nutmeg newsletter

May 2020

CTSCC Future Events

Formulating Sustainably

September 22
Speaker Kseniya Popova, Farmacy Beauty

sponsored by KOSTER KEUNEN

Education Seminar: Preservation

October 20
Multiple Expert Speakers

Look for communication from our chapter on updates on these events as the year progresses.

Challenges of Developing Natural Cosmetic Products

November 17
Speaker Luciana Coutinho
Founder, Chief Product Officer
luluble

sponsored by innospec

Inside this issue:

- Letter from the chair
- Technology Corner: Fats & Oils (Ben Schwartz)
- Photos from the board's new working environments
- Upcoming events

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Letter from the Chair

Dear CTSCC Members and Friends,

As I write this letter from the comfort of my house, with a warm cup of tea and my dog on my feet, I feel the deepest gratitude for everyone globally coming together in this unique time of our lives. I hope you all are healthy, safe and enjoying this new way of life. In our March newsletter, we were looking forward to the changing of seasons and prioritizing the planet through learning about sustainable formulation at our monthly dinner meeting. Instead, we all quickly learned to prioritize the planet by staying home and slowing the spread of COVID-19.

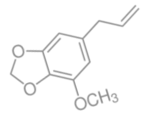
This year is an unexpected adventure, and the CTSCC board is working to adapt and harmonize with our new normal. Fortunately, our wonderful speakers for March and April will be postponed to September and November. We will continue to monitor social distancing policies regarding our future events, and we will communicate that information to you. Please reach out to us if you have any suggestions or ideas to help make our chapter better.

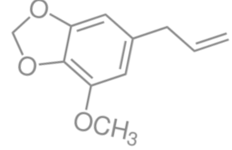
The ability we have as humans to connect with each other and thrive under challenges is extraordinary. One of the silver linings during this pandemic has been the way we all have adapted to this new normal. Thankfully technology has put all the knowledge in the world at our fingertips, and we can learn about anything from the comfort of our own space. From the structure of hair to trends in the personal care space to personal development, there is an online resource for everything. The NYSCC has been hosting their *At Home Live Series* with webinars on relevant topics that I would highly recommend to anyone in our industry, NYSCC.org for more information.

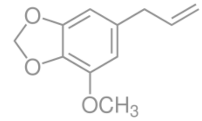
Our industry is working so hard to help keep consumers safe and happy, and I feel very lucky to be a part of it. Many of our local companies are donating money, time, resources and/or products to help bring an end to this pandemic. Still, many consumers are relying on our products for their joyful moments in isolation: dying their hair fun colors; applying face masks for self-care; or even trying out the newest makeup challenge.

Thank you to everyone for your hard work and dedication, I look forward to seeing you at upcoming events, whenever they may be!

Jen Macary
2020 Chair, Connecticut Chapter
Society of Cosmetic Chemists

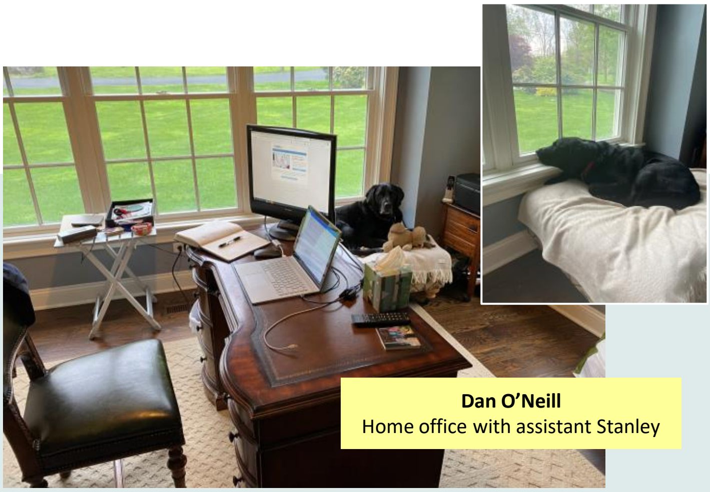




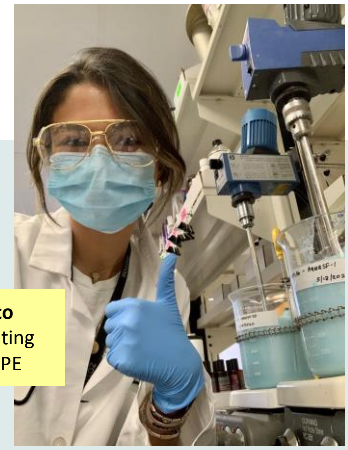


How We're Working Today

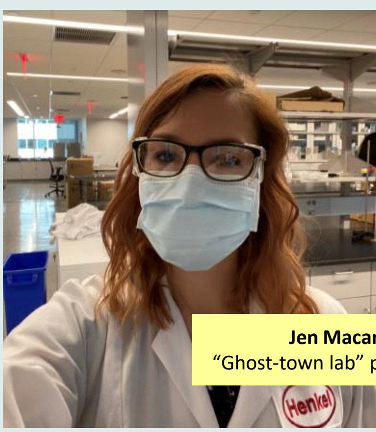
Take a look at how our members are working remotely or differently in today's environment.



Dan O'Neill
Home office with assistant Stanley



Nina Miotto
Color coordinating batches & PPE



Jen Macary
"Ghost-town lab" proper PPE

Faith Corbo
Workstation conveniently next to coffee

Rana Zaki
Bar soap making process

More on page 12!

Technical Corner

How Much Do You Really Know About Fats and Oils?

Benjamin Schwartz
Senior Personal Care Applications Specialist - AAK

Originally published on NYSCC Blog

FATS AND OILS ARE UBIQUITOUS IN PERSONAL CARE AND COSMETIC FORMULATIONS.

So much so that as cosmetics chemists we often take them for granted or fail to appreciate their various characteristics. Whether natural plant oils/fats, synthetic esters, or petroleum-derived hydrocarbons, we often don't consider much more than the aesthetics of whether one feels lighter or heavier, slippery or draggy. Even more overlooked is how their unique chemical compositions determine those characteristics and how they apply to different product types.

Despite our industry's somewhat naive approach, this is a subject that can encompass entire careers for some lipid chemists. But for the sake of blog-post brevity we will keep the scope of this current conversation somewhat narrow.

Here we'll go through a brief overview of how the molecular structure of triglycerides, and the fatty acids that comprise them, determine the interdependent properties of oxidative stability, melt profile, and compatibility of different oils and fats. Knowing how these properties determine the unique characteristics of particular oils and fats can help us to make better choices for different product applications.

WHAT ARE TRIGLYCERIDES?

To take things all the way back to the beginning, we should explain that triglycerides are the major molecular class comprising natural fats and oils. Which is also to say that the science of oils and fats can often be reduced to the science of triglycerides. This is because once natural oils and fats have been put through their typical processing and refinement the only non-triglyceride components usually left will be sterols (and some other sterol-like components), and often at a level less than 1%. So, it can often be safely assumed that the characteristics of different oils and fats are simply the macro level behaviors of different combinations of various triglycerides.

So, let's look at the basic structure of triglycerides and their constituent fatty acids. A triglyceride is composed of three fatty acid chains connected via a glycerol backbone. The bonds at which the fatty acids join the glycerol are ester bonds, created by dehydration synthesis using the carboxylic group of one fatty acid and one of the hydroxyl groups of the glycerol (Fig. 1).

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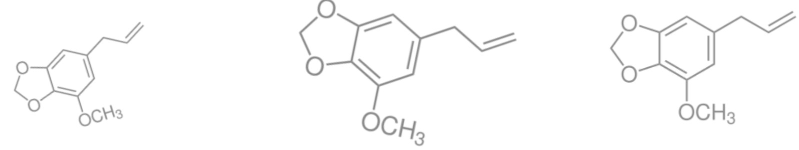

Technical Corner

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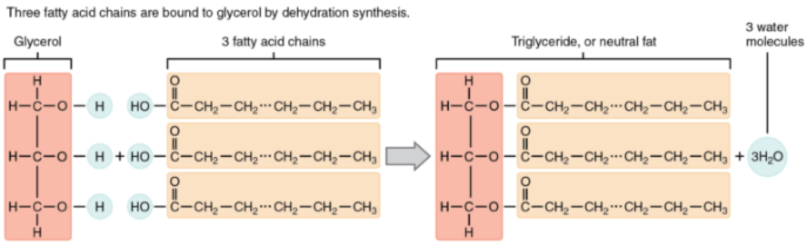

Fig.1 – Triglyceride ester formation via dehydration synthesis

Once the triglyceride is formed we get a structure like that shown in Fig. 2:

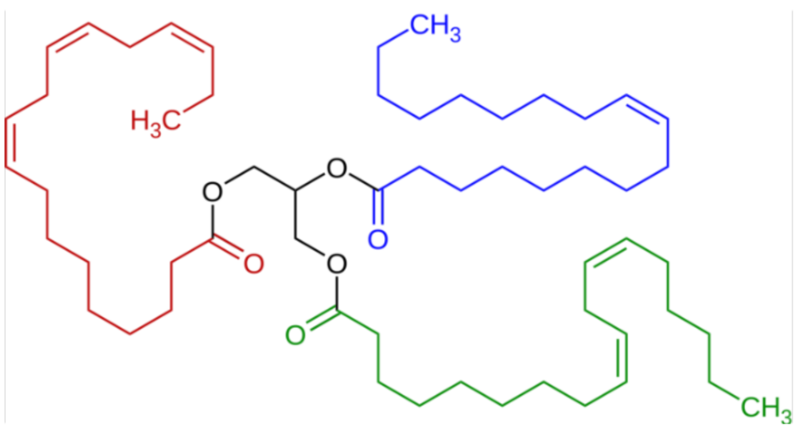

Fig. 2 – Example triglyceride with one oleic chain C18:1 (blue), one linoleic chain C18:2 (green), and one linolenic chain C18:3 (red)

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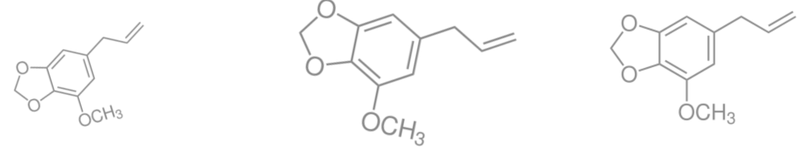

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(It's important to remember that the structure shown in Fig. 2 is a flattened two-dimensional depiction of a three-dimensional object. In reality, this molecule would be folded into a complex, bulky shape.)
As you can see in Fig. 2, there can be different types of fatty acids present in a single triglyceride molecule. Some may be fully saturated, like Stearic Acid (Fig. 3), and have an overall linear shape, with no kinks or bends. Others may be mono-unsaturated like Oleic Acid (Fig. 4), or poly-unsaturated like Linoleic Acid (Fig. 5), and capable of bending and folding in various ways. The degrees of unsaturation (or the number of double bonds in the chain) determine the flexibility of each chain, and thus the possible shapes and comportments of the overall molecule.

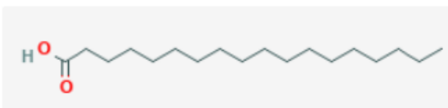

Fig. 3 – Stearic Acid C18:0

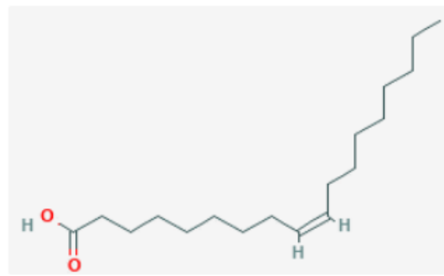

Fig. 4 – Oleic Acid C18:1

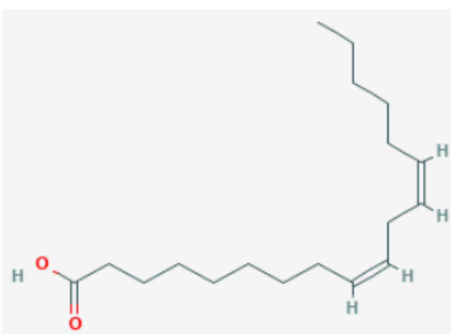

Fig. 5 – Linoleic Acid C18:2

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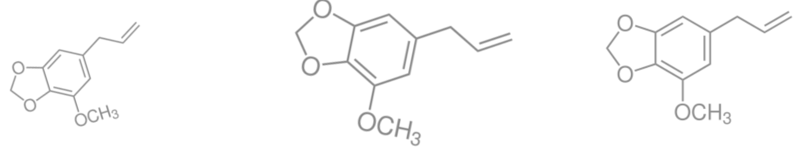

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WHY IS THIS IMPORTANT?

There are two crucial things to take from these descriptions and illustrations of fatty acid chains and their structural contribution to triglyceride composition and shape.

One, is that the relationship between the degrees of unsaturation of the fatty acid chains and the shape of the overall triglyceride molecule is what **determines the melt point of the triglyceride (or rather the melt point of a significant mass of identically constituted triglyceride molecules)**. This relationship between unsaturation and molecular shape also relates to compatibility of different oils and fats, which we won't discuss much here.

Two, is that the degrees of unsaturation within the fatty acids of a triglyceride **determine the vulnerability of that triglyceride to degradation via oxidation (also to photodegradation)**. So, a mass of oil or fat that has higher degrees of unsaturation within its constituent fatty acids will have a lower melt point and a greater vulnerability to oxidation. While a mass of oil or fat that has lower degrees of unsaturation within its constituent fatty acids will have a higher melt point and a lower vulnerability to oxidation.

Thus, degrees of unsaturation and melt point have an inverse relationship. That is, the more unsaturation, or the more double bonds present, the lower the melt point (Fig. 6). As well, the degrees of unsaturation and oxidative stability also have an inverse relationship. That is, the more unsaturation, or the more double bonds present, the lower the oxidative stability.

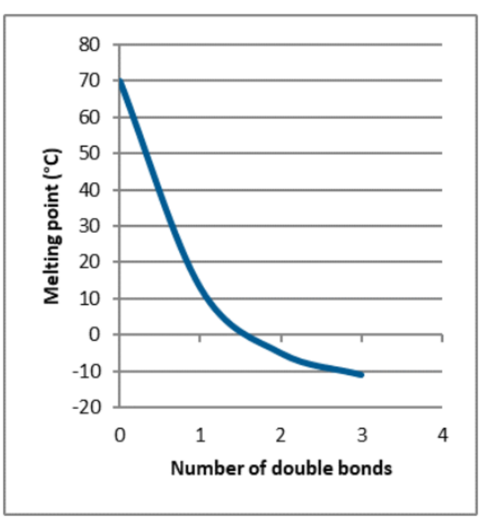

Fig. 6 – Melt point versus double bonds (unsaturation) present in a fatty acid chain

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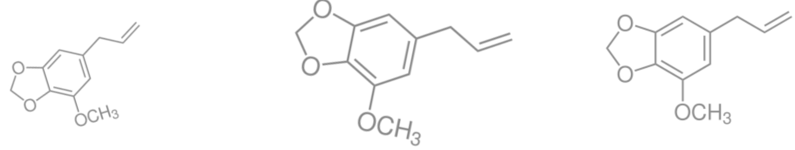

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(One thing that we're not considering for the sake of simplicity is the chain length of the fatty acids, though this can be a significant factor in melt point, and to a lesser extent oxidative stability. Though, it should be noted that the degree of unsaturation has a more significant effect on melt point than chain length for the fatty acid range that we typically consider in plant oils and fats. An example of this would be that the melt point difference between Lauric Acid C12:0 and Stearic Acid C18:0 is about 30C degrees, while the difference in melt point between Stearic Acid C18:0 and Oleic Acid C18:1 is about 60C degrees.)

WHAT'S NEXT?

There is a deeper conversation to be had about how individual triglyceride molecules line up when crystallized into a solid, and how this ability of the molecules to stack and align in a particular fashion is really the mechanism that determines the melt point of individual fats oils and the compatibility between different oils and fats, but that's beyond the scope of this post.

As well, there is another conversation to be had concerning how the double bonds present in mono-unsaturated and poly-unsaturated fatty acids are the sites of vulnerability to attack by oxygen atoms, and how that process occurs chemically, but again that is beyond the scope of this article. (One last technical point is that the analytic measurement used to determine the degree of unsaturation is know as Iodine Value. If you ever see Iodine Value, or IV, on a specification sheet this refers directly to a measurement of how many double bonds there are in a mass of oil or fat. The units are essentially arbitrary, but the typical range is about 0-200, with most natural oils falling in between these two limits. For example, Coconut Oil has an IV of about 8-12, while Flaxseed Oil is about 178.)

Now that we have a decent understanding of fatty acid saturation and how it determines the characteristics of a triglyceride, let's look at a couple of examples of actual oils and fats.

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OILS AND FATS

The first is Coconut Oil, which is a fairly simple example, as it is composed almost entirely of saturated fatty acids (Fig. 7).

Coconut Oil Fatty Acid Composition

Fatty Acid Chain Length	Percentage
Caprylic Acid C8:0	9
Capric Acid C10:0	6
Lauric Acid C12:0	47
Myristic Acid C14:0	18
Palmitic Acid C16:0	9
Stearic Acid C18:0	3
Oleic Acid C18:1	6

Fig. 7 – Coconut Oil Fatty Acid Composition. Dominated by Lauric Acid, a medium chain, saturated fatty acid.

We can see that only about 6% of the triglycerides of Coconut Oil are composed of unsaturated fatty acids. Thus, given what we just reviewed, we should expect that Coconut Oil will have a relatively higher melt point and that it should be relatively stable against oxidation. And that is what we see. Anyone who has seen a jar of Coconut Oil knows that it is solid or semi-solid at room temperature (~22°C), as opposed to most common oils which are fully liquid at room temperature. And anyone who has kept a jar of Coconut Oil in their pantry, or lab, for a significant amount of time will know that it rarely goes rancid. And now we know that these two characteristics of Coconut Oil, solidity at room temperature and long-term stability, are directly determined by its fatty acid composition.

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Let's look at one more example to close out our discussion.
Corn oil is another common oil but it has a fatty acid composition that is markedly different from Coconut Oil (Fig. 8).

Corn Oil Fatty Acid Composition

Fatty Acid Chain Length	Percentage
Palmitic Acid C16:0	10
Stearic Acid C18:0	2
Oleic Acid C18:1	29
Linoleic Acid 18:2	56
Linolenic Acid 18:3	3

Fig. 8 – Corn Oil Fatty Acid Composition. Dominated by Linoleic Acid, a long chain, polyunsaturated fatty acid.

When we look at the composition of Corn Oil, we see that it is composed of only about 12% saturated fatty acids, and almost 60% polyunsaturated fatty acids. Thus, we should expect that it will have a relatively low melt point and should be relatively unstable against oxidation. And again, that is what we see. Of course, Corn Oil is liquid at room temperature, so its melt point is somewhat irrelevant for our purposes. However, we can instead talk about its freeze point, which is about -11°C. This is well below the freezing point of water. So, while Coconut Oil is typically solid at room temperature, Corn Oil will remain liquid well past the point of ice forming. That's a difference of about 35C degrees. Now we can really start to see how the fatty acid composition of different oils can affect their respective melting and freezing points.

Additionally, we can look at the oxidative stability of these two example oils. Corn Oil has a relatively low oxidative stability because it's high poly-unsaturated fatty acid content drastically increases its vulnerability to degradation relative to an oil like Coconut Oil. And if you've ever looked at the specification sheet of Corn Oil that is intended for use in a personal care or cosmetic product, you will likely see that it has some form of antioxidant added. This is necessary for the oil to maintain a decent shelf life. Whereas Coconut Oil will rarely, if ever, have an anti-oxidant added. (In the past, this would have been synthetic compounds like TBHQ, BHT, or BHA. However, as the market calls for more natural solutions we have seen increased use of Tocopherols and Rosemary Extract.)

The last point I'll make about these two oils is that they are not very compatible. That is, if you were to use them at equivalent levels in the oil phase of an emulsion, or an anhydrous product, they would not want to form a very stable, homogenous mixture. And this is again because of the differences in their fatty acid compositions. Their differences of medium chain versus long chain, saturated versus poly-unsaturated, and higher versus lower melt points do not allow for their triglyceride molecules to line up well with each other. They're different shapes and because of this they want to crystallize at drastically different temperatures. Because of this incompatibility we would want to choose one oil as the major portion and the other as a minor portion. Such that there is at least a 2:1 ratio.

CONCLUSION

Hopefully, this brief comparison of two common oils has given us some perspective as to how differences in triglyceride and fatty acid composition directly determine the unique characteristics of different oils and fats.
We could spend a lot more time getting into the details of what we've discussed here, as well as further comparisons of fats like Shea Butter or oils like High Oleic Sunflower Oil, but that will have to be for another time.

AUTHOR

Graduating with a Bachelor's Degree in Biological Sciences, Benjamin Schwartz began his career in Personal Care as a lab technician for The Estee Lauder Companies. After a move to the west coast, he spent 12 years as an R&D Chemist, and then Manager, for contract manufacturer Columbia Cosmetics. Through this experience, he has gained an intimate knowledge of personal care chemistry and formulations. Now having joined AAK, a global vegetable oil manufacturer, he brings this knowledge and insight to the world of plant-based lipids and their applications for personal care and cosmetics.

Volunteer with the CTSCC!

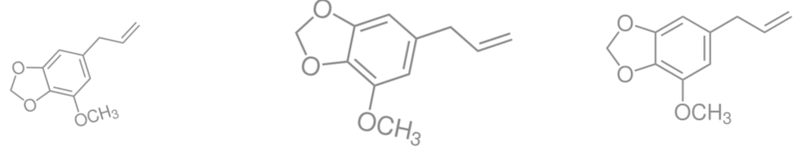
Become more involved with our chapter by volunteering!

As a member of the board, you can gain exposure to the national SCC organization, experience in a trade organization (suitable for adding to a resume), excellent networking opportunities, and a voice in future speakers.

Please contact any board or committee member with questions or for additional details.

Supplier's Day 2020 (New Date!)

Visit nyscc.org/suppliers-day for more information.



Upcoming Events

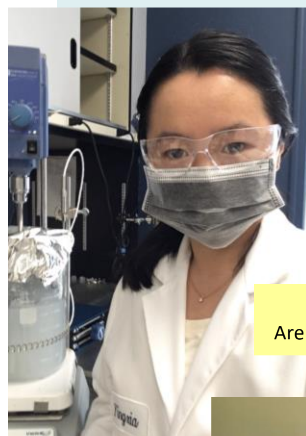
May 19 – NYSCC At Home Live: Tonal Comeback: Future trends 2020 (online)

May 21 – NYSCC At Home Live: Combating COVID-19 with Green Chemistry (online)

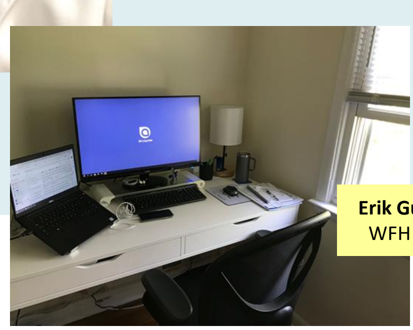
May 26 - SCC Quebec Chapter: Patents Webinar

How We're Working

Sue Sperring
and Autumn



Yingxia Wang
Are hard hats next? ☺



Erik Gutmann
WFH set-up

Connect with area professionals through the newsletter!

Do you have an ***employment opportunity*** in the Connecticut area or beyond?

Is there a ***technical article***, raw material insight, relevant writing, or other piece you'd like to share with the community?

Have you captured ***photos*** at CTSCC events?

Please contact Yingxia Wang to be featured in the newsletter (yingxia.wang@unilever.com).

Are you interested in supporting CTSCC with a newsletter ***sponsorship***? Please contact Michele Margherita for more information (mmargherita@brenntag.com) or visit *ctscc.org/advertising.*

Photo of Hartford by Ilirjan rrumbullaku (Flickr)

We are a chapter of the National Society of Cosmetic Chemists.
The National Organization is dedicated to the advancement of cosmetic science. The Society strives to increase and disseminate scientific information through meetings, continuing education courses and publications. For more information please make sure to visit our website: www.ctscc.org