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**Addressing the need for a quick robust way to monitor frying oil**

I'm pleased to have this opportunity to provide you with an update on my company's years of effort to try to find a better way to monitor frying oil and determine when it needs to be changed.

We all know, that frying oil degrades as it's being used and that after a certain period of time, it needs to be discarded, that, uh, harmful byproducts of frying accumulate, and also, the taste of the foods that are fried deteriorates.

So changing frying oil too frequently is also bad. It's expensive, and, um, so methods are needed to try to find out when is the best time to change frying oil. There are laboratory reference methods. The American Oil Chemists' Society method for total polar compounds is the most reliable and accurate, but it requires a laboratory, a skilled technician, and a lot of equipment, and that's just not practical for a restaurant. There's also a secondary method called Fourier transform near-infrared. It's very good, but it's very expensive, and again, meant for a lab.

So over the years, people have tried to identify quick tests for restaurants to use to help them determine when to change frying oil. Color comparators are used, and there's something called the Gardner color that's a reference color standard. As frying oils get darker, the thought is that they are more degraded and that we should be able to figure out when to change them. This has proven not very reliable. I'll show you in a minute. There are also handheld total polar compound monitors ... There's one represented at the bottom of the screen. They're expensive. They need to be calibrated, and they're only good for certain types of oil.

The 3M company developed a free fatty acids test, a dipstick test, that needs to be refrigerated. It needs to be used in a complicated way, and frankly, it doesn't get very reliable results in many different restaurants. So it's kind of been discarded.

Um, more recently, there's been some liquid or gel tests that have been developed. Oleo and MirOil. There's one represented, the little bit of tubes on the right. Um, but they require an operator to take a very precise amount of material and microwave it, and it's just, just too complicated.

So what is it? Here's the example of a Gardner color comparison. You'll notice in the left-hand side it's commodity soy oil, and the Gardner color reaches 10.2, and the total polars are already above an internationally accepted, uh, level of 25%. This oil should have been discarded. But on the right-hand side, high oleic soy, uh, can achieve a Gardner color of 10.2, the same color, darkness, but it still has a lot of fry life left in it because its total polar count has only increased to 10.5.

So we need a better method. We need a reliable, quick test that ideally would be inexpensive, easy to use, give quick results, work over a broad temperature range of different oils, different oil types and blends, and it would measure total polar compound, content, not free fatty acids or something else. And it should be validated versus reference standard methods to be accepted by a regulatory, uh, community.

So my company has been around for some 36 years, and most of the time, we've developed tests for the biomedical research industry. But in 2012, our senior scientist Dr. Martinez recognized the potential of our tests for lipid peroxidation to evaluate food quality. And in the intervening months, Henry invented a novel dye that changes color with the total polar content of frying oil. That proof of concept, and shortly thereafter, in 2013, we started working with Corteva, and we're developing this proof of concept into a TPC test for frying oil for restaurant.

So a little chronology here. Dr. Martinez started synthesizing dyes and testing their responsiveness to total polars in various oil samples starting in 2013. Work went fairly slowly at first without any external funding for this activity. Um, in the middle of 2013, got, uh, Susan Knowlton at DuPont contacted Dr. Martinez. She emphasized and identified frying oil testing as a major unmet need. And so since then, Oxford and Corteva have been collaborating to develop a simple, rapid, reliable test to measure total polar compounds in oils.

We've developed several test strip formulations, and people at Corteva have been doing the test frying. They've lent their oil expertise and their analytical laboratory support.

More recently, in the last couple of years, we established a division called Food Quality Testing Corp. to commercialize FryCheck. Corteva's been performing experiments of our later stage prototypes using different oils and comparing them to reference methods. And for the last couple of years, the work has accelerated dramatically because we've gotten significant support from the United States Department of Agriculture, which is very interested in seeing this go to market.

So here's some results that were obtained in Corteva laboratories over the last couple of years on an earlier prototype, not the latest one. And you can see at the top high-oleic soy oil, that's been used for frying for different periods of time. The polar content is shown underneath. So the left-hand one, C, is a test strip that hasn't been exposed to oil. Next one is a fresh oil sample, very dark blue. And when oil needs to be changed, around the 25% total polars, it gets increasingly yellow. They obtained similar results using high-oleic canola oil, again, letting them develop for just a short period of time. These were all done at room temperature, and they saw similar results when they tested commodity soy and canola.

And the people at Corteva, particularly Dr. John Everard, who's in charge of this, have also studied the stability of these tests over time. You need to wait a little bit, two, three minutes for it to develop, but what if you left it sit too long? And it appears that the color is relatively stable for up to seven hours. The color does change some overnight, but that's not really relevant for what we're intending to do.

John's lab also found that it didn't matter if the oil was at room temperature or it was hot oil. Uh, we get very similar results. Although, I will say that the test is not intended to be dipped directly into a fry vat. Um, the plastic strip that the oil, the test pad is attached to melts at those temperatures.

This shows the correlation between a reference method, shown at the bottom, and the visual comparison to a color scale. The four people that we asked to evaluate it that didn't know what the, uh, how well used these oils had been. They were asked to determine the total polar content, and you can see that this correlates very well with the reference method, with the error bar showing differences between the different individuals' readings of the tests.

So, I want to show you how it's done. This short video shows you the process going from taking a clean, um, utensil from the restaurant, dipping it into the frying oil, and using it to transfer a few drops of oil to a clean surface. Then a test strip is removed from the vial. It is used to soak the oil on the pad at the tip of the strip, and then set aside to develop for we recommend at least three minutes.

At the end of three minutes, comparing this test strip to the color scale on the vial shows that this particular oil sample has still, it's about 18% total polars. It still has significant fry life, should not be discarded yet. That would be a waste.

And this slide shows you very graphically the difference between, in our latest prototype, a fresh oil sample, an oil sample of about 18%, and an oil sample that is above 25% total polar compounds.

So looking forward, we are in the process of optimizing the performance, the shelf-life, and stability of the test strip under various conditions so we'll be sure that it works well in restaurants. And we're trying to determine if one formula, one test strip, will work for a wide range of frying oils and fats with different composition, uh, and also with blends that have additives. Uh, we are in the process of scaling up the manufacturer of our latest-stage prototype to be able to make thousands, tens of thousands, and millions of test strips.

And we're also developing a cellphone reader application, which may not be needed, but it would be similar to taking a mobile deposit photograph of a check and then your cellphone would take that picture and communicate it with the app to deposit it in your bank. This application would allow the cellphone to compare the color of the test strip to calibrated standards and provide a very reproducible operator-to-operator result.

We're also looking to get independent validation of the performance of the test strip by organizations such as the American Oil Chemists' Society, which is internationally recognized as a reference, uh, association. We're going to be seeking regulatory approval and review as appropriate in different countries. Um, while fry oil testing is not required in the United States, but in many countries around the world, there are strict regulations, and we want to make sure that the regulators appreciate the utility of our test strip and that it is reliable.

In order to commercialize, we are very interested in determining the voice of the customer, assisting restaurants' needs. Do the instructions provide them enough information? Uh, is it cost competitive? Uh, what is, what other feedback do they have to provide us? We are looking to identify, uh, a number of distributors around the world to be able to introduce the product into their appropriate marketplace. These can be oil distributors or restaurant suppliers. Finally, we're looking to launch the product, hopefully by the end of this year, uh, or early in 2021.

I want to thank, uh, my team at Oxford Biomedical, Henry Martinez, Carolyn Jagadics, our senior technician, and Rich McGowan, our marketing manager. And we couldn't have done it without the collaboration of Susan Knowlton, John and Bev at Corteva. And initial pilot funding was provided by DuPont Pioneer and the Grain Farmers of Ontario, and like I mentioned earlier, it's been greatly accelerated in the last year and a half by a large grant from the United States Department of Agriculture, which recognizes the need for such a product.

Finally, I want to support, uh, thank the U.S. Soy Export Council for supporting this webinar, and I want to thank you for taking the time to listen to this presentation. Uh, I hope you found it informative. Uh, please contact us or visit our website if you'd like additional information, you'd like to participate in any evaluations as we get toward the end of this development, of which we think will be a very useful product for the restaurant industry. Thank you very much.