



## **Q&A with Dr. Thomas J. Kelleher, CEO of Xylome Corporation helping Ethanol Plants, Salmon Farms and other Large Industrial Companies convert low-value Feedstock Materials into high-value Products through the Genetic Engineering of Yeast and the use of non-Conventional Proprietary Yeast Strains**



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**CEOCFO: Dr. Kelleher, what is the focus for Xylome today?**

**Dr. Kelleher:** Xylome is focused on emerging markets and needs that are driven by unsustainable but essential products. We do this through genetic engineering of yeast. We work in close cooperation with large industrial clients, for example, the ethanol industry, who have significant amounts of fermentable organic material. By working closely with them, we can specifically develop yeasts to make products which they are able to sell. Xylome uses non-conventional and proprietary yeast strains for the sustainable conversion of low-value feedstock materials into high-value products that our industrial clients can sell. Xylome is profitably renewing tomorrow today for our client industries.

**CEOCFO: Would you give us a two sentence primer on yeast and then an example of what a need might be and how you work to develop something specifically for the need?**

**Dr. Kelleher:** Xylome's genetic engineering is focused on the approximately 1500 different types of yeast, which are known. Of those fifteen hundred yeast types only about five genera have been modified to become industrially useful. Therefore, Xylome is very much focused-in on the other ~1495 yeasts, all of which have different natural ecologies and different metabolic potentials that can become new platform industrial strains for developing many unique high-value products.

**CEOCFO: If there are so many different yeast variations how do you know where to start? What is the process when someone comes to you with a problem and?**

**Dr. Kelleher:** Our primary core competency is a very deep understanding of yeast genomes and in the development of proprietary genetics. The president of Xylome, Dr. Tom Jeffries, was the principal investigator who led a team of scientists during the Department of Energy Yeast Genome Program. They did genome sequences for a very large number of yeasts and they uncovered many unique features in these non-conventional yeasts, which are not currently used for industry. To address our client's objectives, that is the first place that we start. Secondly, we will analyze the client's feedstock, which generally contain significant amounts of organic waste. Xylome will look at what is in that waste and then we will decide which types of non-conventional yeasts have matching genomic information that would allow us to create a productive industrial yeast strains for the bioconversion of their material into a higher-value product that they can sell.

**CEOCFO: Do many companies recognize that yeast solutions are a possibility or is there a lot of education needed so people even think that yeasts could be viable?**

**Dr. Kelleher:** We have focused in on the ethanol industry because it is a market that can be identified and generates 5-billion pounds of by-products per year. In fact, the ethanol industry is one of the largest fermentation industries in the World. There are only about two hundred and forty ethanol plants in North America. Therefore, it is very easy to interact with the organizations that have multiple plants and very large waste streams from their production of ethanol. As a startup, we have focused on that industry as our first market. We have also begun to do some work for other industries. There are many types of waste products from our clients' current operations that could be a feed stock for a secondary non-conventional yeast fermentation to generate both new products or additional product yields.

**CEOCFO: When an ethanol company turns to you what do you look at? What are you looking at physically? What are you looking at through your database or through the source that you have? How do you put a solution together?**

**Dr. Kelleher:** Much of our core technology was developed through the assistance of the National Science Foundation during our SBIR Phase II grant and from a U.S. Department of Agriculture SBIR grant. That early technology development was essential for allowing us to develop our existing proprietary technologies. Xylome can now generate compelling yields and process economics for making new products that meet the needs of the ethanol industry and for the utilization of their specific waste streams. Therefore, we have been able to solicit and obtain materials from many ethanol plants and do chemical analyses to figure out what is in a range of feedstock waste materials that could be re-fermented. Xylome then applies our existing strains or develops a new yeast specifically for addressing the process steps needed for converting those fermentable materials into new products.

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**CEOCFO: Would you give us an example of what might be different from one ethanol company to another? Is it a different percentage of a particular item? Is it different items that are in the waste? What makes the need for a specific solution and a customized solution?**

**Dr. Kelleher:** There are really several points. One is that, although the raw material and feed stocks will vary from each individual organization, there is general interest in similar products and in the use of our platform organisms. Xylome has developed multiple yeast strains to be used generally across a wide range of raw materials coming from a range of ethanol producers. Specific enhancements are made to yeasts as required to meet or exceed the client's economic objectives.

**CEOCFO: How are you reaching out to the companies? Are you going down a list or are they turning to you at a certain point in their process? How do you interact?**

**Dr. Kelleher:** We have been running a trade show booth at the International Fuel Ethanol Conference held once a year called the Fuel Ethanol Workshop. In fact, we started developing relationships with the ethanol companies and some other industries before we had a compelling value proposition for them. In that way, we learned and knew exactly what products they may be interested in. Over the last year, we have managed to move the economics significantly through genetic engineering, so that now we have a compelling value proposition for ethanol plants. Our enabling technology will allow them to put in fermentation equipment, which will re-ferment their waste streams and generate higher value products.

I can give you a couple of examples that we have been working on. Our lead program is the development a palm oil substitute. We have done many interviews with consumer products companies. From those interviews we learned that if a good and price competitive alternative existed for palm oil, many would be interested in purchasing that palm oil substitute today. Therefore, our lead program is to convert ethanol plant waste streams into a palm oil substitute. We can do that economically now, with the breakthroughs we have had in genetic engineering and in fermentation technology.

Our second program is a complete salmon feed. This is a salmon feed that contains all the components necessary for salmon to grow, but without relying on bait fish or fish oils or other components from non-sustainable sources. This product is a composition of multiple yeasts, which when formulated together constitute a complete salmon feed, produced on ethanol by-products. That program is about a year or two year behind the palm oil program, but it is at least equal to or perhaps twice as valuable for the ethanol plants. We will keep working our way into new programs and products that continue to have higher and higher value as we continue to build our technology.

**CEOFCO: Are you primarily in North America today? What is your geographic range and what is the potential outside of the US?**

**Dr. Kelleher:** We are predominantly doing work in collaborating with companies in North America who have multiple ethanol plants. Brazil also has a significant ethanol industry and Xylome has been providing services, collaborating, exchanging materials and information with companies in Brazil as well.

**CEOFCO: Are there other companies working with yeast that you are aware of or is it a pretty open field for you?**

**Dr. Kelleher:** There are a number of government laboratories and academic institutions working on yeast. There are relatively few companies working on non-conventional yeasts specifically for large industrial clients. Some forerunners in conventional yeast (*Saccharomyces*) metabolic engineering have actually been quite successful. These are companies which are five to ten years or more ahead of Xylome in terms of their maturation and their work is generally in different and more specialized markets, including for example insulin production.

**CEOFCO: Why should people be looking at Xylome as opposed to some of the others? What do you understand on the most fundamental level about yeast that others do not?**

**Dr. Kelleher:** The key things that we bring to our clients are a combination of a deep understanding of yeast genetics and the ability to quickly build the infrastructure inside of natural non-conventional yeast to convert them over to industrially useful yeasts. Once created, these non-conventional yeasts can be used as a platform into which we can substitute in many different products. Because we have already made the fundamental investments in that technology, client companies can benefit from our proprietary strains and by simply telling us what they want to produce. Xylome already has several platform strains across several yeast genera that can make a range of products that the client or industry desires. The Xylome advantage exists because of the underlying infrastructure inside of our industrial strains is already in place. Finally, that deep understanding of yeast comes from the forty-year USDA and academic career of Xylome's President and Founder, Thomas W. Jeffries, a respected name in the field, plus Xylome's extraordinary team of metabolic engineers.

**CEOFCO: How do you store the yeast? What is involved in keeping it pure and clean? How do you transport it? What are some of the basic fundamentals of handling yeast?**

**Dr. Kelleher:** The industrial strains from Xylome are genetically cured or modified to meet EPA and in some cases FDA requirements for safe commercial scale-up. We will continue to be a technology provider of unique patented yeast strains for specific purposes to our industrial clients. They will maintain the yeast in what is called a master cell bank, in which they will create a frozen stock of pure samples of the yeast. Periodically, they will take one of those samples out and make what is called a working cell bank that they will use to start each fermentation process. The technologies for maintaining a master cell bank and a working cell bank are very well known and the clients who are working with us have that capability. We do not intend to be a yeast product producer or operate our own factories but depending on the right opportunity, this is also a possibility.

**CEOFCO: Are you seeking partners, funding or investment as you move forward and seem to be where it is potentially profitable for your clients?**

**Dr. Kelleher:** Yes. As I mentioned, within the last year we finally achieved a compelling value proposition in terms of yields and economic productivities that can justify the capital expense of adding secondary fermentations to existing ethanol plants. Now that we have the compelling economics in place, we are working with large ethanol producers who have our strains in their shops. They are evaluating our strains and Xylome will continue to work on improving those strains, if necessary. At this point, we are trying to go to the next stage of scaling-up into large fermentation equipment that the ethanol producers already have and, ultimately, Xylome will be formalizing multiple long-term commercialization agreements. Once a commercialization partner develops a commercial-scale process around a yeast and the recovery of a specific product, like a palm oil substitute, they can sell and relicense the entire commercialization package back out to other plants in their industry. We envision these packages to be at an elevated royalty over the basic royalty that Xylome would be charging for the yeast technology itself. With three or four of those long-term partnerships in place, we expect to mitigate the long-term risks in investing in Xylome. Therefore, we are now in the process of raising funds with interim investors at the combined target investment level of about \$6-million, which is necessary to broaden and deepen Xylome's business, and so we can go faster to really capture the royalty potential of other the non-conventional yeasts. The goal is to broaden the number of industrials and client programs and expand the numbers of royalty streams long term that come back into the profitability of Xylome.