

Matt Kirkegaard: Good afternoon, everyone, welcome to this Brews News webinar. I'm very honoured to be able to present some experts in yeast and also low-alcohol brewing.

Our panel today is Jon Seltin, Jon has been head brewer at a number of craft breweries, and is now head brewer at Melbourne's Brick Lane, where he brews under that label. Brick Lane is also one of the leading contract brewing facilities in the country, and John has worked with a number of brands to develop their alcohol-free products. John, thank you for joining us.

Jon Seltin: Thanks, Matt.

MK: Ruth Leary, who is also very well-known in the industry. Ruth holds a Bachelor of Science degree in Food Science from Otago University, and also an IBD Diploma in Brewing. Ruth studied fermentation science as a post-grad and fell in love with beer, as we all did. But she fell in love with it back when she started at Lion back in 2002, first in the technical team, and then as Yeast Propagator, she is now the Regional Sales Manager at Fermentis.

And we're also joined by Justin Fox who is wandering between breweries in Sydney and will be joining us very soon. Justin in, here he goes, he's now at Batch Brewing in Sydney's inner-west. Justin is Head of Sales, Product and Development at Bintani, before that he has worked as a technical brewer at Lion, and head brewing at Colonial, and he has consulted to a number of breweries, including Hawkes, where he brewed, in 2018 he brewed the Champion Lager at the AIBA. Justin, thank you for joining us as well.

Just to the participants who are watching this stream, we're going to give a very quick overview of low-alcohol brewing, some of the recent developments that we've seen at the full spectrum of the brewing industry, but then also a large number of our brewers probably don't have the technological setup to be able to brew some of those, so we're going to focus a little bit more on the microbiological approaches to brewing, and we'll have our panel to discuss those.

But Jon, maybe you can start by giving us a little bit of an overview of some of the recent developments for low-alcohol brewing, and what it has led to in terms of the quality of the beers that we're seeing on the market these days.

JS: It's been something that brewers have been playing with for a very long time, taking a number of different approaches. Broadly I'd say there are two big churches, or two big schools of thought here. That's not to say you can't combine these two, and indeed a lot of people do combine the two.

Broadly there's a physical approach to the production of alcohol-free beer, that's de-alkalisation, or physically somehow removing the alcohol from, say, finished beer produced using more or less traditional methods. And there's been a lot of innovation in this space over the previous couple of years. This used to be well and truly the territory of large, national brewers with sites producing many million hectolitres per annum. Increasingly there's more and more investment from small

breweries in physical de-alkalisation, and there's a number of people in the craft space in the States and in Europe who have gone down this route.

There's a number of approaches there; the two main ones, I guess I'd categorise as some sort of vacuum distillation, this technology's been around for a long time, where essentially you're using the physical principle of distillation in that alcohol and the other components in the beer matrix will evaporate at different temperatures. And with the application of the vacuum in some installations, a reasonably high vacuum it's possible to essentially fractionate the ethanol out from the other components.

Nowadays there are vendors who are producing these in very, very low flow rates, down as low as 10 hectolitres an hour, operating at fairly low temperatures as well. Temperature has always been a concern for these thermal de-alkalisation approaches in the past from a lot of brewers. I know that several vendors out there are spruiking de-alkalisation temperatures below 40°C now, which is reasonably low.

We can get into the nuts and bolts of some of these, perhaps in the questions, but the other common physical approach is a membrane diafiltration, or dialysis approach, which uses semi-permeable membrane that allows for diafiltration or dialysis, the leaching across the membrane of ethanol and water, and leaving behind a lot of the flavour and aroma active components in the finished beer, essentially creating a permeate of ethanol and water, and trying to hold back the retentate of this flavour active beer essence, essentially, that can be then re-diluted back to a sellable strength. This is an approach that, again, used to be the province of only very, very large brewers. But now there are a number of vendors on the global stage who are making these in smaller and smaller flow rates to meet the demand of smaller breweries, particularly craft breweries. And not just breweries, but other fermented, non-alcoholic industries that have sprung up. Kombucha comes to mind, where larger scale kombucha producers in Australia and in other markets, in the States in particular, I can think of, can get into some regulatory hot water if their ethanol levels in the product are too high.

There are a couple of other really exotic methods that I've certainly never seen on the physical side anywhere in the world, but are out there. They're used in some research or trial-scale plants that I've heard of, certainly in wineries or in other alcoholic beverage industries using more novel techniques, or exotic techniques like fractional freezing using solid state O₂, so dry ice. Spraying a product into dry ice and fractionally freezing products. This is, I've never seen it commercialised, but I've heard of pilot trials here. Likewise, super critical CO₂ extraction, using packed columns and using a solvent to fractionate either across a membrane or across a packed column to fractionate out the ethanol and the other stuff that you want to keep behind. But, again, these are very much in prototype or trial phase. It's mainly that thermal or those membrane technologies that you see out there in the wild in the breweries that I've been visiting.

MK: Tell us some of the vacuum distillation method. You indicated that it's more accessible to smaller brewers these days, what sort of scale are we looking at there?

JS: Good question. I guess it's up to individual brewers to determine what sort of ROI makes sense, but they're still very expensive installations. You can imagine the kind of capital equipment involved in an installation like this is fairly substantial, and even the national brewers that use this approach in Australia, their plants are of surprisingly low flow rates. These products have got a growing place

in the market, right? But they're nowhere near as developed as they are in, for example, Germany, or other European markets, where they're much more of a sizeable chunk of the overall beer market.

I guess the litmus test for me is, who's installing these things? And there aren't many in Australia because they say the market is still fairly young and fairly small. In the craft space, I'm talking outside of the national brewers. If we do look in North America and in Europe, there's a smattering of them. There's a small amount.

One consideration is, if you put in some sort of thermal de-alkalisation treatment, is you've got to run the bloody thing. It requires quite substantial utilities investment. I mean, there's obviously always some sort of energy recovery in these systems, but just to refrigeration requirements alone, if you're running at, say, 20 hectolitres an hour with a 5 Degree DELTA T (ΔT), that's 50 kilowatts of additional refrigeration that you're going to have to find somewhere to make that work. Likewise, there's the steam used. Likewise, the energy for running the vacuum pumps. It's not just an investment in the kit itself, but indeed it's everything around it as well in terms of thermal energy, refrigeration, electricity, and then the hidden one that some people don't think about is, what do you do with the waste stream?

I remember talking to you, Juzzy, several years ago about the approach that was taken at Swan with the de-alkalised beer waste streams. This stuff isn't easy to get rid of. If you put it down the drain, it's very expensive in terms of BOD and contribution to your trade waste costs. It can be dangerous in some installations. You need to consider your ICCX or your explosive atmosphere code if you're distilling this thing at levels that could be flammable.

But there is a degree of complexity, not just in the process itself, but in everything that surrounds it, including those waste streams. Some big breweries are very good at dealing with that, either by putting it into new product types, or blending it, or, for example, feeding it to their trade waste plants and producing biogas out of it. But these are out of the reach, I'd say, of most small craft brewers, certainly of us.

MK: Which I guess is what brings us to the microbiological pathways that we are primarily looking at today. Just out of interest, in preparation for this chat I organised to speak with Philippe Jansens from Fermentis, and I've just shared an article I posted last night into the chat for anyone who is watching that might be interested. It just talks a little bit about, he, Ruth, is it fair to say that he was the Fermentis scientist that discovered the yeast from the yeast bank? Is that the best way? He didn't invent it, obviously.

Ruth Leary: Yeah, and there's a yeast bank of about 8,000, and that's managed by collections managers, a whole team of people who look after what's in that yeast bank and also characterising it all. I think Felipe led the project to find it, to find the right strain, because I know many were tested. To come to choosing the ultimate strain we released first into this space, yes.

MK: And there are strains that either process the more complex sugars, like the maltose, more slowly. But this is one that, from what Felipe said, just doesn't process those at all.

RL: Yeah, and that's the thing. Some of the strains we looked at were very slow consumers of maltose, but they would consume it so it would risk a little bit of higher... We were aiming to get a yeast where you could achieve around 0.5% alcohol with a relatively regular all-malt fermentation,

and quite consistent. Whereas some, and then not go on to attenuate further and cause problems later in the process as well.

That's what we're looking for. Aside from that, and then also flavour considerations, too, were really the top priority.

MK: We want to have a lot of time for questions, which I suspect there will be primarily, so that article's there if anyone wants to read it. But Jon, do you want to tell us a little bit about the processes that you've used? The micro-techniques that you've used, and how you've found them?

JS: Yeah, sure. We actually used, and continue to use, a number of different techniques. When we did a bit of a dive into low- or no-alcohol beer production, we thought about the big picture, about physical approaches or de-alkalisation approaches, and for the scale of what we were considering doing, we thought that a more reasonable approach, or a more easy way to get it up, would be to look on the microbiological, but not just microbiological, I'd say sort of biochemical in general approaches.

I think one of those things that brewers do every day that we're currently good at, and how can we harness those to start making these product types?

One of the basic things that we want to achieve here, instead of removing the ethanol is inhibiting ethanol production in the first place, and still winding up with a product... The litmus test for me is winding up with a product that more or less tastes like beer. And without some degree of fermentation, without the production of aromatic esters, the cuts appear of alcohols, all the other stuff that we associate with beer flavour, it's very difficult to get something that tastes the same. It was a bit of a path here.

We actually started looking not just at yeast, but at the manipulation of the carbohydrate profile of the wort as well. You touched on this a little bit, Matt. Brewers all day, every day, understand mashing biochemistry and we know that by taking what we do every day to its logical extremes, you can actually do some interesting stuff here. So by, for example, inhibiting to the greatest degree beta amylase, which we know works just from that non-reducing end of the starch molecules making small maltose units, and instead creating mashing conditions that promote exclusively or to a higher degree alpha amylase, which can create a less-fermentable carbohydrate profile, is something that brewers do every day. And this is one of the places to start, to essentially make as un-fermentable a wort as possible through manipulating mashing conditions.

Another approach is, some brewers are using this in tandem with a cold water extraction approach. This is something that I don't have any great direct experience of, but I've spoken to plenty of brewers who do, and they've used an approach where they'll seek to get malt flavour and aroma into the beer by cold temperature mashing, sometimes then followed by high temperature mashing, you can get the best of both worlds.

Beyond that, we started to look at how else can we play in the brew house before we start even thinking about fermentation, to set ourselves up for success. Some approaches that some people take include adjunct supplementation of the wort in various ways. Usually to decrease fermentability you use things that are highly polymerised, long polysaccharides. Things like highly polymerised maltodextrin from corn or rice or cassava or tapioca or another source like this, to make a really unfermentable wort.

Some people also, and we've got a great question already that was sent through around using lactose, or other unfermentable sugars, to create highly unfermentable worts. This is an approach. I'll come back to it, but paradoxically you can actually go in the other direction as well. As I was saying, if you make a wort that just won't ferment - and Ruth, you'll be able to talk to this with a greater deal of expertise than I, probably - but it's hard to get some of those fermentation-derived flavours without some degree, without turning on these metabolic pathways in the yeast. So there needs to be some sort of yeast growth, there needs to be some sort of fermentation, that goes on.

And paradoxically, what that can sometimes mean - depending on the yeast choice - can actually mean supplementing the wort even with glucose. Making sure that you've got a really clearly defined and known amount of extract, yeast-fermentable extract, beyond the bread-and-butter maltose that we make every day in the brew house, to make sure that we are getting the right degree of fermentation and right flavour out of the yeast.

MK: Is that where you're talking about, because one of the things that Felipe stressed was that it's a POF positive yeast, so you do get that phenolic addition from the fermentation, is that what you're talking about there?

JS: Yeah, whether it's a contribution from phenolic compounds from yeast metabolism or other stuff. I'm more thinking the other kind of esters that we associate with beer flavour, or the higher alcohols that we associate with beer flavours. These things are present in really small amounts in the beer, right? But they're so integral to beer flavour, without them beer's not beer. Without some sort of fermentation, you lose the very stuff that I think makes beer, beer, and you end up with Malta or malt flavoured soft drink, or something like this. The fermentation, and getting the fermentation right, is absolutely critical to the flavour and aroma profile of the finished product.

MK: Just one other question before we move on, we've had a question from Jonathan Cowry in the chat room. "Re: the selection of the yeast strains," so this is going back to the start of that, "are there possibly going to be further releases with different characteristics for different styles?"

Ruth, I guess you can speak to any hidden laboratory trials that are going on?

RL: Well, I'd get shot if I broke any news, but it's an absolute area of, we've got two top priorities at Fermentis at the moment for new developments, and low-alcohol's certainly a space and I know there's more launches planned. I can't tell you what they are yet, but definitely we're trying to give some variety.

The first launch, as you mentioned, is a yeast strain that perform the best from a consistency and flavour perspective. There's POF positive, not everybody wants that, but you can control your brewing techniques and what else you do with the brew to hide and mask that anyway. But it does contribute to beer flavour, so that was one of the reasons it was selected first.

But there will be others. There'll definitely be others. Watch this space.

MK: Okay, hopefully that answers that question. Now Jon, is now a good time to take the first part of the question that we've already been forwarded, which is Alistair Gillespie asked, he's been trying his hand at brewing... I'm not sure how much of this he wants us to actually reveal from his brewery's point of view. Anyway, he's been playing around with an all-specialty-malt bill, 72°C, and then adding maltodextrin to compensate. Is there 100%, non-fermentable, malt-based body-

enhancing additive that can be added after ferment, or is everyone just doing trial-and-error with maltodextrin until the best value is determined?

JS: It's a big question, that one. I guess there's a couple of different approaches. He specifically said in there, the interesting thing for me is the post-fermentation addition of body-enhancing substances. If there's no yeast present, there's no fermentation that's going to go on. Regardless of the kind of extract that's used, whether it's a maltodextrin with very low DE, or high DP, confusingly. You know, a high degree of polymerisation for low dextrose equivalent. Whether it's something like that, which would contribute extract but not necessarily sweetness to the beer, or indeed, even if it's something, a much sweeter type of sugar. It's not unknown for brewers in Europe, for example, to produce these sorts of beers and supplement with sugars that are highly fermentable and that are very sweet purely to enhance the mouthfeel and the palatability of these products.

If there's no yeast there, that's not going to be a problem. The challenge is, for a lot of small brewers, to ensure indeed there is no yeast there, right? That the product is microbially very sound. We'll be getting to this later, I'm sure Matt, but the playing or the messing with the carbohydrate profile of the wort is one way of doing it. But don't forget that that can also be done at the end of fermentation, after yeast separation. After removal of the yeast.

Pretty fraught for a small brewery, we need to make sure that there's no chance of refermentation or worse, but that is an approach. And Ruth, maybe you've got some experience with, I know that some European breweries will actually supplement the finished bright beer, or beer in filtration, with other flavour or body-enhancing extracts.

RL: Exactly. And there's a whole raft of soluble fibres and things too, a little bit similar to maltodextrin, but you have corn fibres, you have isomaltose, which actually sounds like it's from malt. It's not, it's from sugar. Those things are completely soluble and add to body and they're not at all fermentable, because even if you've got one yeast cell in there, once it's got something to ferment, it will grow or barden, you've got a big problem, potentially, on your hands. There're some other options.

And some brewers, again, if you've removed every single bit of yeast, you could put malt extract in at the end if you really want. It won't matter, it won't ferment.

MK: One of the things that you raise then, Jon, which is one of the issues that Felipe raised when he spoke about it is the residual sugars. It's very, very important, Felipe stressed pasteurisation is important for these beers. He wasn't even convinced about sterile filtering, he said that that may reduce the need for pasteurisation, but he was fairly adamant that, with sugars in there and the potential for yeast, you just need to exclude.

And I guess the other thing that brings in is the potential for hop creep, or the enzymes interplaying with the hops to break down those sugars as well.

JS: Do you want me to take this one, Ruth? Or would you like to speak to this one?

RL: I could add a couple of things to this one, like on the hop creep, for example, I can speak to. Because we've released a yeast strain, the first one, that we've been talking about, LA-01, it won't ferment maltose. It will ferment the simple sugars, however if you're adding a lot of hops during fermentation, so when you've still got a temperature high enough for the enzymes in the hops to

be active enough to then break down some of those sugars into simpler chain-lengths that yeast can assimilate, we've seen brewers end up with a 70% attenuation from hop creep.

That's quite an extreme case, and it was left far too long, but there's a lot of techniques and advice on hop additions to avoid hop creep, so it's right at the end of the whirlpool, then once you've cold-crashed. Looking also at some hop products, potentially, as well. There's all different techniques to avoid it, but it is something you have to be aware of.

JS: On the pasteurisation front, I'd echo Felipe's comments. We absolutely pasteurise all of our low- and no-alcohol products. There's a number of considerations here, there's the ones to do with product quality, for example. The chance of refermentation, of high-pack pressures, of the product safety. If you sell someone a low-alcohol beer, you better make sure it's low-alcohol and that it doesn't indeed have alcohol in it because of the occasions and situations in which people find themselves drinking non-alcohol beer.

For me it's driving home after work, for example. It wouldn't be great for me to try and explain that "no, really, it's alcohol free," when it's not.

The other thing here, and it's worth touching on right, is the significance of the food safety and public health concerns here. A fair bit to unpack here, and probably maybe a little beyond the scope of what we can get into, but we know as brewers, and we're lucky, I guess, in our food safety management in breweries that the beer is generally a fairly safe product. There are all three hurdles to the growth of pathogenic microbes in beer. High CO₂ content, hop bitter acids that inhibit the growth of certain bacteria. Low nutrient [sound beeps], low amounts of available extract to ferment or to grow on. Low dissolved oxygen, and critically, also, high ethanol content.

And if you move one of these things, low acid, also, I should mention. Low pH, high degree of acid. You remove some of these barriers, or you play with some of these things, and it can quite quickly unravel, and you can potentially have food safety concerns that would be beyond the everyday experience of a lot of brewers who are producing generally normal beer types and more in the experience realm of people who are producing beverages that are more risky. Less acid, higher pH, no alcohol, lower carbonation. This is really danger territory, and when you are exploring these product types, it's critical to make sure they're picked up in your food safety management planning as well.

But for us, yeah, pasteurisation for these sorts of products is an absolute non-negotiable. It's critical, we believe, for not just product safety, but from a public health perspective as well.

MK: Justin, did you want to jump in and say anything around that?

Justin Fox: Honestly, I haven't had much to jump in on so far in this at all, because everything Jon has said is really sitting with what I see in the market. And that pasteurisation level can be more significant than otherwise, (unintelligible 28:35) beers are run through between the 12-20 PU mark, and in these products Fermentis has done a lot of work and really found 50 to be the bottom end. It was originally recommended 50-100 PUs and some further testing has come back down to that 50 mark. Absolutely essential. We're very protected in our understanding of food safety and the risks involved in pathogens. And when we're going into this space, we're really changing that landscape.

JS: I should mention, there's a bunch of nasties there that potentially could raise their head as well that we don't think about too much in brewing. There's pathogens that we simply don't see in beer at all, but then there's other things that the matrix could promote growth of, or that could survive in an alcohol-free or a low-alcohol product. You know, things like mycotoxin producing fungus, for example. Or things that, while not acutely pathogenic, could produce chronic health effects like polyamines, the productions of whatever histamines, or putrescine, these kinds of nasties that can have longer term, chronic health effects that could grow in the absence, or produced by bacteria in the absence of alcohol, essentially. There's a whole range of risks there and best managed, certainly in our view, by pasteurisation.

In the best-case scenario, if there was any yeast contamination, we know that breweries are full of normal yeast. With the amount of extract left, no matter what the approach, whether it's using the products that Fermentis make, or whether it's using more traditional arrested fermentation techniques, or the cold contact method, or something rare and novel and sexy like a mobilised yeast or something like that, there's going to be yeast-fermentable extract left in the finished product probably, depending on your approach. And even simple brewers' yeast will mean high pack pressures, it'll mean exploding packs, it'll mean costly product recalls and a headache for the entire segment.

So yeah, I'd really encourage to think long and hard about the way of managing and updating their food safety management around producing these styles of beer. For customers, but then also don't forget what goes on inside the brewery as well from a safety point of view. If you're, I mean, I'm telling brewers how to suck eggs, they're excellent at managing their safety inside breweries, but if it involves hoiking tonnes of bags of some sort of saccharide or soluble fibre into a tank, we've got to think about that as well, perhaps, before going down the path.

MK: Do these technical elements we've been talking about, do they put low-alcohol production out of the realms of the very small brewers? Or are there other solutions that they can look at?

JS: I'd contend not. I think that there's so many different approaches nowadays and so much innovation, that with a keen eye on food safety management, even small brewers can indeed produce these styles of beer. I think there's more research, there's more product availability. I think from a brewer's point of view there's never been a better time to be making these styles of beers, and like I said just earlier, whether the use of novel yeast strains, maltose-negative yeast strains, non-saccharomyces yeasts. There are plenty out there that are used by, for example, German brewers for the production of no- or low-alcohol wheat beers.

There's so many different ways of approaching this nowadays, there's so much written on it and so much experience out there, that I don't think there's a better time, really, to get into it. There's significant challenges, but that's what makes it so fun, I guess, or so interesting to get in to.

JF: And at the low end of the scale, the craft brewers have the advantage of calling it fermentation and moving it into kegs and into their own fridge and really having an opportunity to experiment without necessarily allowing that extra heat to come back in the product, without releasing control of the ambient temperature storage. They have other tools at their protection in this experimentation phase of playing with low- and no-

MK: I'll just remind those who are watching you are welcome to ask any questions. We will be starting to move toward questions if you want to post them. We've sort of skipped across the surface a little bit in terms of the broad topics.

Jon, one of the other challenges in, and I think you touched on this before, is there is a conception of what beer is, and as soon as you start taking something like alcohol out of the consumer's experience with the beer, there's always been a perception that there's been something lacking. We've seen a whole range of interesting recipe development techniques used to try and still give a satisfying drink without alcohol, but with mouthfeel and flavour.

How important are things like balance versus replacing some of that alcohol with hop character? What are the challenges around recipe development?

JS: I'll take myself off mute. You'd think I'd learn by now, right? After this long in lockdown, but no, I still leave myself on mute.

I think that's an interesting question, and you're spot on. There's been a bunch of interesting consumer sensory science stuff done in this space about setting up expectation around these beverages and the way that the brand marketing works and the way that they're talked about for the consumer. Generally, especially in craft beer, if you look at – for better or worse – beer rating websites, there's a pretty linear relationship between alcohol and the general rating of a lot of products. In a review of no- and low-alcohol production - I can post you the details later, Matt, to put up in the—

MK: Yes please.

JS: There was a great chart that someone had done looking at distribution of scores on RateBeer or Beer Advocate versus ABV. It was bang on linear, the higher the ABV, the higher the rating. And a lot of [mic cuts out] brand marketing, all that stuff that I know very little about. The interesting thing for me is, how do you set up a consumer for a great experience and what can you do in the formulation of these products to give people something that really is not a compromise but is something that's interesting and delicious.

In our repertoire of tools, or in our levers we can pull to do that, there's things like various synergistic flavour effects, or masking flavour effects, or dialling certain things up and certain things down, all the way from raw material selection through the brewing process, particularly in fermentation as well. I think the answer is essentially lots and lots of hard work. Lots of trials, lots of work on formulation, but also on mastering the process, really getting to know the process that you're using.

Some of the processes we haven't touched on, like arrested fermentation, or like cold contact fermentation. They bring challenges as well which can be managed. Some of the new or novel yeast strains that are being used will produce high levels of certain off-flavours, like phenolic off-flavours or acetaldehyde or diacetyl is sometimes a big problem in some of these fermentations as well. Getting to really know what challenges you face allow you to unlock ways around them, either in manipulating the process or the raw materials or something else.

That's a pretty boring answer, I guess. Or bit of a platitude, right? I don't know if I did a very good job answering. Essentially the answer is, it's complicated, I guess. And every approach has benefits and pitfalls that need to be managed by the brewer.

JF: Matt I would like to add into that, it's like what we did with mid-strengths. If you go back to the early 2000s, the only real mid-strength beers, or light beers, going around were Cascade and Hahn Premium Light. What's happened with craft brewers is, when everyone started playing in this space, the beers, most of them had a hole in them. Most of them lacked a balance. They were simply something missing things, and brewers have found multiple different ways to fill that gap over the last decade, two decades.

I think the same thing will now happen with low- and no-alcohol. We're no longer trying to [crosstalk] the Germans and other successful European countries have done with low-alcohols because they've stuck to that tradition, and now we're a generation that's going to breach tradition in that no-alcohol space. And it might take us three, four, five years to really get the nuance of fixing that balance and keeping that body and filling those holes. It's only going to be through more and more people experimenting and playing in this market, or say it's in Australia with 700 different brewers out there discovering new ways to do things. The proof will start to come out, people will find ways that really match these beers to the profile we want to drink.

MK: It's interesting, because there is an element at which this is brewing science versus marketing science, if marketing's a science, we're trying to work out. We've had a question in the chat room, it's probably more in the marketing realm, but Andy asked, "I've noticed that most of the 0.5% and 0.0% beers have more sugar than regular heavy beer, which is because of the unfermented maltose in the wort. For consumers we're solving one problem but creating another potentially. Is it a trade-off we have to live with? Or is there some newer techniques that will be possible to deliver a full-flavoured non-alcohol beer with minimum sugar per 100ml?"

JF: I think absolutely there will be. I'm seeing it get closer and closer, some of the beers I've had recently have got, for that perfect beer like Jon said, you grab it out of the fridge at work, it's something to enjoy and just clear the days. You arrive home refreshed and you process that day out, and there's 0.3, 0.4%. I find them quite enjoyable in that aspect, and I know a lot of other brewers who have already entered that, say Modus for example with Nort, Matt up there thoroughly loves drinking that as that first go-to beer that you're just looking for something refreshing at that point, not necessarily looking to get on the booze.

They are coming closer, and they are enjoyable drinks now. Whether the true match up ever comes, where someone can't pick it, time will tell.

MK: But I guess that question was actually looking at the residual sugars that are in there, and it's always a trade-off. In a regular beer, the sugars are converted to alcohol, which is where the kilojoules come in. But a consumer looking at the nutrition panel is still going to see that there are a lot of carbohydrates, or a lot of sugars in that beer.

JF: The consumers have jumped on all these juicys, and they're all finishing at 6 Plato, so I'd argue that a good low-alcohol's got less sugar in it than the TDH Oat Cream craze that's hitting the market now, and the consumers are happy to jump on that.

[crosstalk] about balance and contribution, I guess, and how that works in a flavour profile. And that's why it stands out in a low alcohol, because you're not hiding behind as much stuff.

MK: But low-alcohol, the low-alcohol growth in the market has been on one end, driven by this increasing health-consciousness. We've seen in another spectrum, seltzers very strongly proclaim

their lack of sugar as a marketing thing. With low-alcohol sitting somewhere in that space where it's health-conscious but still beer, do you think that the residual sugars will be an issue? Or, Ruth, is there development.

RL: There's things you can do to reduce the sugars, but there's always going to be some compromises, whether it's on cost, because you're spending a lot on a soluble fibre for body and non-fermentability, or having to really up your dilution factor as well, and then add back everything to give it enough flavour and character. There's definitely things you can do, but the products I've seen that are, there's a famous Asahi Zero Zero product, zero carb, zero alcohol. That's not beer by our regulations, it's made with all sorts of interesting ingredients, and most of them we wouldn't be able to use and call it beer in this market. To have it a beer and fit within there, I think it's quite hard to achieve no residual sugars unless you're spending lots of money.

How important is it?

JS: it's an interesting thought because I'd actually looked at it a slightly different way. I think that, genuinely, without any health washing of these products, they tend not to be ridiculously high in residual sugar. The real extract in a lot of these products, of whatever it's made up of, tends to be not that dissimilar from a lot of standard strong craft beers. And the other thing is, if you're comparing it against what I'd drink, in the occasions where I'd drink an alcohol-free beer, I'd probably otherwise be drinking a CSD, I'd probably be drinking some sugary soft drink. And it's miles apart from that.

I think, honestly without health-washing it or without a brand marketing cap on, I think genuinely they represent... It's not so interesting for me what this means for the craft beer drinker wanting to drink no-alcohol beer, I think the bigger and more interesting thing for me is the CSD drinker that's wanting to get away from 20+ teaspoons of sugar per drink into something that's natural and healthy and far lower sugar and fermented and has all of the other functional health benefits of fermented beverages.

In that regard, I think it's not bad. And certainly, when you look at total, in some of the products, like I mentioned, we make a range of products using a range of different techniques. We've had a cut at this using a couple different approaches, and if you look at – for example – the total energy in these products, they tend to be excellent against a normal beer, but especially if you're looking at it alongside a choice of drinking a carbonated soft drink, which is just really, really terrible for you in comparison to these other products.

[crosstalk]

JF: You can liken it back to when low carb started kicking the social, the health-conscious story, and it was Pure Blonde and all these other beers saying "1/3 of the carbs, 1/4 of the carbs", and if you looked at those beers, at the total calorie input on the body, the 5% alcohol plus no carbs is far more impactful on the body than a 4% alcohol beer. By ripping that alcohol out, you're dramatically dropping the carbohydrate loads and the impact on the body in a health-conscious way. So the question is really, it's exactly as Jon said, the products that these are replacing are carbonated soft drinks, they're iced teas. Would you rather have that than a choc milk on a hot day? It's just replacing a different part of the market, and that nutritional value is far higher in low- and no-

There's been some studies overseas that a couple of 1% beers after sport will rehydrate you far better than water, far better than Gatorade, far better than some of these other products claiming to be the ideal recovery drinks, because that nutritional sugar is natural, it's gone through a fermentation, and it integrates and works with your body better than the other options that are out there. So I think it'll own its own market in that.

And again, it might not be as high as Imperial Stouts even, but it'll own that sugar space, and if we can make it balanced, the products will take, in my opinion.

MK: We haven't had any other questions, so I'll just step back to Alistair's. The second part of his was looking at the benefits of lactose over maltodextrin. Is it used solely because it's non-fermentable, or has it got other benefits?

Jon or Ruth?

JS: I'll have a cut first, if you'd like, Ruth?

Well, it's certainly got some challenges, I'll tell you about that. Depending again on the target market for this product, you're introducing an animal product, so there's no more opportunity to make, say, vegan claims on the products. You're potentially introducing allergens, so you need to think about allergen management as well inside the brewery. Because you're handling milk, so you can't maintain a clean label, perhaps, in the same way that you could have otherwise.

The other thing is, I guess in terms of familiarity of brewers with lactose, it's not something that people are unfamiliar with, so, again, it's a way amongst all the others that Ruth's talked about, the use of your soluble fibres, or polysaccharides, or all the range of other products that are out there, it's just a nother way. All these products have quite different impacts, not just on the fermentability on the finished product, but also on flavour and mouthfeel. If you don't believe me, try tasting glucose, try tasting some powdered dextrose against some soluble corn fibre or very highly polymerised maltodextrin, or maltodextrin from cassava or something like that.

There's quite a huge difference in the, again I think of [cuts out] effect of [cuts out] here, as well as on the fermentability on the wort that you're producing. That's certainly something to consider, and it's something that we think about a lot at Brick Lane through our product formulation phases, and also through brewing trials on these styles of products. We really think about not just what gets us the number at the end of the day, but what gets us the best flavour outcome, what's the best way of producing a wort or a finished product, more to the point, that tastes just how we want it to taste, or just how our customers want it to taste.

MK: Just received a question. Peter Philip, "Jon, have you used the membrane filtration technique? And how are the results if so? And as a follow up..." Actually, maybe answer that, he does have a follow up.

JS: No, I haven't. I've drunk plenty of Adnams Ghost Ship, so I've certainly drunk plenty of beers that've been produced using that technique and spoken to brewers who have used it. Like I said, it's more within the reach nowadays of the smaller breweries. There are a number of vendors on a global level that are producing these at smaller and smaller flow rates.

There are aspects of it that, without having used it, that I really like. From the literature and from the beers that I've tasted, particularly for the production of hoppy beers and hop-flavoured beers,

but it's also not without its challenges. It's energy intensive, uses a lot of electricity to drive the high-pressure gradients across the membranes. It uses a lot of water in the diafiltration phases as well, so it uses a lot of de-aerated water as well. You need to have those utilities there and available in spades to use this technique.

The upside is, if you also want to make a seltzer, that's what comes out the other end of this machine. The waste streams, the co-products that you produce out of one of these plants could be another product stream for you. And it's when you start thinking about this that some of those ROIs or some of these projects might start to stack up commercially. You're not just making one product, potentially you're making a number of them.

I've had several, and I've enjoyed them thoroughly.

MK: Or if not seltzer, maybe hand sanitizer given the times that we're in.

Peter also followed up, "Since the source beer for the membrane technology is a fully-fermented beer, what is the resultant carb/sugar level?"

And I'll be honest, that's something that I've tried to get answers from Heineken about because when you look at the technique that they talk about using, and then the carb levels that are listed on the bottle, there's something obviously being added in at the end for the flavour. Do you know anything about that process, or what's leaving those unfermented sugars?

JS: Not to give up the ghost, or not to give away all of our... we do a lot of work to develop these, not to give away all of our trade secrets, I think a lot of people don't go necessarily one way or the other. There's often hybrid approaches, and I think some of the best approaches to low- and no-alcohol production actually are hybrid approaches that use a number of techniques at once.

Recently I was talking to colleagues in Brazil who are in the brewery that was making a huge amount of Malta, or similarly a colleague in Latvia, who was making a huge amount of Kvass, a similar sort of fermented, low alcohol, [mic cuts out], and it's not just one approach that these guys take, it tends to be a number of simultaneous approaches, a number of ways in. And that will often get the best flavour outcome and the best product in the end.

So it's fiddly, it's a pain in the neck, but nothing comes easy, either. Good things take work, I reckon.

MK: Another question, "I've noticed on the label for Athletic Brewing in the US, who are very well known, that they don't call the product beer, they only mention 'brewed'. It does contain yeast, though. Any thoughts on why it's not labelled beer? I'm assuming it's fermented, as it does contain yeast."

JS: That might be one for you, Ruth. I'm not sure about the regulatory framework over there as much as I am in Australia.

RL: Neither, about the US. I know little bits and pieces, but I know you have to ferment to call it a beer, which'll be part of it. What was on the label?

MK: Brewed, it just says that it's brewed, but not...

RL: I know that their regs say you can use any carbohydrate, a suitable carbohydrate source includes things like sugar for a beer, that's why seltzer can be pure dextrose and still be a beer, for example. They are fermenting. I think they're using some sort of specialty sugar, Athletic Brewing, as well. Or fibre. Sorry, I can't really answer that one.

MK: I'll take that as a question on notice and do some research for the show notes.

The one other we'd had submitted was from Alistair, saying that he finds that if he gives the yeast no work, "for example almost no fermentable sugars, that the resulting beer is very worty without many esters, beer flavours. Conversely, when I create a beer at +1.5% I need to dilute heaps, and then it's a gamble without proper de-aerated water and minimal lab equipment to calculate any dilutions. Not sure if I just need to do more lab trials to find a dilution middle ground? Or is it just up to the technical prowess of his diluting game?"

RL: I was just going to speak to a little bit of that, because that's something that we've been giving advice on, of course, with some of... If you want to play, run with the technique with fermentation. There's the cold contact talked about, or the arrested fermentation you're going to get not much flavour development, you were talking about it before, Jon. And that's why we were looking for a yeast that did create some beer character as much as possible, when the maltose hasn't been touched. So you're only, maybe in a typical all malt wort, fermenting up to 15% of the sugars.

There is some tips, when you're fermenting the pH also naturally decreases, so you look at things like pre-acidifying the wort down to maybe 4.5. Obviously you get a good body, which used to be a problem with low-alcohol beer, they were all thin and watery, but when you've got some residual sugar, and maltose adds a lot of body and not as much relative sweetness as something like sucrose or glucose, that's going to be quite nice. If you balance it out with hops, so the hop additions are really important. Obviously avoiding the hop creep. Carbonation, playing around with carbonation to add a little bit of acidity and bite as well. If you're making a wheat beer then it's good, you can enhance that phenolic POF character to your advantage.

Some of those techniques on pre-acidification, the best beers I've had made with some of these lower-attenuating yeasts, definitely pre-acidification and hop character is the key.

JS: I think he's hit on a couple of really important points in that question. Giving the yeast work, I like his term there, and I think Ruth and I would agree that there needs to be fermentation-derived flavours there, in my mind that's essentially what makes beer, beer. Depending on, there can be some small pitfalls depending on the yeast choice and the yeast strain that you're using if you are producing a highly unfermentable wort with no yeast fermentable extract in it at all, so very low glucose or very low fermentable extract. You may risk not developing any fermentation-derived flavours.

As brewers we know how to manipulate the various metabolic pathways in the yeast by playing with the process. But paradoxically, I've seen products like this made that actually supplement wort with fermentable sugar. That supplement wort with glucose so that there's a predefined amount exactly of fermentable glucose in there to get the yeast doing its thing. To produce flavour, to produce these superior alcohols, and to produce these esters that are so critical to making it within cooee of what an actual beer tastes like.

The other point that I really like from the question is around the process control. If you are using arrested fermentation, or even if you are using special yeast, for example, control of the carbohydrate profile in the wort, or of the yeast separation, or of the chilling of the tank is critical. In a 5.5% beer, if you over-attenuate by 0.2% ABV in the green beer, it's a small remedial dilution to make the difference up. In a 0.5% beer, an over-attenuation by 0.2% is almost a 50% dilution to make up the difference. Everything requires a higher degree of control, requires really close process monitoring and really close control of the process, and some of these techniques – including, I'd say, some of the maltose-negative yeasts – even they, depending on their interaction with hops, as we talked about in the past, really need a very close eye.

It's easy for breweries that are running around the clock. So we've got that in our back pocket in that we've got people on site 24 hours to help manage these fermentations and help manage these products through the process, but good process control is essential. Because your goal posts, your operating envelope is so narrow in comparison to, say, a standard 5% beer, or 12* Plato beer. It's quite a different beast.

MK: Justin, were you wanting to jump in there?

JF: Yeah, just one quick comment on that around the differences between actually targeting your 0.5% at the start or targeting 1.5% and diluting, remember the higher the gravity, the exponential curve of those esters and some of those fermentation flavours we're looking for. The interesting trial might be to go more than 1.5%. It might actually be better to dilute, say, 4.5% or even higher, because you're going to concentrate those esters to a rate that will then be higher in the overall 0.5% beer. Nothing I've actually looked at or experimented, just the thought around the importance of getting the fermentation characters in and another lever you can pull to get more in there in the end product.

MK: Great, well that's the last of the open questions and we've done our hour, so if there aren't any more questions... Ruth, is there anything that you wanted to say to finish off with?

RL: No, just that I'm really happy to take any questions as a follow up. If anybody wants some tips and tricks on how to get the most out of using a specialty yeast, for example, or some other biological approach questions, I'm really happy to help on that.

MK: Justin, anything that you wanted to finish off with?

JF: Not at all, thanks everyone. I think, from my point of view, everything that Jon and Ruth have added in there is just one point, incredibly. Sammy says goodbye, from Philter, now open, great looking brewery. And thanks to the Batch guys for a lovely beer. Thanks, Matt for putting it on, as well.

MK: Pleasure. Well guys, and Jon, thank you very much. Is there anything you wanted to finish off with, Jon? I guess you've had the lead run with this.

JS: Just a big thank you to everyone. Thanks for asking us to participate. Big honour, and always a great opportunity to learn as well, so thanks, Ruth, for all the great information. And likewise, if anyone has any questions about these sort of products, feel free to get in contact. At Brick Lane we're doing this a fair bit now, so feel free to reach out if anyone has anyone has any questions.

MK: And obviously SAF LA-01 is available from Fermentis via Bintani, so you can get in touch with Ruth or Justin outside. I was trying to limit the number of calls you were going to take, Jon, given that you've got a day job. Whereas answering questions about this is Ruth and Justin's day job. I'll put contact details in the show notes, but thank you very much, everyone, for joining us. Thank you everyone who's been part of this webinar for joining us, and to Fermentis for making it possible. It's been a fascinating journey into the world of low-alcohol beer.

RL: Thanks for having us. Thanks, Jon, I've learned a lot.