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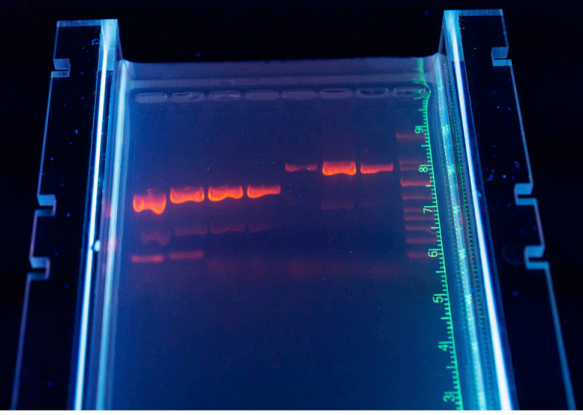

# How To Improve and Simplify Your Electrophoresis Workflow

**SPEAKERS**
**Lucy Lawrence, Paulius Palaima**

**Lucy Lawrence (LL):** Hello and welcome to Opinionated Science. My name is Lucy Lawrence, and I'm the digital content producer here at *Technology Networks* and today I will be your host.

The episode that you're listening to right now is very, very kindly sponsored by Thermo Fisher Scientific. I'm sure you're already familiar with them, but just in case you're not, they offer services and products that help customers around the globe in labs and clinics, on production lines, and even out in the field. They are a true driving force in the research, healthcare, industrial, and even applied markets.

They generate about 40 billion pounds in annual revenue. I am so very excited to tell you that today we are being joined by Paulius Palaima, the product manager for precast nucleic acid electrophoresis at Thermo Fisher Scientific and we'll be talking all things electrophoresis, although the title probably gave that one away!

You're in for such a good episode, because we're discussing the Invitrogen E-gel Power Snap Plus electrophoresis system, and the features and benefits in both high- and low-throughput applications. And there's even a mention of Pokémon to listen out for. I know that you're about to be absolutely hooked on this podcast, so I hope you enjoy it.

**LL:** Hello, how are you doing?

**Paulius Palaima (PP):** Hey, I'm doing quite okay. It's the beginning of winter.

**LL:** Yes. I'm so excited to be speaking with you. And thank you so much for giving us your time. You've got an interesting background and for the benefit of the listeners, could you introduce yourself and give us a bit of a background on you, and then tell us a bit more about your research?

**PP:** Yes! So I've now been a product manager at Thermo Fisher for the past few years. But I started as a geneticist, and I have a Ph.D. in biology and biotechnology with a focus on genetic studies in humans.

**LL:** I'm really wondering how and why did you make the transition from a researcher to a product manager at Thermo Fisher Scientific?

**PP:** So that's quite an interesting one as essentially, what happened was, I originally applied for a position as a researcher here. But after several rounds of applications, and interviews with different groups, I got into an interview for Product Management. And I really liked the way that they described the position

because that was completely and utterly new to me. I didn't know that such a thing was within my scope of abilities. They offered me the position and I am glad that I took it because it's really interesting. It's a lot of dynamics, it's a lot of cooperation, and I get to speak with a lot of different people every day.

**LL:** Wonderful. And then, from this, I guess, it would be really beneficial if you could tell our listeners what is electrophoresis, and why it was originally created.

**PP:** So electrophoresis solved a pivotal problem for molecular biology, in the sense of being able to differentiate your substrate based on some sort of characteristic. So specifically for nucleic acid electrophoresis, as that's been used in practice for over 50 years now. Originally electrophoresis was meant for proteins and the instrument itself took up a large part of the room because it was using a different type of matrix and was very cumbersome to use.

Later on, scientists started to use a slightly better matrix, meaning we started using corn starch, and after that, they began using it for nucleic acid separation. And in the end, it hasn't really changed that much in the last 50 years. You still have a matrix, which is now agarose, which is a sugar of some sort that makes this gelatine kind of structure. And it's run with an electric current when it's submerged in a buffer and you separate your nucleic acids based on their size within the matrix.

It then gives you some information, which is very relevant to a lot of questions. It gives you size, whether the fragments that you have amplified is the correct one, it tells you if it was the size that you expect, or in most cases, whether the thing has worked altogether. Because sometimes you just really need to know if it has worked. That is sometimes the question.

**LL:** Nice. And then what I'm wondering is, how have you used electrophoresis, in your own research?

**PP:** I've used it a lot. So, as I mentioned, I did my doctorate in molecular biology, meaning genetics. I did molecular genetics in humans, which meant a lot of genotyping. I used to run at least one gel, which is approximately 96 wells a day. This is because I had a lot of cohorts, you had a lot of people that you needed to genotype, and you had to prepare them for sequencing, like sanger sequencing to check whether they carried a mutation.

So from my perspective, I pretty much used it for the genotyping part. I used it for screenings and checking for mutations. I also used it for cloning, to check and isolate the gene and to see whether the gene is in the plasmid and then insert it into the bacteria. From here you'd then you'd check the digesting plasma, so I've used pretty much the full spectrum of atrophies.

And I got introduced to it all at university as it's a standard procedure. They give you this tank and they say that you can load ONE well, and that is because there are like 20 people that are waiting for you to finish.

But when I did my studies in the UK which is where I did my masters, I did a one-year placement in Liverpool, in which I did fungal genetics. So genetics is pretty much a theme throughout my career. However, there I did other types like RNA which is much more sensitive to degradation than DNA. So those gels are still agarose based, but they are very nasty to make. And they have methanol in them and other angry chemicals in the buffers. So, I use those as well for Northern blotting. Throughout my career, I've been through pretty much the full spectrum.

**LL:** Yeah, you've been across most of the types, which is pretty interesting. But what would you say a typical electrophoresis workflow looks like? And are there any challenges? Because for example, I know from experience it is difficult to pour your own agarose gels, have you also found that to be pretty tricky?

**PP:** This can be tricky, certainly! Because you have to make your buffers correctly, and I've been known

to dilute them too much or not dilute them enough. This meant that I got a fuzzy picture, and then had to repeat the whole experiment. This has been a huge problem in troubleshooting. I remember it took us a long time to realize that we just didn't dilute the buffer correctly. But generally, electrophoresis takes around two hours.

It starts with melting off the agarose, sometimes this can be very easy. If it's 1% agarose, you just add it into your microwave, you melt it very quickly. But if it's 3% or higher, then it becomes a chore. And you have to make sure it doesn't boil over because it's very sticky. Because it's like molasses, and it's very difficult to melt. You have to make sure that you've melted it properly, and then you have to cool it. And cooling is a whole different issue in itself because the principle of it is that you use ethidium bromide and that's mutagenic so you have to have dedicated spaces for it and even dedicated rooms for it. And you have to have all the equipment essentially dedicated specifically for electrophoresis in that dedicated room because you cannot cross-contaminate. So, once you've cooled the agarose gel you add the ethidium bromide and you sometimes can forget that it's still cooling.

And I've seen several students that have hidden in the electrophoresis room that tried to take out the little magnet that's inside that is spinning so it could go in again. But then there are other stories where you think that you've sealed the tank properly, so you pour your gel, then you come back 30 minutes later when it's set, and you can see that your gel is all over the table because you just didn't glue the tape properly.

So, there are a lot of steps in which problems can arise. And I think a lot of researchers can really resonate with running your gel, and then picking it up from the tray to go image and it's slipping out of your fingers, completely getting destroyed on the floor. And then you're just trying to piece it together. And hopefully, the part that you need is within those pieces that are still whole! But really, if you fail at any of those steps, you have to return back to square zero. And that takes again, 30 or 40 minutes depending on if you had done the whole thing and you just broke down your gel entirely, then that's pretty bad, then you have to repeat the whole thing again, from the very start. So that's another two hours!

**LL:** Yes. Which is an incredibly long time to be spending on something you've already done.

**PP:** Yeah, it is! It really is, it gets very frustrating. It's, it's, it just breaks your will.

**LL:** But this is kind of where it gets exciting because we've got the Power Snap Plus, and can you tell us a bit more about the Power Snap Plus, specifically how you found the transition from pouring your own to using the Power Snap Plus?

**PP:** So when I joined the product management team here, I was actually initially responsible for another portfolio. And I got introduced because I wasn't aware of the Power Snap system, I had only seen it once or twice in the lab. I was speaking with the product manager one day, and he showed me it and I thought it was amazing. I couldn't believe that the first Power Snap was a little small device. That was crazy and that piqued my curiosity.

From here I managed to take over from him because he got promoted and I took over his portfolio. And there was this project called the E-Gel Power Snap Plus. My first thought was to think about the most annoying things that I had to do during my electrophoresis, and it was so great to just speak with the team and bounce ideas. And I'm very happy that we managed to first of all make the workflow seamless. Because I told you previously that this stuff was consuming, and I only spoke up until the imaging prep, but even the imaging part is very time-consuming.

So, what the Power Snap Plus does, essentially incorporates all of these aspects into this one device, as the original Power Snap did. But it also innovates a lot on the existing instruments.

So, we have network functionality, you can print directly from the instrument, you have much more internal storage, you have a much better camera on it, you have ethernet connectivity, and all of these aspects. Because we know that our customers wanted it all but I also wanted to do it myself, why do I have to go somewhere else to get my image? I want to be able to do it on the device instantly. So, it was really solving a personal vendetta from like five and a half years of just making those agarose gels in the lab!

**LL:** I can imagine that was very, very satisfying.

**PP:** For sure! We have one here in the office, and we recently presented it to a lot of researchers at a conference. And you can see everyone coming up to it and asking what it does. Because it doesn't look like an electrophoresis machine, which is strange but it also is very welcoming.

I call it a little Bulbasaur because for some reason it reminds me of the Pokémon!

It has a design that is welcoming to use, and we very much want it to be like that. So, we want it to be an instrument that you want to use. But also, because electrophoresis is such a basic technique, and I often relate to it like just salting your dish cooking, because it's not complex. It's not in any way a technique that usually gives you the final answer. It's nothing fancy or flashy it's just a routine technique. It's like, again, it's like adding salt to your dish. So if you have to make your own salt every single time, it'll be a chore! So why not have something small that you can don't need any dedicated spaces and you have it on your bench side right next to you? You use your PCR to do everything, and you quickly just put them out into the instrument which literally takes up just a bit more space on a toaster. It's crazy. This is the workflow I always wanted to have had.

**LL:** I guess I'm wondering, can you tell us what the key differences are between Power Snap, and then the Power Snap Plus?

**PP:** So, I touched a little bit about it in the previous answer. So the new Power Snap is bigger because it has to have a lot more in it. But also, with that, it comes with extended throughput. So, what I mean by that is that while the original Power Snap was only meant for very low throughput users, the new Power Snap is meant for power users. So you can run everything from 11 well to 96 wells. So we have a wide span of different details in different percentages and different well volumes and different numbers. But it essentially can run the vast majority of the jobs that we currently sell.

So, this is a huge benefit for customers. However, sometimes you don't need the high throughput capacity, you might just need to run 8-10 samples so you can just run a smaller e-gel in this instrument. So that's one.

Then we have the ethernet, we have the cloud compatibility, so ethernet was a very common ask from our customers because the original Power Snap couldn't do that. And there are a lot of people that just want to connect to the internal network. So, for an institute, this instrument is very beneficial because you can just connect it to existing drives and all of your results are straight there.

So, I know that this is great functionality, because we used to have instruments like this and it would be very frustrating that you can't do that. We would have to use flash drives which now seems a bit risky and a lot of this has to do with cybersecurity. So we know that a lot of clients cannot use any flash drives at all in labs for cybersecurity.

It also has cloud functionality and that was a great like win for my engineering team! I am very proud of the team for this because it means that Wi-Fi compatible, so it comes with a little dongle that you plug in.

If you have a Thermo Fisher Connect, which is free, you get two terabytes of free storage online. And in the online application, you get applets like eyebright analysis software which you can use to analyze your e-gels.

We also have other quality-of-life improvements, for example, we have a more robust connection, a bigger touchscreen, addition of some analysis tools that were not previously available. There is a myriad of options, but these are the primary ones that really differentiate it from the older instrument.

I was thinking about a good metaphor for this. So the original Power Snap is like an mp3 player. So you remember that you used to carry those around and they used to play music, and it was fine. This is great and some people still need it today which is perfectly fine. But the new Power Snap, the Power Snap Plus is more like a smartphone it can do more than just play music, it can do so much more. And, you know, none of us can live without our smartphones. So I hope that's the future.

**LL:** Yeah, it's those things that you don't realize that you need at the time. But then when you have access to them you really think of how much time has been saved and you become really annoyed to have not had this sooner! So, it sounds really cool.

**PP:** Exactly. Exactly. This is pretty much the sentiment that we get from anyone that touches this device. And what I find extremely cute, is that like I said, scientific instruments and design functionalities are always a bit of a difficult subject. And what I really find extremely cute and when I showed it to my researchers here that did the beta testing. And I said wait...it can do pinch zoom! And they said oh my god, it was a moment of mind blown!

**LL:** That is quite cute! I'm wondering what kind of workflows would benefit the most from this instrument?

**PP:** So basically, any real workflow that requires electrophoresis, so primarily I would say the functionalities would be screening, because we have the inherent ability to load the 48 and 96 gels, even just the support of them, already opens up the venues for a lot of screening applications.

And by that what I mean is, essentially, you have multiple cell lines, and you don't know which of those cell lines have your genetic mutation. Obviously, you have to be able to see them, in the electrophoresis applications there has to be a size difference between them. But it will really speed you up. Because normally, it would take like two hours, just to run the electrophoresis. And with Power Snap Plus, you can get the answer in like 12 minutes.

I gave a presentation at a seminar once, and essentially, it took me five minutes to load a 96-well gel. And then it took 12 minutes to get the results. So it is really, really, really fast. It's amazing. So, for a person that used to do this and spend a lot of time on it, getting these results so quickly was for me, still kind of mind-blowing it's just such a win.

And then we have like other applications, like RNA applications for producing our EX gels. You can have cloning applications as well, we really support all of the gels and we call them low throughput, but they're like 11 to 22 well, for general purpose. So there are the general-purpose gels that you often use for cloning. Let's say, just to check whether your fragment is there. But they are also supported.

And with the specialty gels like the 4% gels that we already mentioned, they are incredibly tedious to make. We have them ready, and, you know, for these applications, and you get your answer in like, what, 20 minutes, while in 20 minutes previously, you would just be finished melting your agarose. So, it's just great. It's the future!

Oh, and some other applications probably would be CRISPR cell line, and quality control as well. So, quality control is very big, especially if you're working with a lot of cell lines. And we know that even some of the mycoplasma testing kits suggest using gels for the fastest result. So, it's applicable pretty much anywhere!

**LL:** Yes! If you want to save time this is what you've got to be using!

**PP:** Pretty much. Yeah!

**LL:** And then from that, what would you say are the benefits for the users of using these new instruments?

**PP:** Time! You save so much time.

**LL:** It's a no-brainer.

**PP:** It's ridiculous. Like, with some applications, like LAMP. So we recently released an app note in which we tested our LAMP testing. So LAMP is an isothermal amplification kit, together with the e-gel system. And this was meant for viral detection. And the whole process took, I think half an hour, instead of you needing to set up a qPCR, and then running the qPCR, which would have been at least two and a half hours. So again, this is a very direct example, which makes it really, really fast. But then it's like also the convenience.

So speed is really good. But if it's you know, if it's not convenient enough, it wouldn't be that much use. And with this, it's super convenient. Like I told you, like 96 for each which took me five minutes to load.

**LL:** That's unbelievable.

**PP:** That's ridiculous. Yeah, and it's because it's of the multi-channel giving the convenience. In the way that you can just export your images, you can print your images directly, if you need from the device into compatible printers, obviously. But it's also convenient, in the sense that because of the multitude of e-gels available, you can always find something for your applications.

So just to give you an example, we recommend some of the applications. So we say like, Oh, our e-gel EX line is super high performance. They're super-fast. But they're primarily for DNA applications. And what we found is that our customers, because as I mentioned previously, like RNA gels are difficult, they often require very problematic buffers to run. So, what we saw in actual literature is that people started using those EX gels for RNA applications, extremely successfully. So yeah, we kind of got blown away by that and we are trying to work it out like ourselves. Maybe we can improve the existing protocols that we found maybe, you know, so we can offer better support for our customers in that regard, because this is a real pain point. So again, this is solving an existing issue that would otherwise take a lot of time. Which is extremely inconvenient in that regard.

**LL:** Nice. And then, maybe a tricky question, actually. Because it does feel as though we might already be in the future and have all of these incredible technologies within the power snap plus, but where do you see the future of this field heading?

**PP:** This is a good question. So, as I mentioned that the way that I see a lot of electrophoresis is I wanted to be completely and utterly like you don't need to think about it, Power Snap Plus is a huge step in that direction. As well as Power Snap, it's completely revolutionary, it revolutionized it! It's important to say that these instruments are still unique, they do not have any competition. They're the only ones like this in the market. And you don't need any buffers, you don't need anything. And this is a huge part of why we are trying to make electrophoresis not this hassle. So that if you have to do something, you have to wait, and you then have to do something again. And then if it breaks down or something happens you have to restart again. We don't want that!

I personally have a mission of just completely and utterly making it a seamless process, you go five

minutes, and it's done. And we are very close to that. We are currently at eight minutes. I think this is where it will eventually go in meaning that it will be entirely seamless, like children of the future will not understand what we do. And we will tell them saying like, Oh, I had to make this and I had to do this.

**LL:** And they'll be like, Why? Why did you have to do that?

**PP:** Exactly, I get this from my nephews all of the time about this. We're trying to introduce them as much as possible in schools too, because of the safety requirements. And because we have the e-gels for safety.

For them, it's just very easy and doesn't require the additional expenses associated with disposal. And it's a singular instrument, the size of a toaster, it looks awesome, you can pick it up, and you can interact with it very easily. It's very difficult to break even for a child because there's really nothing that can break in a sense. So, we see a lot of people from education that have an interest in it. So, we want it to be, you know, used both in the future as something that's a stepping stone for something that makes electrophoresis absolutely seamless. And part of the education is to introduce children, and secondary school pupils probably, in this case, to electrophoresis and molecular biology as early as possible. Because we can do that now. It's a safe environment.

**LL:** It's making it a lot more fun as well. It's so easy with this process.

**PP:** Yeah. And you can check on it any time. So as I said, like, do you have eight minutes to run. And that's the full run by the way. So if your question is, as it often is, whether it has worked, to begin with, you have your answer almost immediately, because you will see the separation happening in real-time. And you can very quickly check and just you know, if it didn't work, cancel the run throw away the gel and begin again. And that will take you another eight minutes.

**LL:** Which is hardly anything in comparison to what we had to do before.

**PP:** Exactly. You know, you can wait those eight minutes and mix and melt the agarose or you can just, you know, repeat the for the full experiment.

**LL:** Fantastic. We are sadly almost out of time. But if people would like to contact you for further information, what is the best way they can get in touch?

**PP:** I'm on LinkedIn , but I don't post that much. What I post is usually with Power Snap Plus because it's my you know, my COVID baby because it was developed at that time. It is my current love. But otherwise, you can always reach out over email or to customer service. I'm sure that we can help you out.

**LL:** Brilliant. Well, thank you so much for joining me. I mean, as I've said, I've really enjoyed myself, and thank you ever so much for joining this incredible Opinionated Science Podcast.

**PP:** Thank you so much for having me. It was a pleasure.

**LL:** What an incredible podcast that was. Thank you so much for joining us and I hope I'll see you again very soon.

*Paulius Palaima was speaking to Lucy Lawrence, Digital Content Producer for Technology Networks.*

**Further Resources:**

Get Your Head in the Cloud: Building the Smart Lab with the E-Gel Power Snap Plus Electrophoresis System