and those are data we gather as well when we're doing our trained sensory evaluation. We give them an administer at time zero a highly acidic solution. They spit that out, and then after they've expectorated that, they then spit out saliva for a full minute, and then we can measure that and determine whether they're low, medium, or high rate of saliva release.

And that gives us some information as well when we're looking at our perception of certain things-- of stringency or bitterness. It can give us good information there. So again, another source of variation and why you may not perceive things the same as somebody else next to you.

This is just showing the influence of sucrose on our perception of astringency. So I don't want to go into this too much, because actually I'm running a little low on time. So we've got three figures here. And if we look say just at that first figure A, where it looks at time to maximum

intensity-- and along the bottom we've got the concentration of sucrose from 0% to 20%-- and what we see is that as we increase the concentration of sucrose, there's not much, but there's a little bit of effect on the time to maximum intensity. How long it takes for you to perceive astringency varies with how much sucrose is present.

How much-- so if you look at figure B, the maximum intensity-- how high or how intense you're finding that particular solution does vary with the concentration of sucrose. So if you look in the dark circle at the top-- that's the high tannin line. So what they find is that when there's no sucrose present, our maximum intensity is maybe about 750, 780. But when sucrose is present, it decreases to both about 650.

So what I wanted to show there is that the interaction-- what goes on in the wine; what else is present can influence our perception of specific atttributes.

Now, we talked about threshold last time in webinar two. So threshold is the minimal concentration that's required to produce a change in perception. So with ethanol, it's the minimal concentration, or the minimal change in ethanol concentration before consumers can tell a difference. So if you have a wine that 13.5% alcohol and a wine that 13.6% alcohol, the question is can you perceive it? Yeah, you can tell there's a difference with analytical tools, but can you actually perceive the difference?

So they did a study in two types of wine-- chardonnay and zinfandel-- a white wine and a red wine to compare differences. And they looked at it for orthonasal and retronasal detection. So if you look at the orthonasal, that's up the front of the nostrils. If you look at the little figure, it illustrates there these aromas traveling right up the front of the nostrils getting to the olfactory epithelium which is that little yellow region in the little figure.

The retronasal-- those are the aromas that are perceived once the product is in the mouth. So once the product's in the mouth, you can see that it's got that back arrow that leads to retronasal olfaction. It gets to the same area-- it gets to the olfactory epithelium. It just gets there a different route. And so they looked at detection of both of the these. Orthonasal-- again, that's the wine when it's in the glass and you're sniffing it. Retronasal is once the wine is in your mouth.

And so they found that for chardonnay, the ethanol concentration needed to be 0.5% or higher before people could tell the difference. And so it would be between 13% and 14% they could certainly tell a different. Retronasal-- it needed to be a little bit higher, the concentration, before they could tell the difference. It was around 1.1%. And that's because of everything else was going on in the wine. It's more complicated to kind of tease out ethanol. But they needed concentration differences above 1% in order to tell the difference.

Then they repeated the same study in red wine, and they found out for orthonasal-- so for aromas up the front of the nose-- that the concentration just in ethanol, the difference needed to be about 1%-- 1.12%, whereas once it was in the mouth it needed to be 1.3%. So quite a bit

higher compared to the orthonasal. And that's because of the competition. That's because of what else is going on in the wine it's more difficult to pick out the ethanol when you've got tannins in there and you've got maybe some sourness and some bitterness.

So what I wanted to show you there is that's something you can look at on the label of wine. So you cam look at the percentage alcohol that's found in there. Of course it's going to vary with what else was going on in the wine, but this does give you at least a little bit of information about we're you could expect to see differences, especially if you're quite sensitive to alcohol.

Now, this is talking a little bit more about the impact of ethanol on wine. This is an area of research I've done quite a bit in. So ethanol does change perceptions of aromas and flavors. It does tend to enhance the heat, of course, so the more ethanol you have, the more burning you're going to perceive. It can also enhance roughness-- it can enhance bitterness. It can reduce perceived astringency, so you may perceive less astringency, and it can affect other volatile compounds, and I'll show you that in a moment-- how it affects others smells that you may have, just because ethanol is a solvent and it dissolves certain compounds better than others.

This is one study that looked at the effect of ethanol on astringency and bitterness, and what they found was that at higher range from 0% alcohol to 15%, which is in the dark box, and they found that as they increased the concentration of astringency, the perception of ethanol decreased. I'm sorry-- as they increased the concentration of ethanol, the perception of astringency decreased, and then they saw a reverse trend in bitterness.

So at the higher concentration of ethanol, that wine was found to be more bitter than at the lower concentration of ethanol-- meaning that ethanol certainly does have an effect on perceived astringency and its perceived bitterness. So it's not just you're going to get more burning, but it's going to affect how you're perceiving the astringency and the bitterness in those wines as well.

And if we flip forward to look at specific aroma compounds, what we've got here are different aroma notes, and then we've got the alcohol concentration along the bottom, ranging from 0% to 16%. So this is work we did a few years ago, but what we see is that if you look at the red boxes, those are floral, fruity, caramel aroma and flavor-- what we see is that as alcohol concentration increases, we tend to see a decrease in those notes. So as alcohol concentration increases from 8% to 15%, people tended to perceive less of these floral, fruity, caramel notes.

In similar trend as with earthy and herbacious, patients which are in yellow, you tended to see-- those notes tended to decrease as we increased the concentration of alcohol, and we saw that striking reverse trend when we looked at sulfur aromas and flavor. So with sulfur, as the concentration of alcohol increased, we tended to see increase in perception of those sulfur aromas and flavors, meaning they found the wines to have more sulfur aroma notes than the floral notes and the earthy and herbacious notes.

So the higher alcohol wines aren't just higher alcohol. They affect bitterness, they affect astringency, and they also affect some of these aroma compounds as well and those aroma attributes.

So moving on with white wine mouthfeel. A wine mouthfeel was developed for white wine. I've got it right here. It's also on the next slide. It was in 2008. It contains taste parameters. And it also contains-- if you look at it, it's got discrete and integrated sensations. So discrete sensations are divided into those that finished early and those that finished later, and then it's got integrated sensations which consists of more than one sensation.

So it uses a time dimension. So if you look at it, at 12 o'clock are the things that you perceive first, and then you work your way around-- I went the wrong way-- you work your way around the wheel. And so you start at 12 o'clock and then work your way around. I'll talk about it in a moment when you've got it in front of you, because it's hard to relate to it. So descriptors are orderd clockwise.

And then I've got a couple of notes here about ethanol, which I just wanted to put that in there. It's that kind of heat drying. And glycerol, which tends to be associated with viscosity.

So let's take a little bit of a closer look at the white wine mouthfeel that you have in front of you. So when you first put the wine in your mouth, you'll start at 12 o'clock, which is that yellow spoke, which is sweetness. And you'll work your way through those tastes. The notes that are in that kind of salmon color are associated with sparkling wine, so if you're not having a sparkling wine you can kind of skip over that.

But then we go into pucker, and [AUDIO OUT] water, and then we skip over these salmon terms if we're doing a white wine. And then we go to fullness and surface texture. Those are all-- those initial ones were early, and then we start getting into finish notes. So when we look at finish, we tend to get into things such as irritation, mouth coat, overall drying, and length.

So we start with the early notes, and then we get into the late notes or the finish-- the things that are left in our mouth after we spit out the wine. Those are all considered to be discrete sensations.

Integrated sensations are more complicated, and they consist of more than one sensation-- more than one concept. And so you can look at them here. They all have different terms. And as I mentioned before, within integrated, the salmon colored terms are associated with sparkling wine.

So this is getting pretty complicated. So we've got a red wine mouthfeel which focuses a little bit more on fabrics. So it's got the astringency spoke and it's also got the tactile mouthfeel. And now we've got a white wine mouthfeel wheel that goes in perception in the order in which you're thought to perceive once the wine is in your mouth, starting with sweetness. So starting with early finishing, going through to later finishing, and then you've got the integrating idea.

So this is getting pretty complicated, but it's a good-- look through it and see if there are any terms that kind of speak to you. And it does certainly help you tease out various mouthfeel aspects.

So now moving on to serving temperature. This is work that we've done over a number of years, and I was drawn into it because there really isn't much scientific research out there that talks about serving temperature. There's a tremendous amount of anecdotal information, and when we started off in this research area, I was thinking, well, what should I serve this red wine at, you know, for our research. What temperature should we do? Just room temperature? Or does it really make a difference if it's a little bit lower? And so that's what brought us to this research area.

So there is a trigeminal receptor that does respond to temperature in our mouth, so we are able to pick that up. Cool temperature tends to enhance prickling and prolongs effervescence, and that's why we serve sparkling wine cold. Conventional serving temperatures-- white wine-- the cool temperature was thought to suppress sweetness and enhance acidity. Red wines-- the warmer temperature is thought to suppress bitterness and astringency. But in doing further reading, there really hasn't been much research done in the area. But the preferred serving temperature may primarily be a reflection of habit.

So was there really a difference was our question. And so we [? tested to answer ?] that, and are still working on this research because there's a lot to learn.

So this is the first set of studies that we did. When we looked at pino grigio, which is the white wine, and we looked at merlot, which is the red wine, and we served it at three different serving temperatures-- four degrees, 10 degrees, and 18 degrees Celsius. So four degrees is refrigeration temperature. 18 degrees Celsius is a little bit cooler than room temperature.

And so what we found is there are differences in aroma as you increase the serving temperature. There were significant differences in aroma, and that's represented by those different letters. With sweetness and acidity, we did not find that there was a significant difference in people's perception of sweetness or acidity. You saw a bit of a trend, but it wasn't consistent.

Red wine-- same sort of thing. We saw differences with aroma. Those serving temperatures were 14, 18, and 23. 23 is room temperature, and 14 is, well, a little bit colder than that. And so it was not as cold as refrigeration. I mean, it was cooled down to that temperature. We didn't hold it in a refrigerator. But it was probably cooler than most people would consume a red wine.

And we found that there were no significant differences in astringency and bitterness. And it could have been a function of the wines that we worked with. So we are doing white wine research again-- not re-doing it. But this is a real result. But we're doing continuing on with this

area. And we did this research, or we continued on with it, already in red wine temperature. So this is a recently published research.

We used a different type of methodology-- something called napping-- and that is-- nappe is French for tablecloth, and so what we give to our panelists is a large piece of paper. And what they do is the-- and then a series of wines. Eight wines or six wines. And they sit with those wines in front of them. They taste each of the wines and they cluster them based on how similar they are to each other.

So if they think-- they try the first one and they set it over here, and then they taste the next one and say, well, that's really different from the first wine. I'm going to put it over here. They can use whatever parameters they want to to distinguish the line. That's where the data analysis gets a little tricky.

So they can use whatever they want. They can use sweetness, they can use astringency-- whatever attributes are meaningful to them to distinguish these wines. And so at the end of it you have a tablecloth with their wines on it, and then you can have them do something called enriching it, where they write down how they separated the wine.

And so we had them do that, and so what we did here was we had six different wines, and they were all lembergers. I was trying to work with a Washington varietal. We served them at three different serving temperatures, and I have it translated down here from Celsius to Fahrenheit. So it's 50, 51, and 72 Fahrenheit. And this was red wine. And they were all served to the panelists, and then they clustered them.

And what we're graphing here are the different attributes that people could agree on, and then we had the number of mentions. So that's the number of people who mentioned this particular attribute as describing the sample.

So translating all of that-- if we look at bitterness in the top right, we've got the three serving temperatures 10, 16, and 22. And what we see is at 22, a lot fewer people used the term bitterness to describe that sample that was served at 22 degrees Celsius, implying that it was less there. And we looked at astringency. We see that a lot fewer people at the high temperature used high astringency to define that particular sample, but more people used the term low astringency.

So we did actually see-- in this study we did actually see differences in astringency and bitterness. And you can see all the differences that we did find among the wine samples. This was just the selection of the significant differences we saw. We had a huge number of terms that were generated. People perceived all kinds of things.

OK. So moving on to overall impressions, and then we'll finish it up with a little bit with win-- with a little bit of wine faults. So we talk about wine finish, which is short versus long, and those are tastes, aromas that linger after either swallowing or expectorating the wine. In the past, the

vocabulary has been sort of short, which is just a short reminder of the wine; and then long finish, which is a feeling of lingers there. It's kind of nice.

We've done some research in this area that I'll quickly go over. In white wine, we looked at the effect of oaking on chardonnay on finish time, and then in red wine we looked at the effect of different components of the red wine on finish time.

In chardonnay-- it's this right here-- we've got percent oak. And these are commercial chardonnays that we purchased. There was an unoaked chardonnay, there was a highly oaked chardonnay, and then there was sort of a medium oaked chardonnay is what we're calling there. And what we see is that of three-- if you look at the top figure-- people liked-- [? hedonic ?] mean was along a seven point scale-- people liked the 0% chardonnay the best-- the unoaked chardonnay the best. They liked the highly oaked chardonnay the least of the three samples.

We also did a willingness to purchase. So we asked them how much they'd be willing to pay for these wines, and how willingly would be to buy the wines, and we found that they were more willing to buy the less oaky one. They wanted a non oaky chardonnay.

In addition to asking people how much they liked the finish, we also sent each consumer into the booth with a stopwatch, and then actually put the wine in their mouth, they spit it out, and then they hit the timer, and they timed how long that wine took to finish. And they actually found that-- we had some really good results with 60 consumers. It was very impressive.

So what we found is for the high oak wine it took about 53 seconds to finish-- so almost a minute-- whereas for the unoaked wine, it took about 45 seconds to finish. And that was just people sitting in there with the timer recording how long that oaky flavor lingered in their mouth. So we did find that there were people who were able to perceive that, and there were differences.

This is more recent work in red wine. This is a sirrah that we took. We dealcoholized it and we brought it back to two alcohol levels-- a 10% and 16%. The 10 is the low alcohol, and the 16 is the high alcohol. And then we also added different compounds to it. We added a bell pepper compound, a coconut compound, and a floral compound. And what we found was that for all the high ethanol samples, all of these compounds took longer to finish.

So in bell pepper, the high alcohol sample finished 7.7 seconds later than the low alcohol. For coconut it was about 6.8 second difference, and for floral, it was quite large. It was a 12 second difference. In the high alcohol wine the floral stuck around in your mouth longer than in the low alcohol wine.

We did a similar study, but this time we varied tannin levels, so we had a high astringency wine and a low astringency wine. We didn't find differences with coconut and floral, but we certainly did with bell pepper. So that the bell pepper-- it took longer to finish in the high tannin wine. It tended to stick around longer.

So we are finding differences due to the composition of the wine due to the alcohol concentration, and then also due to the tannin concentration as well. So that does affect our finish.

So moving on with the overall impressions. We talk about complexity in a wine, which is the presence of many distinct elements. How many discrete things can you sort of pick out of this wine. We also talk about balance or harmony, and this refers to equilibrium where individual perceptions do not dominate. So there's not one thing that jumps out of you. There's sort of harmony.

And I mentioned this earlier on-- maybe in webinar one-- it tends to be something you don't notice until it's absent, because you might try a wine and think, wow, all I'm getting out of this wine is sourness. Well, that would imply that the wine is not balanced. It's just not very harmonious.

And also looking at the balance, and depending on the wine, but balance between different sensations. So if you've got a table wine, having a balance of sweetness and soundness. As I mentioned before, if you've got a dessert wine you may not have that balance, but that's OK.

The same thing is with food. If you want something to be intentionally very spicy, then it might not be imbalanced. And again, that's OK if that's what you're expecting. Body can balance astringency, and then you can have heat or alcohol that balances acidity. So depending on what else is going on in the wine, these different things interact.

Other elements of overall impressions-- so development. These are changes in the aromatic character that occur during sampling, during tasting, during evaluation. How does the wine change over time? How does it develop?

Duration-- how long the fragrance retains a unique character. So how long could you smell oakiness? How long can you tell that's still oakiness?

Interest is how interested are you. Are you going to buy this wine again? Are you going to tell people about it? Was it worth the money that you spent? And the memorableness, similarly. Was it unforgettable? Would you buy it again, I think is the question. Would you buy it again for $20? What if it was $10-- would you buy it again?

All these ways of evaluating how much you like something and how much you value something. Those are all things to kind of take into account.

This study looked at recognizing wines, and what it found was that people have different abilities to recognize different wines from each other if they're given two wines of the same varietal. So it can be harder for them to tell sangiovese apart from each other, but if they're given two samples of chardonnay, they can tell them a little bit easier. It's easier for them to tell them apart from each other.

So this is the ability to recognize different varietals maybe due to different growing regions or different areas or even just something-- even just different wineries. So people's ability to recognize different wine differs. It can also be easier for them to recognize that wines are different from each other, versus they're the same varietal.

Now, moving swiftly on, we've got wine faults. These are wine faults that are in mouth. Most of the wine faults that we talk about are obvious to the nose, meaning that you can smell them. Most of them you can pick up in the aroma, and they need really only confirmation by the palate, except for a few that I'm going to talk about-- one being metal contamination. That's something you don't usually pick up until it's in your mouth.

There are gustatory faults as well. This refers to something like the structure of the wine. Are the elements imbalanced? We just talked about that. Is it harsh or sour? Because that could be considered a flaw. Is it excessively tannic? Is it very bitter? Is it really astringent? Meaning that it may not be astringent if it had a high enough alcohol concentration, or something was competing and balancing with it. It's really that if it's out of balance, it's going to appear to be too something or other.

Other things. Excessive alcohol. This refers to a wine being too hot-- too high in ethanol. And commercial wines have certainly increased in alcohol concentration. So in the 1970s we were looked at 13% alcohol, and that would have a big wine. Now we're looking at 15%. We have some wines in the lab that we bought commercially that are 16.3%. So very, very high in alcohol. I mean, almost fortified wine territory.

So some of these wines-- if they don't have anything else competing with that high alcohol, that's all you're going to get. And as we showed previously in this webinar, it can affect the aromas that you get out of the wine, as well as the perception of bitterness and astringency. So it's not just going to exist on its own.

Another thing to think about is harsh tannins-- so the tannins and the astringency. So these are tannins that are responsible for wine astringency. It's a component of mouthfeel, and you think back to those mouthfeel wheels and the attributes you evaluate for mouthfeel. And so it's very much a component-- very much something that's present in red wine.

And just a little bit of information about where the tannins come from-- from the seeds and the rest of the grapes. So a lot of it is tannin management in the winemaking and in the vineyard. So it's kind of both places that they manage these tannins. But it is something to keep in mind that if it's out of balance, it comes across as a flaw and something not desirable in your wine.

So I think that takes me to the very end of the webinar, and I'd like to thank you for your time. If you have questions, I think you can send them in. I can either answer them online. I can try to answer them now, or I can also-- if you want to email me any questions, I'm happy to answer them.

But thank you for attending the webinars. I hope you learned something about wine tasting, and have fun with it.

CORY: Thank you everyone for tuning into our wine sensory evaluation webinar series. If you have any questions for Dr. Ross, please feel free to post those in CougSync, and we'll get those answered for you.