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This article highlights several talks that exemplify the high-quality science presented at the 2019 AOCS Annual Meeting & Expo, held in St. Louis, Missouri, USA, on May 5–8.

Microencapsulation with Maillard Reaction Products to improve the oxidative stability of chia oil

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Is “green” diesel an emerging alternative to conventional biodiesel? Preliminary investigations demonstrate the possibility of converting an aqueous emulsion of triglyceride oil into liquid hydrocarbons within the diesel fuel range using a Ni/C catalyst.

Insects: an emerging source of protein
We’re not all eating them yet, but scientists and food companies are working hard to turn insects into a mainstream source of nutritious and sustainable protein for people the world over.

2019 Annual Meeting & Expo photo summary
Were you unable to make it to St. Louis? The pictures are worth a thousand words.
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Science highlights from St. Louis

Despite a forecast calling for storms, attendees of the AOCS Annual Meeting May 5–8, reveled in sunny days in St. Louis, Missouri, USA. Blue skies and warm temperatures made for picturesque selfies near the St. Louis Arch during the day and comfortable viewing of a Cardinals’ game in Busch Stadium at night. While inside the conference hall, nearly 1,400 attendees experienced educational short courses, lively division meetings and receptions, and a bustling Expo. They went home energized from the comradery and with memories of metal straws and a multi-block city blackout.

Making new connections and gaining a fresh perspective on your career is what the annual meeting is all about. Even established members get a jump start from attending. Kaustuv Bhattacharya, edible applications technology division vice chair, said he was grateful for the opportunity to meet Filip Van Bockstaele, food science professor at Ghent University in Belgium, Netherlands. “He has a great mind, and I plan to communicate with him to discuss our division activities,” Bhattacharya said. For governing board member Phillip Kerr, the highlight was the AOCS Member and Volunteer Appreciation Luncheon, where volunteers for the Society were recognized before a broad audience of their peers and fellow members. “The luncheon provided an opportunity to recognize the extraordinarily impact of the careers of many long-term AOCS members, while highlighting those mid-career members who are on track to make a significant contribution to the industries they serve,” Kerr said. Bhattacharya and Kerr both said they look forward to new experiences at the 2020 AOCS Annual Meeting & Expo Montréal, Québec, Canada on April 26–29.

The following is a sliver of the impactful science that was shared at the 2019 meeting. Unfortunately, there are not enough pages in Inform for a complete review of all the stimulating presentations that were given.

USE OF EPIGENETICS TO IDENTIFY THE ROLE OF FATTY ACIDS IN PERSONALIZED NUTRITION

Presented by Iwona Rudkowska, Department of Kinesiology, Laval University, Canada

Dietary fat intake affects our cardiometabolic health benefits by influencing the amounts of low-density lipoprotein (LDL), high-density lipoprotein (HDL), insulin resistance, and stiffness of our arteries. However, there is no simple formula determining what food we should eat to stay healthy.
We may believe that the lipid-rich plaque in our arteries will decrease if we simply change our diet or decrease our intake of saturated fats or cholesterol. That is often not the case.

One of the first studies to show the variability of LDL, HDL, and triglycerides after a low-fat diet was published in 1997, by Schaefer et al. While 55% of men on the low-fat diet decreased their LDL, 3% of them showed an increase. For women, only about 39% decreased their LDL, with 13% increasing it. Given the age of the study, it is apparent that we have known for a long time that few people respond the same way to a diet.

The question remains: What causes these differences in response? Our gender, bodyweight, health status, and environment factors, such as physical activity, smoking, and medications, all play a role, but so do our genetics, epigenetics, and microbiome. Due to this myriad of factors, Rudkowska stated that we cannot determine that any one food will be beneficial to all people. Any formula for determining if a food has cardiometabolic health benefits for a person should evaluate the food’s dietary fat content against that person’s individual variations, considering the bioavailability of the food and the individual’s biological responsiveness.

Aside from about 1% of the genome, all humans are genetically identical. That 1% could account for our different responses to various foods. In addition, our interaction with our diet modifies our gene expression, determining our phenotype. To explain, Rudkowska relayed results of experiments on omega-3s she performed as a post doc at Laval University. A range of results on the effect of triglyceride lowering by omega-3s have been previously reported in the literature. This could be due to multiple factors, like eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) doses or differences in background diets.

Rudkowska was curious if it was due to genetics. She conducted a study of the French-Canadian population, giving participants three grams of omega-3s (EPA and DHA) for six weeks. Most of the population was identified as responders, meaning they showed a decrease in triglycerides. However, about a third showed no change. She performed a genome-wide association study (GWAS), looking at all the genotypes of the individuals, and compared the genotypes of those who responded to those who did not respond to omega-3s (https://doi:10.1194/jlr.M045898). Her team identified 13 polymorphisms that were significantly different between the groups (Fig. 1, page 8). This indicates that there is a genetic component that could determine whether an individual responds to omega-3s.

Using these results, the team created a genetic risk model that predicted who would respond and who would not respond to the omega-3s. The model successfully predicted responders for a different set of French-Canadian participants. They tried the same study on a different population with a different
genetic background and found that the model was unable to predict who would be a responder. This finding reiterates that fact that dietary response has a genetic component.

Further, Rudkowska reviewed a study by Corella et Ordovas (https://doi.org/10.1002/bies.201300180) on the Mediterranean diet. This diet incorporates more monounsaturated fatty acids (MUFAs), lower saturated fat (SFAs), and moderate polyunsaturated fatty acid (PUFAs) compared to a Western diet. This study examined if there was a genetic component to the Mediterranean diet’s success. The TCF7L2 gene regulates blood sugar, and individuals who have the gene are prone for diabetes. One polymorphism (rs7903146) of this gene has the C-allele or T-allele carriers. People with this T-allele usually have higher risk of hyperglycemia, hypertriglyceridemia, hypercholesteremia, type-2 diabetes, and cardiovascular disease compared to the C-allele carriers. Would the added fat component of the Mediterranean diet still improve the health of people with this polymorphism? These researchers found that people with the T-allele experience a normalization of their plasma glucose, cholesterol, and triglycerides on the Mediterranean diet.

Rudkowska went on to explain that in addition to genetics, an individual’s response to dietary fats is determined by their epigenetics and microbiome. Nutritional genomics is a field of study that identifies the dietary patterns for individual variations that determine a phenotype and can predict nutritional profiles that will benefit that individual. They evaluate if a Mediterranean diet, a low-fat diet, or a high-fat diet, is best, and recommend specific foods and nutrients, such as MUFAs, PUFAs, and SFAs that may benefit certain individuals. She acknowledged that more studies are needed to confirm the findings of many of the reported results and that the field is too new to have conducted long-term viability studies.

**NEW INSIGHT INTO MOLECULAR ORIGINS OF COCOA BUTTER POLYMORPHISM**

Presented by Saeed M. Ghazani, University of Guelph, Canada

Edible Applications Technology

Cocoa butter is fat extracted from the seeds of the cocoa bean after it is dried, fermented, and roasted. The physical properties of chocolate (sharp melting profile, gloss, snap, etc.) are related to the physical properties and polymorphisms of the main three triacylglycerols (TAGs) in cocoa butter: 1,3-dipalmitoyl, 2-oleoyl glycerol (POP); 1-palmitoyl, 2-oleoyl; 3-stearoyl glycerol (POS); and 1,3-distearyloyl-2-oleoyl glycerol (SOS). Understanding the interactions of these three TAGs may expedite the development of a product that mimics cocoa butter. A full replacement of natural cocoa butter may eventually be needed since cocoa supplies are diminishing. Cocoa trees are under threat for various reasons depending on the region where they are grown. Demand for chocolate currently outweighs supply with reports of an outright shortage by 2020.

To find a fat that mimics the same chemical and physical properties as cocoa butter, Ghazani and his colleague first looked at the triacylglycerol composition of cocoa butter to figure out the polymorphism and physical properties of the three major TAGs present. They also studied binary and ternary interactions between POP, POS, and SOS in their triclinic solid-state structure. They accomplished this using cocoa butter crystallized from both an organic solvent and directly from the melt. Ghazani started isolating pure TAG components from Kpangnan butter and Chinese tallow butter to obtain high-purity POP and SOS. He developed crystallization procedures to obtain the most stable crystal polymorphic form of POS (β1), then crystallized the samples for about two years at room temperature to allow for the most stable crystal form to be achieved and avoid transients. He then synthesized cocoa butter equivalents using enzymatic interesterification to observe the physical property effect on manipulating the POP, POS, and SOS ratios.

Two new triclinic polymorphs, β1, and β2, were obtained for POS. The small and wide-angle powder X-ray diffraction pattern of β1 POS was identical to that of form V in cocoa butter (Fig. 2, page 10). The melting point of POS in β1, β2, and β crystal polymorphic forms was 32.9°C, 33.8°C, and 38.7°C, respectively. Next, Ghazani evaluated the binary interaction of POP, POS, and SOS in both the meta and the most stable crystal polymorphic forms using static tempering (AOCS protocol) or shear tempering. He found that the static tempering method was not sufficient to transform the crystal polymorphic form of POP and POS individually or in their binary mixtures (POP:POS and POS:SOS) from pseudo-β1 to β forms. By contrast, solvent crystallization yielded the form β1, similar to results obtained with cocoa butter. Temperature cycling (30°C to 18°C) was found to influence the 1:1 binary interaction between POP:POS, POP:SOS, and POS:SOS. In ternary interactions between POP, POS, and SOS, he found a strong eutectic region between POP:POS mixtures. The researchers conclude that POS dominates crystal forms IV and V of cocoa butter and modulates their transformations from form IV to form V. This
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study suggests a relationship between POS polymorphic transitions and the fat bloom defect formation in chocolate. Since POS showed a critical functionality in the crystal polymorphism and melting behavior of ternary mixtures of POP, POS, and SOS, they recommend the inclusion of POS in the design of cocoa butter equivalents.

**DISHWASHING APPLIANCE TRENDS’ IMPACT ON DETERGENT FORMULATION**

**Presented by Monica Ochoa Ruiz, Home and Personal Care, DuPont, The Netherlands**

The surfactants and detergents industry obviously must keep pace with changing trends in automatic dishwashers. However, Ochoa Ruiz explained that these trends are determined by multiple consumer preferences, not just established by the machines themselves.

Three factors affect automatic dishwashing: the detergent, the appliance, and the food. No factor can be considered independently as a focus of customer satisfaction. For example, consider the relationship between the food and the appliance. If manufacturers only focus on running the appliance at lower temperature, customer satisfaction will not be met because the appliance will not be able to remove fat residues from the food we eat. The relationship between the food and the detergent requires detergent formulations that are specific to the foods consumers routinely consume. The detergent must contain active ingredients and enzymes that are effective against foods popular with consumers. Lastly, there is a potential for auto-dosing to become popular in appliances. Homecare professionals need to think about how such appliance technology will affect detergent formulas. It is important for formulators to consider all these factors when looking to the future.

The current appliance trend in North America is a focus on sustainability. Consumers want to have a clear conscience about the products they use, and they want brands that embrace similar values, reports Ochoa Ruiz. Today, appliance manufacturers are investing in reducing the impact of dishwashing on the environment. According to the Consumer Electronics Show held in Las Vegas, Nevada, USA, in January 2019, two popular manufacturing trends influenced by sustainability were half-load options and more efficient drying. Half-load only runs a wash in half the machine, saving time, water, and energy. Drying efficiency is achieved by building machines with stainless steel interiors which are standard in Europe and becoming more so in North America.

Aside from sustainability, manufacturers seek to provide customers with high-performance, convenient appliances. They have added a steam option to machines as a prewash for stain removal, and redesigned wash arms that operate in dual zones, offering variable water force where needed. Machines are now connected to smart devices so they can be started at any time and from any place. The ultimate combination of all these trends is a product by Heatworks based in Mt. Pleasant, South Carolina, USA. They have created a dishwasher the size of a coffee table, with no water supply hook-up.
of a toaster oven that sits on the counter and does not require a water supply connection (Fig 3.). Some of these trends will improve the cleaning performance of dishwashing appliances, but they will likely create new challenges for detergent formulators.

Just as a focus on sustainability is popular among consumers, so is a greater focus on eating healthfully. The population of people who are eating vegan or vegetarian has increased over the years. Globalization has also influenced consumer food choices, since food from all over the world can easily be found in North America. To understand how dietary choices will influence detergent formulations, Ochoa Ruiz’s group performed a consumer study. They surveyed North American consumers about their most-consumed food, how often the food stains, and how difficult it is to remove the stains. Tea, coffee, and curry were the most commonly reported and difficult-to-remove stains. The survey respondents also reported difficulty removing dried-on and baked-on food.

After gathering all this information about trends in consumer preferences, Ochoa Ruiz sought to determine what these trends mean for detergent formulators. She tested standardized stains, of mixed starches, to see how detergents performed at different cycle lengths. She found that performance of both amylase and protease enzymes were reduced when wash cycles were shortened from one hour to 30 minutes. The Sinner’s cycle states that temperature, chemistry, time, and mechanical action must all be in harmony to achieve optimal cleaning. If any aspect is decreased, another must compensate. Ochoa Ruiz stated that if less or cooler water is going to be used to satisfy consumer trends toward sustainability, detergents need to be improved. Enzymes are key in this capacity, she said. After adding more enzymes to the detergent formulations used in the cycle length comparison study there was no difference in cleaning performance despite a shorter cleaning time.

**Restructuring Lipids for Functionality and Health**

Casmir C. Akoh, University of Georgia, USA

Biotechnology

Akoh presented an overview of the research that takes place in his lab, where they focus on structuring lipids with the intention of creating molecules that will provide a health benefit on consumption. Either chemical catalysts or enzymes are used to modify these lipids. However, enzymes provide more mild conditions than chemical catalysts and are, therefore, used more often in the Akoh lab.

One food material Akoh is studying is a replacement for human milk fat. Human milk fat analogs primarily contain oleic acid, palmitic acid, and linoleic acid, in stereospecific arrangements, for example oleic-palmitic-oleic (OPO) or oleic-palmitic-linoleic (OPL). In addition, they contain substances like docosahexaenoic acid (DHA, 22:6n-3) and arachidonic acid (ARA, 20:4n-6). Akoh’s lab is working on infant formulas that would duplicate this stereospecific structure of the fats found in human breast milk.

They begin with the vegetable oil tripalmitin and replace the outermost palmitic acid groups with oleic acid groups in one- or two-step reactions using a sn-1,3-specific lipase enzyme (Fig. 4). However, the OPO produced by either method does not have many of the free fatty acids that an infant will need and must be mixed with a preformed DHA and arachidonic acid in infant formulas. More recently, the Akoh group attempted another synthesis method by starting with two triacylglycerols and then adding two different enzymes along with the desired free fatty acids. They allowed these reactants to compete, and the result was a mixture of molecular species which included OPO, as well as some fraction of triacylglycerols with DHA or ARA attached in place of the oleic acid groups. This synthesis was then improved by a two-step method that

better controlled the fatty acid placement. By forming an intermediate with a higher concentration of palmitic acid on position 2 of the triacylglycerol backbone, the researchers had the ability to selectively add DHA, ARA, or oleic acid.

These experiments used vegetable oils as a starting point for the structured lipids, however, human milk fat has a unique triacylglycerol structure. In milk produced by humans, the glycerol has unsaturated fatty acids at the 1 and 3 positions. Research shows that unsaturated fatty acids in these positions allow for palmitic acid to reside at the 2 position, which is critical for calcium absorption by the infant. The Akoh group has started to develop triacylglycerols with unsaturated chains to take advantage of this health benefit.

Triacylglycerols with different degrees of saturation, in addition to a mixture of chain lengths, have a benefit not just to infants, but also for endurance athletes. Akoh’s group is working on products that will provide both immediate and sustained energy for active consumers. They produced medium- and long-chain oils by starting with coconut oil and removing the undesirable fatty acids. They were able to replace the 50% lauric acid concentration in the oil with high oleic sunflower oil, resulting in a product containing only 20% lauric acid.

Before concluding his talk, Akoh described the other lipid restructuring efforts in his lab, which include menhaden oil structured lipids, and the synthesis of 1-o-galloylglycerol and cocoa butter substitutes. Throughout the talk, he emphasized his group’s reliance on enzymes to make these structural changes possible.

MCPD AND GLYCIDYL ESTERS—PRESENT AND FUTURE EU LEGISLATION, IMPLEMENTATION IN GERMAN RISK MANAGEMENT

Martin Kaminski, Federal Office of Consumer Protection and Safety, Germany

Analytical

Maximum levels for contaminants in foods were set by the European Union (EU) in 2006. These regulations cover contaminants such as, nitrates, mycotoxins, heavy metals, dioxins, and 3-MCPD. The regulation was amended several times to include other contaminants, the latest amendment made in 2018, that set maximum limits (ML) for glycidyl esters. EU regulation 290 determined that the maximum level of glycidyl fatty acid ester in vegetable oils is 1,000 µg/kg. If the oil is being used to make baby food, the limit is 500 µg/kg. If the vegetable oil-based infant food or formula is intended for medical purposes, the limit is 500 µg/kg. If the vegetable oil-based infant food or formula is intended for medical purposes, the limit is 500 µg/kg. If the vegetable oil-based infant food or formula is intended for medical purposes, the limit is 500 µg/kg. If the vegetable oil-based infant food or formula is intended for medical purposes, the limit is 500 µg/kg. If the vegetable oil-based infant food or formula is intended for medical purposes, the limit is 500 µg/kg. If the vegetable oil-based infant food or formula is intended for medical purposes, the limit is 500 µg/kg. If the vegetable oil-based infant food or formula is intended for medical purposes, the limit is 500 µg/kg.

Kaminski reported that Germany’s Federal Office of Consumer Protection and Food Safety is currently discussing their maximum limits for these contaminants. For oils like coconut, rapeseed, and palm kernel, they are considering a maximum limit of 1,250 µg/kg and a limit of 2,500 µg/kg for marine-based oils. Baby food and formula limits will likely be set just above the EU standards. These potential maximum limits were issued for glycidyl esters, but not for 3-MCPD because of discrepancies in the limits set by the European Food Safety Authority (EFSA) and the Japanese Food Safety Authority (JFSA). EFSA set the tolerable daily limit of 3-MCPD at 0.8 µg/kg of body weight, but JFSA established a limit of 4 µg/kg. Due to the discrepancy the EFSA reevaluated their data and in 2018 reset the TDI to 2 µg/kg.

When considering these proposed maximum limits for 3-MCPD, Kaminski first questioned whether they were achievable. Looking at 2012 data from the EFSA on 3-MCPD in vegetable oils, he found that for most oils on the market the ML was less than those under consideration by the German government. This is true even in the case of infant products, which require stricter food contaminant MLs given high-quality raw materials are used. However, the palm oil and olive pomace oil industries may have difficulty meeting proposed limits since both oils exceed them in the 2012 data.

Since most MLs can be met, Kaminski stated that regulating oil blends is likely to pose the most difficulty. An oil mixture will have to comply with the MLs for all the components of the mixture. For example, the resulting limit for a mixture of 50%...
coconut oil with an ML of 1,250 µg/kg and 50% palm oil with an ML of 2,500 µg/kg, would be 1,875 µg/kg for glycidyl esters. If the composition of the mixture is unknown, the ML is 2,500 µg/kg. Kaminski stated this puts an undue burden on official control laboratories to determine the composition of the oils, which are often unknown or proprietary. Even when compositions are reported, the laboratories cannot be certain they are accurate. This puts them in the position of always adhering to the higher of the two limits, which may not be safe. Kaminski stated the lower limit would be preferable. The regulation of blended oil becomes increasing complicated when having to consider both the EFSA and the JFSA 3-MCPD standards.

Kaminski reported that his lab is responsible for Germany’s risk management of 3-MCPD and glycidyl esters by organizing the proficiency tests and coordinating method standardization. Once established, these tests are implemented in German control laboratories. The last test, to be released in early 2020, will be the determination of 3-MCPD and glycidyl esters in fish oil. The current 3-MCPD and glycidyl esters standard methods for various food matrix categories are limited to oils, and oil-based emulsions, but Kaminski said methods are needed for matrices like food supplements, fried potato products, instant noodles, and fish meal products. In January of 2019, his lab established a standardization working group to address these missing methods.

Rebecca Guenard is the associate editor of Inform at AOCS. She can be contacted at rebecca.guenard@aocs.org.
The oil obtained from the seeds of chia (Salvia hispanica L.) is a valuable plant source of omega-3 polyunsaturated fatty acids (PUFA). Chia oil’s high PUFA content makes it an interesting source for enriching foods with these essential fatty acids, but the oil’s high PUFA content also makes it susceptible to oxidation. Consequently, one of the most relevant challenges is to protect the oil from oxidative deterioration.

Recently, different studies have demonstrated that microencapsulation confers chia oil with protection against this type of deterioration [1–5]. Moreover, the oxidative stability of chia oil can be further improved through other strategies, such as using compounds with antioxidant properties. Toward this end, the Maillard Reaction Products (MRPs) formed during the classic chemical reaction between amino acids and reducing sugars are a good encapsulant system for oils with high PUFA contents [6] since these protein-carbohydrate conjugates possess emulsifying and antioxidant properties. Although questions about possible toxic effects of MRPs have been raised, some studies have reported that these products are not likely to be dietary mutagens or genotoxic, and some MRPs even have health-promoting effects [6].

Our research work has focused on generating MRPs from different heat treatments of sodium caseinate (NaCas) (10% wt/wt) and lactose (10% wt/wt), then applying these MRPs as wall material in the microencapsulation of chia oil by spray drying.

To promote NaCas-lactose conjugates production through the Maillard Reaction, we applied two different heat treatments (60 or 100°C, 30 min) to the protein-carbohydrate mixture, with an unheated mixture of NaCas-lactose mixture serving as a control. The absorbance, measured using a spectrophotometer at a wavelength of 465 nm, and the color of the aqueous phase indicated that heating the mixture to 100°C produced the most browning, which is associated with the formation of MRPs called melanoids. Also, Fourier-transform infrared spectroscopy (FTIR) spectrums showed that the most intense heat treatment promoted MRPs to a greater extent than lower or no heat treatment did. A DPPH (2,2-diphe-
Microencapsulated chia seed oil was produced by spray-drying the emulsions at 170/90°C of air inlet/outlet temperatures on a laboratory-scale equipment. Figure 1 summarizes the process of microcapsules production.

Measurements of microencapsulation efficiency (ME%) (ME% = surface oil/total oilx100), moisture content, and $a_w$ were performed immediately after powder production. The results showed high microencapsulation efficiency (~99%), with moisture content and water activities ($a_{w25^\circ C}$) in the range of 0.02-3.00 % (d.b.) and 0.243-0.470, respectively. Thus, the

FIG. 1. Spray-dried microencapsulation process for chia seed oil
resulting microcapsules from this process presented an oil load of 33% wt/wt, with a 1:2 core:wall ratio. The low levels of moisture content and \( a_{w,25^\circ C} \) are adequate for incorporating these powders into different dried powdered foods. With this in mind, we investigated the dispersibility of the powders using a laser diffraction instrument. After adding a portion of the samples (~0.3 mg of powder/mL) to the stirring chamber containing distilled water, the obscuration and the particle size were monitored as a function of stirring time. The rapid powder dispersibility (<2 min) suggested that the microcapsules could be suitable for use in instant products.

Figure 2 shows the scanning electron microscopy (SEM) images of the obtained microcapsules at different magnifications. Regardless of the treatment, most of the particles had sizes between 10 and 35 micrometers, a spherical shape, and smooth external surfaces. With respect to the internal structure, we observed the presence of a hollow space in the center of the particles. This space is surrounded by the dry solid matrix, with the core material distributed inside of it. This cavity was likely due to the expansion of the microcapsules in the latest stage of the drying process. [7].

In terms of oxidative stability, all the microencapsulated systems had a protective effect on the chia oil (Fig. 3). At \( t=0 \) d, the peroxide value (PV) of chia oil was 2.6 meq/kg, whereas the PVs of the microencapsulated oils were 3.9, 3.5, and 5.0 meq/kg for the unheated, and the 60 and 100°C-heated treatments, respectively. Although the microencapsulation process slightly affected the initial oxidation status of chia oil, all treatments resulted in PVs lower than the upper limit recommended by the *Codex Alimentarius* for this type of oil (< 10 meq/kg).

The evolution of PV in the bulk oil and the microcapsules during 75 days of storage in the dark at 25 ± 2°C and 33% relative humidity was also investigated. Figure 3a shows the evolution of the PV, / PV index, with PV being the value at different storage times, and PV the value corresponding to the initial time. The PV of the bulk chia oil increased 14 times during 75 days of storage, while the PV levels of the microencapsulated systems only doubled or quadrupled. Microcapsules obtained from emulsions constituted by the aqueous phase submitted to heat treatment of 100°C, 30 min had the lowest PV level. The inverse relationship observed between the MRP and PV values suggests that the protection of chia oil against lipid oxidation during storage was higher when the most intense heat treatment was applied. Thus, the MRPs generated with the treatment at 100°C, 30 min was not enough to confer additional protection to the microencapsulated oil.
Conversely, MRPs generated with treatment at 100°C, 30 min increased the stability of the microencapsulated oil, allowing it to maintain a PV < 10 meq/kg after 75 days of storage. The accelerated oxidation test, measured by Rancimat equipment (98°C, 20 L/h), was consistent with the PV measurements (Fig. 3b). The induction times of the microencapsulated oils, which were four times higher than the induction time of the bulk chia oil, showed that the microencapsulation process protected the chia oil from lipid oxidation in all cases. Although the oxidation status of the microencapsulated systems did not differ significantly at the beginning of the storage test, the microcapsules prepared with the aqueous phase treated at 100°C, 30 min had the highest induction time at the end of the test. No significant differences in the omega-3 content of the microencapsulated oils were observed between the initial and the final storage time.

Thus, applying MRPs as wall material improves the oxidative stability of spray-dried microencapsulated chia seed oil and appears to be a viable alternative for delivering and applying this oil in the production of omega-3 fortified foods. Additional studies are necessary to investigate other temperature-time combinations that could promote higher quantities of MRPs and have a greater impact on the oxidative status of chia oil and the characteristics of the microcapsules.

References


This is a promising preliminary study investigating the effects of important variables on the conversion of canola oil into hydrocarbons (Fig. 1). Specifically, the effects of temperature (295–315°C), catalyst: oil ratio (4–10%), reaction time (6–12 h), and hydrogen pressure (1.52–2.76MPa) were determined. After analyzing the results, the best conditions within the investigated ranges were identified for the various parameters, and a test reaction was then conducted under these conditions. Since fatty acids were the major intermediates and still retained the original oxygen in the triglycerides, they were treated as reactants in the calculation of conversion, yield, and selectivity.

The reactor (Fig. 2) was equipped with a heating mantle that was originally hard-wired to a 4821 temperature controller (TC) which had the capacity to regulate the motor, heating, and cooling of the reactor.

Canola $\xrightarrow{H_2, H_2O}$ Hydrocarbons + Oxygenates $\xrightarrow{Ni/C}$ fatty acids + gases [CO, CO$_2$, H$_2$, CH$_4$, C$_2$H$_6$, C$_3$H$_8$]
Decarboxylation experiments were performed in the stirred 1L reactor described above. In a typical experiment, ~200g water, 100g canola oil, and catalyst (~1.67wt.% of loaded reacting materials) were placed in the reactor. The reactor was sealed and purged with N\textsubscript{2} for 4 min. Afterwards, the pressure line was switched to the hydrogen supply, and the reactor was purged for 2 min before pressurizing to the desired headspace pressure. The heater was switched on, and the temperature of the reactor was measured using a type J (Iron-constantan) thermocouple connected to the model 4831 TC.

After each run (Fig. 3) and following cooling and releasing the gas, contents were collected and weighed in a tared beaker. The liquid phase, mostly consisting of water was separated from the solids by filtration using a pre-weighed 15.0 cm diameter WHATMAN\textsuperscript{®} filter paper (934-AH) fabricated from microglass fibers (1.5 micrometers) on a porcelain Buchner funnel until a clear aqueous phase was obtained. To make sure there was no loss of important organic product, the aqueous phase was usually washed with hexane, after which the mixture was shaken vigorously for about 10 min and then transferred into a 1000 mL separating funnel and left to stand overnight in the fume hood. Afterwards, the lower aqueous phase was drained from the funnel, and the top organic layer collected in a flask. A portion was taken for analysis by gas chromatography.

The procedure for recovering the actual organic products from reaction was as follows: The mushy solids left after the removal of the aqueous phase (a mixture comprised of important organic products and the solid catalyst) were dried using molecular sieves, then extracted in hexane. After extraction, separation was achieved by vacuum filtration using surfactant-free cellulose acetate (SFCA) membranes known to be resistant to chemical attack by hexane. Finally, the products were recovered using a Büchi rotovapor (Büchi Labortechnik AG, Flawil, Switzerland). To ensure representativeness of samples, the recovered organic products were gently warmed by heat from a water bath, and samples were taken and diluted further in fresh hexane for analysis. The leftover, non-extracted products retained with solid catalysts were weighed.

Our preliminary experimental results suggested that a smaller initial hydrogen headspace pressure was beneficial to alkane formation, thus supporting the non-linearity of the dependence of hydrocarbon yield on hydrogen. One other important effect hydrogen had on the reaction was in the formation of esters, particularly stearyl stearate. When the initial hydrogen input was decreased by 45% from 2.78 MPa to 1.53 MPa, the amount of stearyl stearate in the product mix decreased by 77%.

Temperature had a positive effect on alkane formation. At 295\textdegree C, the yield was very low (2%), but improved as the...
temperature was increased. Although hydrocarbon formation was enhanced with temperature, the selectivity did not increase proportionately. For example, at 305°C, the yield was 16.8%, and increased about 10% at 315°C. However, the selectivity actually decreased from 33% at 305°C to 28% at 315°C. At higher temperatures, the propensity for side reactions and gas formation increased. Even with model feedstocks, multiple side reactions such as those involving cyclization, aromatization, dehydrogenation, isomerization, and various cracking reactions have been noted to occur alongside the alkane forming reactions in an organic solvent. Consequently, temperature had a negative effect on the overall mass balance. At 315°C, the loss of material was over 30% of the weight of starting feedstock.

Indicative of extensive side-reactions was the fact that the amount of identified and quantified products was only about 75%. The unidentified products were oxygenates that had retention times within the alcohol and lower ester (C16 and

FIG. 4. Reaction composition at different temperatures, 8 h, Ni/C: oil ratio =4%

FIG. 5. Product composition after 8 h of reaction at different catalyst: oil ratios
C18) regions of the chromatogram. It is worthy to note that although temperature appeared to generally have a positive effect on alkane production, the increase in yield between 295 and 305°C was not commensurate with that between 305 and 315°C (Fig. 4).

There was a strong positive correlation between the yield of desired alkanes and the catalyst: oil ratio. The yield of alkanes increased as the ratio of catalyst to oil was increased. At a loading of 5g Ni/C per 60g of oil, i.e., a catalyst-to-oil ratio of 8%, the selectivity was 55%, and increased 9% to 60% at 10% catalyst: oil. However, the yield increase was approximately 30%, suggesting that although better yields were realized at higher ratios, more by-products were also produced. A plot of the composition of the main products as a function of catalyst: oil ratio is given in Figure 5.

Increasing the catalyst loading resulted in a decrease in the formation of stearyl stearate. It should be noted that the oil loading, i.e., the concentration of the oil in water was 33 wt.% at catalyst: oil ratio of 5%, and 20 wt.% at the other catalyst: oil ratios. The reason for the drop in the formation of stearyl stearate at higher oil loading is unclear since according to its mechanism of formation two stearic acid molecules are needed for every mole of the ester, which suggests a strong dependence on oil loading. However, it is possible that the lower hydrogen: oil ratio at catalyst: oil ratio 5% was the reason behind the irregular trend. Hydrogenolysis of stearyl stearate produces C18 alkane. At higher ratios, the amount of octadecane increased while that of stearyl stearate decreased.

After the studies on the effects of relevant process parameters, the best conditions within the limits of available materials and equipment were identified. Test reactions employing these conditions were conducted, and the results are presented in Figure 6 (page 22). The first of these two experiments was conducted for 12h with a constant initial H2 supply. The conditions are presented in Table 1.

No tri-, di-, or mono-glyceride was observed in the final product mixture. Thus, with respect to the starting canola oil, conversion was 100%, but since the intermediate oxygenates were considered as precursors for hydrocarbon production, the calculation for conversion involved treating them as reactants as well. Thus, conversion was calculated as the measured intermediates oxygenates in the final products subtracted from the weight of the original feedstock. No glycerol or nickel was observed in the aqueous phase. Also, no unsaturated alkanes were formed. The fragmentation pattern for the heptadecane major product was matched to the observed fragmentation pattern of the standard acquired from Sigma Aldrich. One hundred percent of the oil reacted, forming approx. 37% intermediate oxygenates and about 63% of observed hydrocarbon products.

Further, by continuing the experiments for three time periods (for practical lab-safety considerations) consisting of two consecutive 8 h runs and one 7 h run, a total of 23 h reaction time was completed. Between the runs, the existing gas phase of the reaction mixture was released and fresh hydrogen was introduced, to investigate the amount of alkane formation after 12 h of reaction.

After 23 hours at 305°C, complete conversion of the initial triglycerides was achieved. Alkanes were produced with high selectivity (>75%) and yield (65%) with respect to the feed-

**TABLE 1. Reaction conditions for experiment under 12 h, 315°C, 10wt.% Ni/C: oil**

<table>
<thead>
<tr>
<th>Reaction time (h)</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil (g)</td>
<td>61.4</td>
</tr>
<tr>
<td>H2 (MPa)</td>
<td>1.95</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>315 ± 5</td>
</tr>
<tr>
<td>Reaction Pressure (MPa)</td>
<td>11.73 ± 0.69</td>
</tr>
<tr>
<td>Catalyst: Oil ratio (%)</td>
<td>10</td>
</tr>
</tbody>
</table>

**References**


7. Sinichi, S. (2016) Production of biodiesel from yellow mustard compatible with food protein production; University of Toronto (Canada), ProQuest Dissertations Publishing, 10194555.


During the course of our many investigations, we learned several things.

- This project has demonstrated the possibility of converting an aqueous emulsion of triglyceride oil into liquid hydrocarbons within the diesel fuel range using a Ni/C catalyst.
- Within 12 h reaction, at 315°C and using an initial hydrogen headspace pressure at 1.93MPa, moderate yield (>50%) and complete conversion into intermediate oxygenates and hydrocarbons were obtained with 70% selectivity.
- After 23 h at 305°C, complete conversion of the starting triglycerides was achieved. Alkanes were produced with a high selectivity (>75%) and a good yield (65%) with respect to the feedstock.
- The limitations and challenges experienced during this initial study justify additional work which is presently underway.

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If you ask many North Americans and Europeans whether they will consider consuming insects as part of their staple/daily diet, they will most likely answer “no.” For people living in these regions, eating insects would be the last resort in their diet. This aversion seems quite normal for many of us. We squirm at the site of a spider in our backyard, we use pesticides to eliminate ants in our homes, and we flinch when a bee flies by.

However, not everyone in the world feels the same way about insects. Entomophagy, or the practice of eating insects, is common in many countries around the world. In fact, it is estimated that more than 2 billion people eat insects worldwide. There are close to 2,000 insect species that are considered edible including: beetles, caterpillars, wasps, ants, bees, grasshoppers, locusts, crickets, cicadas, leafhoppers, plant-hoppers, termites, dragonflies, and flies (Fig. 1 and Fig. 2, page 24). So, the question is: Why aren’t we all eating insects?
In North America, insects are generally considered a novelty item. This is despite the knowledge that Native American tribes (for example, Utah Paiutes) were known to practice entomophagy and even shared insect-food with European colonists. Today we know that by the year 2050, with the growing global population, agricultural production will need to increase by at least 60% in order to produce enough food to feed the world (Food and Agriculture Organization). This has created pressure to find alternatives for providing humans with their protein needs using affordable, healthy, and eco-friendly resources. Insects are a good source of carbohydrates, lipids, minerals, vitamins, and are overall high in protein (including essential amino acids). Crude protein content of insects ranges between 50–75% (dry matter), depending on species and life cycle stage.

Table 1 gives an overview of the protein content of several edible insects. In terms of sustainability, insects are known to emit significantly lower greenhouse gases and ammonia per kilogram mass gain than conventional livestock, and the environmental costs of producing them can be lower. In the United States, for insects to be considered as “food,” they must be raised following Good Manufacturing Practices (GMPs). It is important to note that the US Food and Drug Administration (FDA) prohibits the collection of insects in the wild, to prevent foodborne pathogens or contamination from pesticides in the environment. In addition, harvesting insects from the wild would defeat their sustainability, as it could lead to an imbalance in the ecosystem.

Because many people are hesitant to eat whole/intact insects, food companies are stepping in to provide familiar food products formulated with insect protein powders, primarily using cricket species. For example, protein and energy bars made with cricket protein powders have been launched in the United States by the companies eXo™ and Chapul®. BittyFoods® has a line of cricket products that includes snacks and baking flour, and Mighty Cricket® has a variety of cricket protein breakfast cereals. Ovipost® (Labelle, FL) and Entomo-Farms® (Ontario, Canada) are two examples of farms that currently raise crickets exclusively for human consumption.

Meanwhile, scientists are currently looking at optimal protein extraction and fractionation methods, which are important in producing insect protein ingredients with adequate functional properties needed during food formulation.

One effective protein extraction method involves using commercial enzymes to hydrolyze the insect protein (Fig. 3). The resulting protein hydrolysates can have improved nutritional benefits (e.g., soluble small peptides and free amino acids) and techno-functional properties (e.g., solubility, foaming, emulsification) that will allow for their application in food and beverage formulations. Protein hydrolysates are also highly studied for their hypoallergenic applications in infant formulas, and their biological activity in the prevention of chronic diseases such as diabetes and hypertension.

As efforts continue to encourage entomophagy via insect-derived ingredients, safety and allergenicity remain a major concern. Current research provides information on the cross-reactivity of insects and major shellfish allergens. Insects are arthropods just like lobster and shrimp, and therefore have similar proteins that can trigger an allergic response. Enzymatic hydrolysis and microwave treatments are being studied for their role in producing hypoallergenic peptides for food applications. This is because enzymatic hydrolysis and microwave radiation seem to alter linear epitopes that would translate to changes in IgE binding. In addition, scientists are also exploring

### Table 1. Approximate protein content of some edible insects

<table>
<thead>
<tr>
<th>Edible insect</th>
<th>Protein (g/100 g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cockroach (<em>Periplaneta americana</em> L.)</td>
<td>66</td>
</tr>
<tr>
<td>Common fruit fly (<em>Drosophila melanogaster</em> nymph</td>
<td>56</td>
</tr>
<tr>
<td>House cricket (<em>Acheta domesticus</em>) nymph</td>
<td>20 15</td>
</tr>
<tr>
<td>Tropical banded cricket (<em>Gryllodes sigillatus</em>)</td>
<td>57</td>
</tr>
<tr>
<td>Palm weevil grubs (<em>Rhynchophorus ferrugineus</em>)</td>
<td>26</td>
</tr>
<tr>
<td>Yam beetle (<em>Heteroligus meles</em>) larvae</td>
<td>38</td>
</tr>
<tr>
<td>Mealworm (<em>Tenebrio molitor</em>) larvae</td>
<td>24 19</td>
</tr>
<tr>
<td>Earthworms (<em>Lumbricus terrestris</em>)</td>
<td>10</td>
</tr>
<tr>
<td>Superworms (<em>Zophobas morio</em>)</td>
<td>20</td>
</tr>
</tbody>
</table>

1Values (g/100 g) are on a dry weight basis for adult insects unless specified.
the possibility of new allergenic peptides forming from these “emerging” protein sources. Therefore, allergy-risk assessments are geared toward studying whether insect proteins can elicit an allergic reaction in the shellfish-allergic population (cross-reactivity), or if insect proteins are able to induce a new allergic response (sensitization).

Introducing insect-proteins into the food chain offers both societal and environmental benefits as we prepare to meet the world demand for food in the next 25–50 years. Consumers, stakeholders, the food industry, policy makers, and public health authorities require a better understanding of the allergenic risks associated with these novel insect-based foods. As we work toward developing traditional foods formulated with insect protein powders, we need to consider the adequate labelling of these novel foods.

Andrea M. Liceaga is an associate professor in the Food Science Department, Purdue University, Fort Wayne, Indiana, USA. She earned a Ph.D. in food chemistry from The University of British Columbia, and in 2009, became a faculty member in the Food Science Department at Purdue University. Her research program aims to develop approaches for the application of alternative protein sources, particularly insects and fish by-products. Her research includes protein extraction methods, protein structure-function interactions, bioactive peptides, sensory evaluation and consumer attitudes towards alternative proteins, and protein applications through food product development. She can be contacted at aliceaga@purdue.edu.

Further reading


The 2019 AOCS Annual Meeting & Expo in St. Louis, Missouri, USA, on May 5–8, provided nearly 1,400 professionals, scientists, researchers and students from the fats, oils, protein and surfactant industries with a forum to build their knowledge of today’s market and learn about the latest scientific research. Attendees, who represented more than 580 companies and 49 countries, could choose from:

- eight featured sessions covering key issues such as ingredient transparency, healthy oils and personalized medicine, global advancements to guarantee olive oil quality and fight fraud, and career management and networking;
- more than 400 oral and 150 poster presentations (48 of which were given by AOCS Award and grant winners) during 57 technical sessions and 10 poster sessions, with topics ranging from protein assessment methods to biopolymers;
- 92 exhibits by companies representing the latest products in the international fats and oils industry;
- 25 Technology Fast Track presentations by industry leaders; and
- numerous Division, Section, social, and networking events.

Enzymes were big news at the meeting. With biotechnology tools becoming faster and cheaper, designing new enzymes has never been easier. Whether for degumming, hydrolysis, or interesterification, enzymes perform chemical conversions using fewer solvents and less energy (see “Enzymes in oil processing: a search for milder, more sustainable, and economical solutions,” Inform, June 2019, page 6, https://www.informmagazine-digital.org/informmagazine/june_2019/MobilePagedReplica.action?Cover=undefined&pm=2&folio=12#pg14). In addition, cleaning product formulators are adding enzymes to laundry and dishwashing detergents to increase their effectiveness for cold temperature washing that is better for the environment.

If you were not able to attend the meeting this year, visit the AOCS Facebook page (https://www.facebook.com/AOCSfan/) to see photos and watch recordings of live streamed presentations, such as the video honoring the Award of Merit winners (https://www.facebook.com/AOCSfan/videos/392464444932498/) or the session on guaranteeing olive oil quality and fighting fraud (https://www.facebook.com/AOCSfan/videos/2780928271978726/).

Meanwhile, enjoy these photo moments and mark your calendar to attend the 2020 AOCS Annual Meeting & Expo in Montréal, Québec, Canada, April 26–29.

Science evangelist and guest plenary lecturer Anissa G. Ramirez challenged the audience at the Opening Plenary to make science more accessible by telling better stories that help non-scientists understand the impact, benefits, and challenges of science, while inspiring children from all walks of life to understand and embrace science. Watch a snippet of her talk at https://www.facebook.com/AOCSfan/videos/2345116632218570/.

Newcomers were gathered into the AOCS family, and old friends reconnected at The President’s Reception—Welcome to St. Louis. Exhibitors were on hand to demonstrate the latest equipment and give away interesting freebies. A certified brewmaster explained the chemistry of the brewing process and recommended beer pairings, while attendees at the mixologists station could pick up a signature cocktail and learn about the chemistry of the cocktail.
The sold-out exhibition featured 92 companies representing the latest products in the international fats and oils industry, plus a Technology Fast Track that included 25 presentations by industry leaders from around the world. A panel of AOCS Past Presidents chose Metrohm USA as the inaugural winner of the AOCS Best in Show competition. See a video of them receiving the award at https://www.facebook.com/AOCSfan/videos/333683380669664/.

Attendees could choose from more than 400 oral and 150 poster presentations given during 57 technical sessions and 10 poster sessions. See “Science highlights from St. Louis” on page 6.

During the Analytical Division luncheon, the Division’s outgoing secretary/treasurer, Cynthia Srigley (US Food and Drug Administration, College Park, Maryland, USA), received a certificate and a gift card for her service. Division and Section luncheons provided an opportunity to recognize and interact with peers in the same interest area or geographical region.

The 2019 Expo featured networking breaks throughout the day that provided attendees with a relaxed environment to talk with each other on an informal basis.

Nuria Acevedo (Iowa State University, Ames, Iowa, USA), co-chair of the Professional Educators Common Interest Group and JAOCs and AOCS Books author, and several other dedicated volunteers shared what volunteering for AOCS has meant to them during a special AOCS Member and Volunteer Appreciation Luncheon that celebrated the efforts of all AOCS volunteers.
A more sound process?

Olio is an Inform column that highlights research, issues, trends, and technologies of interest to the oils and fats community.

Rebecca Guenard

Ultrasound is best-known as a diagnostic tool, but fats and oils researchers who have applied these waves in various applications are finding that ultrasound can also be a processing asset. Diagnostic devices use low-intensity ultrasound that propagates a medium without disruption; however, high-intensity waves directly affect a material’s physical properties. Studies show high-intensity ultrasound (HIU) induces crystallization and improves extraction yields, but these findings are still at the research level. Will ultrasound become a routine step in fats and oils processing in the future? The technique certainly shows promise.

Ultrasound was introduced to liquid fats a decade ago in anticipation of consumer pressure to reduce trans-fats in processed foods due to studies linking them to heart disease. That initial health concern evolved into a complete elimination of the fats as an ingredient in multiple European countries. In 2018, the United States implemented its own ban on trans-fats (https://tinyurl.com/y38crlt5). At the same time, the World Health Organization has called for a worldwide ban by 2023 (https://tinyurl.com/y74vo9ny). Without trans-fats, food manufacturers searched for replacement processing techniques that provided the same physical qualities without the adverse health effects. Silvana Martini, professor of food science at Utah State University in Logan, Utah, USA, was the first to apply ultrasound to change the physical properties in bulk lipids. Over the past 10 years, more researchers have started using HIU in food applications.

Martini says that after so many years of studying HIU applied to a myriad of fats and oils, the definitive conclusion is that it accelerates crystallization and forms smaller crystals. “The generation of these smaller crystals are associated with a higher hardness in the sonicated samples,” says Martini. “That translates into higher elasticity and a different melting profile of the sample.”

Sound waves affect the properties of a fat or oil through a phenomenon generally known as cavitation. Exposing a liquid to an acoustic field causes bubbles to form, and a new surface, or cavity, is created within the body of the liquid. In theory, the cavity may be empty or filled with vaporized liquid, but either way the pressure that the bulk liquid exerts on the cavity’s surface means it is destined to collapse. When the bubbles burst, they produce a shock of high temperature and pressure that resonates throughout the liquid, altering its phase transitions. These general theories describe the basics of the effects of ultrasound, but experts on fat crystallization find that the mechanism to explain fat crystallization is more complicated. According to a recent paper, “Local pressure changes can increase the melting point in the vicinity of the collapsing cavity, increasing the degree of supercooling, furthermore, introduction of shear forces and turbulence can affect the crystallization kinetics as well as the cavitation bubbles and violent collapse can form active sites for secondary nucleation.” The degree of speculation surrounding how ultrasound influences fat and oil crystallization shows research is still needed to truly optimize this tool.

“What excites me most about the technology is that we can use it in fats that have low levels of saturates and of course have no trans.”

—Silvana Martini
As researchers work through the basis for ultrasound’s effect on fats and oils, they are also discovering more ways it can be valuable. Lars Wiking, associate professor at Aarhus University, Aarhus, Denmark began applying HIU back in 2011, when he collaborated with the Danish dairy industry to bind more oil to milk fat (https://tinyurl.com/yy764gmh). “In Denmark, you produce a lot of dairy blends where you add rapeseed oil to the butter in order to make the product more spreadable,” Wiking says. His research team believed that if they could produce smaller fat crystals, they could get more rapeseed oil into a milk product. They found that the HIU treatment sped-up crystallization, especially for fat blends with high amounts of rapeseed oil. However, they did not achieve the desired hardness. In addition, ultrasonicated products produced a bad taste. “The main problem that we have faced in lipid-based products is the taste,” says Wiking. “We can sense an off flavor.” He says that, in theory, cavitation could generate free radicals that initiate an oxidation process, but no oxidation products were measured. The off taste was also not the same as the flavor of an oxidized dairy product, so there could be another culprit. Wiking says they will need to perform more experiments to identify the source.

Wiking has also tested HIU to homogenize whole milk, and to accelerate the acid gels for yogurt with positive results. “We are making gels from whey protein isolates, and we have some very good effects. We can make them gel faster and with better strength,” Wiking says. Still, he is concerned about the off taste. Wiking says the many papers on HIU have proven that it imparts desirable traits on food structure, but he would like to see more research that takes a holistic approach to studying their sensory properties.

Martini’s group also observed an improvement in oil-binding capacity using HIU, and their results indicate no oxidation products that could lead to off flavors. “Ultrasound is changing the way triacylglycerols interact to form crystals,” she says. “One of the latest things that we have shown is that ultrasound can improve the oil migration or the oil-binding capacity of a sample.” However, she has tested many different fats, oils, and blends, but the oxidation values (determined by the level of peroxide in the sample) have always been the same before and after sonification. “So, we are not producing any off flavor or any oxidation products during the process,” says Martini.

The difference in the findings of the two research groups could just be a matter of time. Martini uses HIU on samples for only 10 seconds, while most research groups expose their samples to the soundwaves for more than a minute. One of Martini’s early experiments was designed to test the effects of different HIU settings, like power level, as well as different durations of exposure. She found that too long of an exposure led to a detrimental temperature increase in the sample. “No matter how well you cool the sample, it heats up too much,” says Martini. “You actually melt your crystals while they are being formed, and crystallization is not very good.”

Martini’s group is currently preparing a paper on their latest experiments comparing texture changes in sonicated and non-sonicated palm oil over time. She says that preliminary results indicate that HIU alters palm oil’s phase change kinetics.
by producing smaller crystals. By studying the melting behavior of the crystalized oils with differential scanning calorimetry (DSC), they found that HIU samples exhibit a different melting profile. “Our hypothesis is that we are increasing the interactions between the triacylglycerol, and that is changing the melting profile,” she says. Her group has observed that melting takes place at a lower temperature over a smaller range for HIU samples. “There are some changes at the molecular level that we still do not fully understand, and we will keep exploring,” says Martini.

Though there are still fundamental questions to be answered, Martini and Wiking both believe that HIU has the capability of moving out of the lab and into food manufacturing plants. Neither have done economic studies, but surmise that the lower energy costs and faster processing speeds of HIU are likely to improve production costs. Both speculate that implementation of HIU into a manufacturing process would cause minimal disruption. They predict that adding a flow cell would be enough to accomplish the task.

The growing body of research on HIU for fats and oils production indicates that the technique will soon make the leap into manufacturing. HIU has been shown to improve the quality of oil resulting from the degumming process. In another study, HIU increased the yield of materials in extraction materials. “What excites me most about the technology is that we can use it in fats that have low levels of saturates and of course have no trans,” Martini says. “I think that is where the application will be most impactful.”

References


Han, H., S.S. Wang, M. Rakita, Y.T. Wang, Q.Y. Han, and Q. Xu, Effect of ultrasound-assisted extraction of phenolic compounds on the characteristics of walnut shells, Food Nutr. Sci. 9: 1034–1045, 2018.


Olio is produced by Infrom’s associate editor, Rebecca Guenard. She can be contacted at rebecca.guenard@aocs.org.
Global nutrition, health and materials company Royal DSM, has set a target to phase out all chemicals of high concern from products produced in its coating resins business by 2025.

Chemicals that DSM considers of high concern include carcinogens; mutagens; reproductive toxicants (CMRs); and persistent, bioaccumulative, and toxic (PBTs) substances.

The target was set for its resins business largely because solvents are often used in coating resin products, some of which are thought to cause adverse effects to human health and the environment.

DSM began its plans to introduce safer water-based alternatives to solvent-based coating products “decades ago,” including its decision to sell its solvent business DSM Synres in 2014, the company said. The phase-out target is an “acceleration” of this work and was specifically set for its coating resins business because of the potential exposure to customers and consumers, and ongoing discussions in the EU and US around chemicals used in coatings. It did not say whether this goal would eventually apply to its other businesses.

“We pursued this objective by divesting our solvent business, replacing chemicals of concern, and innovating new sustainable technologies, such as water-based, powder, plant-based, and UV technologies,” it said.

The company said it recognizes there are risks associated with using certain chemicals. “We take responsibility for minimizing possible safety risks and adverse effects on human or animal health and on the environment, that could be caused by chemicals present in our finished products throughout the value chain and life cycle,” it said.

Minimizing these risks, it added, is also necessary for promoting and enabling recycling and the circular economy, which is a key strategic objective for the company.

DSM said it is committed to replacing these substances with safer alternatives. To avoid regrettable substitutions—meaning to ensure the selected alternative is safer—expert opinion will be used to confirm the expected toxicological properties of safer alternative candidates.

These decisions will be based on in vitro tests and international methodologies, such as quantitative structure-activity relationships (Qsars), read-across and the NGO-developed hazard assessment tool GreenScreen.

DSM said its overall sustainability strategy will allow it to stay ahead of future regulatory changes and meet the increasing market demand for more sustainable materials.

Leigh Stringer is Global Business Editor for Chemical Watch.

I was recently searching for specifications of oils produced in Chile, and came across the following document: “Reglamento Sanitario de los Alimentos Dto. N° 977/96 (D.OF. 13.05.97)” (Food Health Regulations N° 977/96 (D.OF. 13.05.97)), which was last revised in 2016 (http://www.indap.gob.cl/docs/default-source/extensionrural/alimentos-procesados/reglamento-sanitario-de-los-alimentos-decreto_977_96_actualizado-mayo-2017.pdf?sfvrsn=2). Following are some of the regulations, conveyed in a Q&A format.

**Q:** What are the general specifications that fats and oils must comply with in Chile?

**A:** Title X, Paragraph I, Article 248 specifies that the moisture and volatiles content must not exceed 0.2% in edible oils and 0.5% in butters or fats. The free fatty acid content should not exceed 0.25% free fatty acid (expressed in oleic acid), and the soap content should be below 50 ppm. Also, the maximum peroxides content should be 2.5 mEq O₂ peroxide/ kg of fat on the expiration date, and 10 mEq O₂ peroxide/ kg of fat during the product’s shelf life; the organoleptic properties cannot be altered. Exceptions exist for the free acidity of olive oil and cocoa butter, which both have a maximum free acidity of 2.0% (the maximum free acidity is con-
veyed in terms of oleic acid). Avocado oil, pork fat, and bovine fat butter, are also exempt and should have a free fatty acid content of 1.0% and 0.8%, respectively (conveyed in terms of oleic acid). Extra virgin olive oil is exempt from this rule in terms of its peroxide value, for which the maximum level is 20mEq O₂/kg of oil. The level of trans fatty acids from industrial origin should be less than or equal to 2% of the total fat content of the product.

**Q:** What is considered butter or oil of vegetable origin?

Title X, Paragraph II, Article 251 states that vegetable oils are those obtained from fruits, their parts, or the oleaginous seeds of cotton, safflower, sunflower, corn germ, peanut, olive, rapeseed, sesame, soy, Chilean hazelnut, rice, tomato seeds, wheat germ, flaxseed, rosehip, avocado, and other plants authorized by the Ministry of Health. Such oils must be fluid at 15°C and have an erucic acid content below 5% (Article 252). Article 253 defines vegetable butters or edible vegetable fats as those that are solid or semisolid at 15°C, and are obtained from the following fruits or their parts or seeds: cacao, coconut, Paraguay coconut, babassú, palm, palm kernel oil, and others authorized by the Ministry of Health. Article 254 defines the reference fatty acid profiles obtained by gas chromatography, which are characteristic for each fat type.

**Q:** What is considered butter or fat of animal origin?

Title X, Paragraph III, Article 255 states that edible oils of marine origin are those obtained from fish or marine mammals which have not been subjected to hydrogenation processes and are fluid at 15°C. Article 256 defines butters or fats of animal origin as those extracted from the adipose tissue of porcines, ovines, bovines, and bird. They must be solid or semisolid, with maximum point of fusions of 40°C, 45°C, 48°C, and 30°C for pork butter or fat, bovine fat, ovine fat, and bird fat, respectively. Article 257 details reference fatty acid profiles (obtained by gas chromatography) which are characteristic for each fat type.

**Q:** How are other edible fats defined?

Title X, Paragraph IV, Article 258 defines “modified marine oils” as oils that are fluid at 15°C, obtained from pelagic species, and are then subject to hydrogenation and fractionation. Article 259 states that “modified butters” are those products obtained from vegetable or marine oils which have been subject to hydrogenation processes and eventually transesterification, interesterification, and fractionation. The maximum fusion point should be 45°C, and higher fusion points are allowed in raw materials. Article 260 describes “emulsified butter” as the emulsion obtained from butters or fats of animal, marine, or vegetable origin and water. The water content must be declared. Article 261 states that “mixed oil” is a product arising from mixing marine and vegetable oils. The maximum level of marine oil allowed in the mix is 50%. Article 262 states that “margarine” is a product in the form of emulsion (usually waiter in oil) obtained from edible fats and oils. The rules governing the different types of margarines are as follows: a) “table margarine” has a maximum fusion point of 37°C, a maximum water content of 16%, and a minimum fat content of 80%. Likely, other margarines would be considered “table margarines” if they have lower than 16% water and lower than 80% fat, but they must disclose the water content. b) “baking margarines” are those for which the maximum fusion point is 45°C and the water content and intended use are indicated on the label. Article 263 states that margarines will have no more than 0.25% free fatty acids (conveyed in terms of oleic acid), and that “table margarines” should contain 30,000 UI of vitamin A and 70 g of linoleic acid per kg of finished product. Article 264 describes how margarines should be stored: refrigerated, or in a moisture-free environment away from sunlight.
“Thanks to an inquiry on inform|connect, I was able to reach out to someone who I would never have met without this service. My company was able to provide support and eventually earn their business.”

“We were able to find two labs that could do the work we needed. AOCS members were so helpful and generous with their time.”

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New Governing Board member on research, teaching, and AOCS

Member Spotlight is a regular column that features members who play critical roles in AOCS.

Silvana Martini, a native of Argentina, has held a research and teaching appointment at Utah State University in Logan for more than 13 years. In addition to teaching two undergraduate classes (sensory evaluation of foods and chocolate: history, science and society), she also teaches a graduate course on crystallization in foods. Her research relates to the physicochemical characterization of fats and the role that fats play on sensory perception.

As if that doesn’t keep her busy enough, her involvement with AOCS is wide-ranging and includes her role as a senior associate editor of the Journal of the American Oil Chemists’ Society. Her most recent contribution, however, is as a member of the AOCS Governing Board.

“The Governing Board is responsible among other things for ensuring that the Society has an appropriate mission statement that is in line with the needs of its constituents,” she explains. The Board also evaluates the performance of AOCS’ chief executive officer and provides oversight for the financial resources and assets of the Society. “Within the Governing Board, I am involved with the Constituent Relations Working Group, where members work to improve and monitor programs and services offered by AOCS, including conferences, seminars, short courses, and awards.”

Involvement came easily to Martini, who says she had always wanted to volunteer for AOCS and give back to the organization that has done so much for her. “Perhaps the biggest challenge that I would like to address is to encourage more and more people to be involved with AOCS. Perhaps this could be summarized as member retention and commitment to the Society.”

Her volunteer work supports the AOCS mission by encouraging and promoting the dissemination of research related to fats, oils, proteins, and related materials. She is also active in promoting professional interactions by contributing to the organization of meetings and by encouraging colleagues and students to join AOCS.

My volunteer work for AOCS has helped me to grow as a professional,” she stresses. “I have acquired significant leadership and communication skills through it, and involvement has broadened my professional network. Volunteering for AOCS has also allowed me to meet professionals outside my area of expertise, to establish new collaborations, and to broaden my knowledge of fats and oils research.”
Protein solubilization
Sathe, S., V.D. Zaffran, S. Gupta, and T. Li
Abstract: To address the anticipated global need for increased protein supply for human nutrition, particularly for developing and underdeveloped regions, concerted efforts are required. Although animal proteins satisfy nutrition needs, they may not be acceptable to all consumers either due to their cost or dietary restrictions followed by the consumer. Soybean has served as a nonanimal protein source; however, alternative protein sources will need to be cultivated and explored in the future to satisfy anticipated increased global needs. To effectively utilize a food protein source, separation of proteins from the nonprotein components present in that source is often needed or desired. Such separation requires understanding of protein properties and interactions of the protein with its environment. In chemical separation processes, protein solubility is a critical property as it often governs protein preparation and utilization and is the focus of this review. Emphasis is on nontraditional protein sources.
Presenting author: Sahil Gupta, Florida State University, USA
Look for the presentation in inform|connect: PCP 4b: Protein solubility

The interaction of the soybean seed high oleic acid oil trait with other fatty acid modifications
K. Bilyeu, et al.
Abstract: Oil value is determined by the functional qualities imparted from the fatty acid profile. Soybean oil historically had excellent use in foods and industry; the need to increase the stability of the oil without negative health consequences has led to a decline in soybean oil use. One solution to make the oil stable is to have high oleic acid (>70%) and lower linolenic acid content in the oil. Other fatty acid profile changes are intended to target market needs: low-saturated fatty acid and high stearic acid content in the oil. The objective of this study is to determine the interaction of the high oleic acid oil trait with other alleles controlling fatty acid profiles. Soybean lines containing high oleic acid allele combinations plus other fatty acid modifying alleles were produced, and the seed was produced in multiple field environments over 2 years. Stable high oleic acid with low linolenic acid (<3.0%) was achieved with a 4-allele combination. The target of >20% stearic acid in the seed oil was not achieved. Reducing total saturated fatty acids below 7% in a high oleic acid background was possible with mutant alleles of both an acyl-ACP thioesterase B and a β-ketoacyl-[acyl-carrier-protein] synthase III gene. The results
identified allele combinations that met the target fatty acid profile thresholds and were most stable across environments.

Presenting author: Kristin Bilyeu, USDA/ARS, USA

Look for the presentation in inform|connect: BIO 3: The interaction of the soybean seed high oleic acid oil trait with other quality traits

**Journal of Surfactants and Detergents**

An analytically defined fire-suppressing foam formulation for evaluation of fluorosurfactant replacement

Hinnant, K., et al.

Abstract: A 4-component, analytically defined, reference fluorosurfactant formulation (Ref-aqueous film forming foam [AFFF]) composed of 0.3% fluorocarbon-surfactant concentrate (Capstone 1157), 0.2% hydrocarbon-surfactant concentrate (Glucopon 215 UP), and 0.5% diethylene glycol monobutyl ether by volume in distilled water was found to have rapid fire extinction comparable to a commercial AFFF in tests conducted on a bench scale and a large scale (28 ft², part of US Military Specification, MIL-F-24385F). The Ref-AFFF was analytically characterized to provide the identity and quantity of the chemical structures of the surfactant molecules that were lacking for commercial AFFF formulations. To arrive at an acceptable Ref-AFFF formulation, 3 candidate formulations containing different hydrocarbon surfactants in varying amounts were evaluated and ranked relative to a commercial AFFF using a bench-scale fire-extinction apparatus; varying the hydrocarbon surfactant was found to affect the fire-extinction time. The ranking was confirmed by the large-scale tests suggesting that the bench-scale apparatus is a reasonable research tool for identifying surfactants likely to succeed in the large-scale test. In the future, replacing the fluorocarbon surfactant with an alternative surfactant in the Ref-AFFF enables a direct comparison of fire extinction and environmental impact to identify an acceptable fluorine-free formulation.

Presenting Author: Arthur W. Snow, U.S. Naval Research Laboratory, USA

Look for the presentation in inform|connect: S&D 3.1: An analytically defined fire-suppressing foam formulation for evaluation of fluorosurfactant replacement

Self-assembly of polyethylene glycol ether surfactants in aqueous solutions: the effect of linker between alkyl and ethoxylate

Bodratti, A., et al.

Abstract: The aqueous self-assembly behavior of two homologous series of poly(ethylene oxide) (PEO)-containing nonionic surfactants based on a C₁₀-Guerbet hydrophobe
Edible Oleogels
Structure and Health Implications
Second Edition
Edited by Alejandro G. Marangoni and Nissim Garti

Edible Oleogels, Structure and Health Implications, Second Edition presents a novel strategy that can be used to eliminate trans fats from our diets. Topics covered include how to avoid excessive amounts of saturated fat by structuring oil to make it behave like crystalline fat, and how to develop trans-fat-free, low-saturate, functional shortenings for the food industry. The major approach to forming these materials is explained in a way that helps manufacturers incorporate specific molecules (polymers, amphiphiles, waxes) into oil components.

This an ideal resource for those in product development and anyone interested in understanding the role of trans and saturated fats in health and nutrition.

Key Features
- Presents emerging science on beta gels using natural triglycerides, ethylcellulose oleogels and oleotropic liquid crystals
- Outlines a novel strategy that can be used to eliminate trans fats from our diets and avoid excessive amounts of saturated fat by structuring oil to make it behave like crystalline fat
- Reviews the structuring of edible oils to form new mesoscale and nanoscale structures, including nanofibers, mesophases, and functionalized crystals and crystalline particles

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The resulting HMF crystals were visibly free of entrapped liquid fat, and subsequently characterized by thermal analysis, X-ray diffraction, and electron microscopy. The HMF crystals were found to be mostly beta' and beta(2)' crystalline structures, with a lamellar thickness of 42.7–44.1 ångstrom. Additionally, crystal size was determined to be > 1 μm in length and 0.4–1 μm in width. Atomic force microscopy (AFM) was used to further characterize the HMF crystals. AFM enabled 3D mapping and visualization of crystal layering, as well as simple determination of layer thickness (similar to 4.2 +/- 0.8 nm); a value in close agreement with the results obtained via X-ray analysis. The AFM characterization approach provides a simple method of characterizing HMF crystals, without suffering the limitations of other widely used techniques.

**Continuous non-destructive hydrocarbon extraction from Botryococcus braunii BOT-22**


In-situ extraction of microalgal oil without cell destruction has been proposed as a cost-effective alternative solution for the production of algal biofuel. This study examines the viability and efficiency of n-dodecane in both column and shake-flask systems for the continuous extraction of botryococcene from *Botryococcus braunii* (BOT-22). Botryococcene from *B. braunii* was found to be non-destructively extracted using n-dodecane without negatively affecting the growth and photophysiology of the microalgae. Recirculation of the culture (23 times per day) through a column system containing n-dodecane with a daily effective extraction time of 276 s resulted in 21% higher botryococcene extraction (25.1 mg g⁻¹ biomass) when compared to a constantly stirred shake flask consisting of both algae culture and n-dodecane together in a vessel. Botryococcene extraction was highest in the first 24 h of extraction when compared to the rest of the extraction period. These results suggest that recirculation of *B. braunii* culture through a column system containing n-dodecane is efficient for the non-destructive extraction of botryococcene and less toxic compared to other previously tested solvents.

**Simultaneous extraction of microalgae Ankistrodesmus sp. oil and enzymatic transesterification with ethanol in the mineral diesel medium**


This article describes the simultaneous extraction of microalgae *Ankistrodesmus* sp. oil and its transesterification with ethanol using the lipase Lipzyme TL IM as a catalyst with mineral diesel in the reaction medium (mass ratio of oil to mineral diesel, 7:93). To optimize the process of simultaneous extraction and transesterification of oil, dried and wet microalgae biomass was sonicated. The optimum processing conditions were as follows: temperature, 42°C, molar ratio of ethanol to oil, 8:1, biocatalyst Lipzyme TL IM, 9.6% (of the oil mass), process duration, 12 h. The use of dry
microalgae under these conditions resulted in 97.69% oil tran-
sesterification. The final product contains 6.8% of algae oil ethyl
esters in mixture with diesel fuel and meets the requirements of
the European standard for mineral diesel fuel. High efficiency
of extraction and transesterification of oil is obtained using dry
microalgal biomass, and as moisture content increases, the effi-
ciency of oil extraction and transesterification decreases.

**BIO IOP** Biological pretreatment of lignocellulosic biomass for biofuels and bioproducts: an overview


Increasing energy demands are not only exploiting the fossil
resources but, also depleting natural environment. Biofuels from
lignocellulosic biomass is a renewable, ecofriendly, sustainable, and
could be a promising alternative to fossil fuels. However, pretreat-
ment is an essential step to disarray the layers of lignocellulose prior
to enzymatic hydrolysis. Among various pretreatments of ligno-
cellulose, the biological pretreatment using microorganisms such as
bacteria and fungi are gaining popularity due to its financial and
environmental benefits. Careful selection of the suitable microbial
consortium for efficient pretreatment of biomass is a critical step.
The co-culture of bacteria and/or fungi in consolidated bioprocessing
(CBP) is highly beneficial in the breakdown of complex bio-
polymer due to their high enzyme activity. Our selection of highly
promising bacterial and/or fungal consortium has the ability to
produce various extracellular enzymes including cellulase, hemi-
cellulase, and lignases. It can be used in CBP for efficient biologi-
cal pretreatment of lignocellulosic biomass following production of
biofuels and bioproducts.

**BIO IOP** Enhancement of lipid accumulation in microalgae by metabolic engineering


Microalgal lipids have drawn great attention as a promising
sustainable resource for biodiesel or food supplement produc-
tion. The development of high-performance strains of microalgae
by metabolic engineering is invaluable for increasing the quan-
tity or quality of desired lipids. The synthesis routes of lipids used
as biodiesel in microalgae are based on fatty acid synthase (FAS)
and triacylglycerols (TAG) biosynthesis pathway. Polyunsaturated
fatty acids (PUFAs), including omega-6 and omega-3 fatty acids,
are essential nutrients for humans. Notably, microalgae possess
two distinct pathways for polyunsaturated fatty acids (PUFAs)
biosynthesis, including the desaturase/elongase pathway and the
polyketide synthase (PKS) pathway. Thus, it is necessary to identify
which biosynthetic pathways are responsible for PUFAs synthesis in
particular microalgae species. In recent years, various key enzymes
and functional domains involved in fatty acid and TAG biosynthe-
sis pathway were identified and potentially regulated by genetic
engineering approaches to elevate specific lipids content. In addi-
tion, other studies have reported the implementation of strategies
to increase lipid accumulation based on increasing acetyl-CoA/
NADPH supply, enhancing photosynthetic efficiency, or blocking
competing pathways. Furthermore, other efforts have used tran-
scription factor engineering to simultaneously regulate multiple
genes related to lipid accumulation. This review summarizes recent
research about a variety of microalgae lipid biosynthesis pathways
and discusses multiple gene manipulation strategies that have been
employed for specific lipid overproduction in industrial microalgae.

**EAT** Bio-based cellulose nanofibril-oil composite films for active edible barriers


Low-concentration oil-in-water emulsions stabilized by cellulose
nanofibrils (CNFs) extracted from primary plant cell wall mate-
rials are used to prepare thin bio-based CNF-oil composite films by
solvent casting. Flexible, transparent, and biodegradable compos-
ite films are obtained, with increased thermal stability (up to 300°C
as the oil concentration increases. Examination of the microstruc-
ture demonstrates a clear dependency on the oil content, as a mul-
tilayered structure where the oil phase trapped between two layers
of CNFs is appreciated at high oil concentrations. The embedded
oil significantly influences the mechanical and wetting properties
of the films, confirming their potential for use in packaging sys-
tems. Encapsulation of curcumin in the composite films leads to an
increased antioxidant (up to 30% radical scavenging activity) and
antimicrobial activity, inhibiting the growth of foodborne bacteria
such as *Escherichia coli*. The resulting composite films show promis-
ging results in the field of active packaging for applications in the food,
pharmaceutical, and cosmetic industries.

**EAT** Encapsulation and controlled release of hydrophobic flavors using biopolymer-based microgel delivery systems: sustained release of garlic flavor during simulated cooking


The objective of the current study was to determine whether biopolymer microgels could be used to encapsulate and control the release of allyl methyl disulfide (AMDS), a lipophilic compound in garlic, which has flavoring, anticancer, antioxidant, and anti-
microbial properties. AMDS is a volatile compound that is easily lost
during food processing, storage, and preparation, which reduces
its desirable functional attributes. In this study, AMDS was loaded
into oil-in-water emulsions that were then incorporated into bio-
polymer microgels. These microgels were fabricated by injecting a
mixture of AMDS-loaded lipid droplets and sodium alginate into
a calcium ion solution. The impact of microgel properties on the
amount of AMDS retained during heating from room temperature
to boiling for 30 min was determined to simulate cooking condi-
Hello!

The AOCS Latin American Section is looking forward to welcoming our global oils and fats community to Brazil this October. We have an outstanding technical program planned. Hope to see you there!

Sincerely,
Leon Pablo Espinosa
AOCS Latin American Section President
Desmet Ballestra North America Inc.
Resveratrol is a natural polyphenolic phytoalexin that can be found in various foods including blueberries, peanuts, and red wine. As a natural food ingredient, resveratrol possesses antioxidant, anti-inflammatory, and cardioprotective properties. Moreover, resveratrol exhibited promising effects in suppressing the initiation and progression of cancers. Noncoding RNAs (ncRNAs) have been universally accepted as vital regulators in cancer pathogenesis. The modulation of miRNAs and lncRNAs by resveratrol has been described. Thus, the mechanism involving the domination of ncRNA function is one of the keys to understand the anticancer effects of resveratrol. In this review, we focus on the antagonistic effects of resveratrol on cancer progression through regulation of miRNAs and lncRNAs. We also discuss the potential application of resveratrol in cancer management.

**H&N Noncoding RNAs as molecular targets of resveratrol underlying its anticancer effects**


Resveratrol is universally recognized as a potent antioxidant molecule expressed naturally by grapes and other botanicals, notably Japanese knotweed plant. A lot is known about resveratrol bioactivity, but it remains unclear how and what exact role resveratrol plays in maintaining health and wellness in humans. This review discusses resveratrol’s role in managing cancer, but a more holistic review of the literature is needed to understand the compound’s full contributions in protecting human cells.

Cancer is a significant disease burden worldwide. Chemotherapy is the mainstay of cancer treatment. Clinically used chemotherapeutic agents may elicit severe side effects. Remarkably, most of cancer cells develop chemoresistance after a period of treatment. Therefore, it is imperative to seek more effective agents without side effects. In recent years, increasing research efforts have attempted to identify natural agents that may be used alone or in combination with traditional therapeutics for cancer management.

Resveratrol is a natural polyphenolic phytoalexin that can be found in various foods including blueberries, peanuts, and red wine. As a natural food ingredient, resveratrol possesses antioxidant, anti-inflammatory, and cardioprotective properties. Moreover, resveratrol exhibited promising effects in suppressing the initiation and progression of cancers. Noncoding RNAs (ncRNAs) have been universally accepted as vital regulators in cancer pathogenesis. The modulation of miRNAs and lncRNAs by resveratrol has been described. Thus, the mechanism involving the domination of ncRNA function is one of the keys to understand the anticancer effects of resveratrol. In this review, we focus on the antagonistic effects of resveratrol on cancer progression through regulation of miRNAs and lncRNAs. We also discuss the potential application of resveratrol in cancer management.

**H&N Avenanthramide A induces cellular senescence via miR-129-3p/ PIRH2/p53 signaling pathway to suppress colon cancer growth**


Avenanthramides are a very special class of polyphenols expressed mostly by oats. They are excellent protecting agents with anti-inflammatory properties. The question is why Avenanthramides are expressed by oats and do not occur in nature universally like vitamin E and other anti-inflammatory compounds like phenyl propanoids do. Oats are considered a healthy food with many health-inducing benefits. Their exact role in oat plants need to be investigated further. This may lead to a better understanding of their role in human health.

Cellular senescence is the state of irreversible cell cycle arrest that provides a blockade during oncogenic transformation and tumor development. Avenanthramide A (AVN A) is an active ingredient exclusively extracted from oats, which possesses antioxidant, anti-inflammatory, and anticancer activities. However, the underlying mechanism(s) of AVN A in the prevention of cancer progression remains unclear. In the current study, we revealed that AVN A notably attenuated tumor formation in an azoxymethane/dextran sulfate sodium (AOM/DSS) mouse model. AVN A treatment triggered cellular senescence in human colon cancer cells, evidenced by enlarging cellular size, upregulating β-galactosidase activity, γ-H2AX positive staining, and G1 phase arrest. Moreover, AVN A treatment significantly increased the expression of miR-129-3p, which markedly repressed the E3 ubiquitin ligase PIRH2 and two other targets, IGF2BP3 and CDK6. The PIRH2 silencing by miR-129-3p led to a significant increase in protein levels of p53 and its downstream target p21, which subsequently induced cell senescence. Taken together, our data indicate that miR-129-3p/PIRH2/p53 is a critical signaling pathway in AVN A induced cellular senescence and AVN A could be a potential chemopreventive strategy for cancer treatment.

**H&N ANA Chemical composition of commercial cow’s milk**


This is a fantastic contribution that brings all the known chemicals from bovine milk into one place that is available to researchers. This will help to spur a discovery phase that will expand our knowledge pool about bovine milk and may also help us understand the benefits of human milk in a new context.

Bovine milk is a nutritionally rich, chemically complex bio-fluid consisting of hundreds of different components. While the chemical composition of cow’s milk has been studied for decades, much of this information is fragmentary and dated. In an effort to consolidate and update this information, we have applied modern, quantitative metabolomics techniques along with computer-aided literature mining to obtain the most comprehensive and up-to-date characterization of the chemical constituents in commercial cow’s milk. Using nuclear magnetic resonance (NMR) spectroscopy, liquid chromatography–mass spectrometry (LC–MS), and inductively coupled plasma–mass spectrometry (ICP–MS), we were able to identify and quantify 296 bovine milk metabolites or metabolite species (corresponding to 1,447 unique structures) from a variety of commercial milk samples. Through our literature analysis, we also found another 676 metabolites or metabolite species (corresponding to 908 unique structures). Detailed information regarding all 2,355 of the identified chemicals in bovine milk have been made freely available through a Web-accessible database called the Milk Composition Database or MCDB (http://www.mcdb.ca/).
“AOCS links my past and present as I develop my career in lipid research. Volunteering in AOCS has provided opportunities to meet professionals outside of my research field and to think about other applications and inspire ideas.”

Megan Hums, Analytical Protein Scientist, Eurofins Lancaster Laboratories PSS
- secretary, Young Professional Common Interest Group
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Identification of hydroxytyrosyl oleate, a derivative of hydroxytyrosol with anti-inflammatory properties, in olive oil by-products


Hydroxytyrosyl esters with short, medium and long acyl chains were evaluated for their ability to reduce nitric oxide (NO) production by lipopolysaccharide-stimulated RAW264.7 macrophages. Among the compounds tested, C18 esters, namely hydroxytyrosyl stearate (HtySte) and hydroxytyrosyl oleate (HtyOle), were found to decrease NO production in a concentration-dependent manner, while the other compounds, including the parent hydroxytyrosol, were ineffective in the tested concentration range (0.5–5 μM).

Further study of the potential immune-modulating properties of HtyOle revealed a significant and concentration-dependent suppression of prostaglandin E2 production. At a transcriptional level, HtyOle inhibited the expression of inducible NO synthase, cyclooxygenase-2 and interleukin-1β. Moreover, HtyOle was identified for the first time in olive oil byproducts by means of high-performance liquid chromatography coupled with mass-spectrometry. By contrast, HtyOle was not found in intact olives. Our results suggest that HtyOle is formed during oil processing and represents a significant form in which hydroxytyrosol occurs.

Can we prevent lipid oxidation in emulsions by using fat-based Pickering particles?


Interest has recently been rising in the development of food-compatible Pickering emulsions, i.e., particle-stabilized emulsions, and various bio-based particles have been demonstrated as useful for such a purpose. Most of the related work has focused on the physical stability of the emulsions, but whether such particles can be advantageous in terms of chemical stability, and particularly with regard to lipid oxidation, is largely unexplored. Recently, we found that colloidal lipid particles (CLPs) are efficient Pickering stabilizers; the objective of the present study was to investigate the oxidative stability of emulsions stabilized with those particles. Three types of sunflower oil-in-water (O/W) emulsions were considered: Pickering emulsions stabilized with colloidal lipid particles (CLPs) made of high melting point (HMP) fat (tripalmitin or palm stearin), adsorbed onto the liquid oil droplets; and, as references, two conventional sodium caseinate-stabilized emulsions, of which one contained only liquid oil, and the other liquid oil mixed with HMP fat as the core of the emulsion droplets. In the presence of iron, the latter oxidized faster than conventional liquid oil and Pickering emulsions, resulting in 2- to 3-fold higher amounts of primary and secondary lipid oxidation products. This may be due to infra-droplet HMP fat pushing oxidizable lipids towards the oil-wa-
ter interface, which would promote lipid oxidation. This shows that the localization of solid fat in O/W emulsions affects lipid oxidation. We also found that CLP-stabilized Pickering emulsions had similar oxidation rates as conventional sodium caseinate-stabilized emulsions containing only liquid oil. This suggests that the potential of such Pickering particles to prevent lipid oxidation is limited. This could be because diffusion of small pro-oxidant molecules is not hindered by Pickering particles, as they cannot form an interfacial barrier that is structurally homogeneous at such a small scale.

LOQ H&N Health benefits of olive oil and its components: impacts on gut microbiota antioxidant activities, and prevention of noncommunicable diseases


The current study reviews recent findings on the health benefits of olive oil consumption, including its effects on gut microbiota, its antioxidant activity, and its ability in preventing cardiovascular disease (CVD). The potential mechanism involved in these health-promoting effects is also discussed. The study findings showed that olive oils originating from various regions of the world can pose some positive effects on gut microbiota. Moreover, this edible oil (especially the extra virgin type) can prevent CVD due to high levels of valuable bioactive components including phenolic compounds (e.g., oleocanthal, tyrosol, hydroxytyrosol, oleuropein, and oleuropein aglycone) and the presence of highly bioavailable health-promoting carotenoids such as provitamin A, β-carotene, and lutein. Furthermore, the oral intake of extra virgin olive oil can be beneficial in preventing cancer and type 2 diabetes. Therefore, the consumption of olive oil, especially the extra virgin type, can be recommended not only because of its healthy fatty acid profile (particularly oleic acid) but also due to valuable positive effects of its bioactive components on human health.

LOQ EAT Effect of subcritical water processing on the extraction of compounds, composition, and functional properties of asparagus by-product


Asparagus by-product can be an interesting source of nutrients, like dietary fiber and antioxidant compounds. This study demonstrated that the antioxidant yield obtained from this byproduct can be maximized using subcritical water extraction (SWE), which is considered a green solvent. The SWE also promotes dietary fiber concentration in the treated material, due to the removal of sugars, and improves functional properties which can facilitate the use of this material in the development of new food products.

The aim of this study was to submit the asparagus by-product to the subcritical water treatment, evaluating the extraction of antioxidants compounds (AC) and total reducing sugars (TRS), as well as, the composition and technological properties of the residual material. The effects of temperature (100–160ºC) and pressure (100–200 bar) on extraction were evaluated, for total extraction time of 120 min. The results showed that the increase in temperature favored the removal of AC, and this variable did not cause modification of most of the compounds identified by mass spectra analysis. The highest removal of AC was observed up to 30 min. The increase in temperature decreased the TRS content. The pressure did not affect the extraction of sugars and AC in the conditions evaluated. The treatment was efficient for the modification of the physico-chemical composition and technological properties of residual material, reducing the TRS content and improving the ratio of soluble fiber to insoluble fiber.

PRO EAT Structural characterization of pectin obtained from cacao pod husk. Comparison of conventional and subcritical water extraction


Pectin was obtained with citric acid and subcritical water extraction from cacao pod husk with or without a previous step consisting of a supercritical fluid extraction of phenols. By subcritical conditions a higher yield (10.9%) was attained in a time 3-fold shorter than that obtained by conventional extraction (~8%) and a greater effectiveness in the recovery of pectin with higher molecular weight (750 kDa) was also found. Regarding pectin structure, galacturonic acid and degree of methyl esterification content were similar (~55 and ~36%, respectively) in both methods. Moreover, pectin recovered by citric acid presented 2-fold higher amount of impurities as compared to subcritical water extraction. Hardly any effects of a previous supercritical treatment were observed in the structure and composition of pectin, indicating the efficiency of the integrated supercritical carbon dioxide and subcritical water extraction as green processes for the obtinement of phenol and pectin from cacao pod husk.

PRO ANA Manipulation of recrystallization and network formation of oil-dispersed micronized fat crystals


A detailed investigation was carried out on the modulation of the coupling between network formation and the recrystallization of oil-dispersed micronized fat crystal (MFC) nanoplatelets by varying oil composition, shear, and temperature. Sunflower (SF) and bean (BO) oils were used as dispersing media for MFC nanoplatelets. During MFC dispersion production at high shear, a significant increase in the average crystal thickness (ACT) could be observed, pointing to recrystallization of the MFC nanoplatelets. More rapid recrystallization of MFC occurred in the SF dispersion.
than in the BO dispersion, which is attributed to higher solubility of MFC in the SF oil. When the dispersions were maintained under low shear in narrow gap Couette geometry, we witnessed two stages of recrystallization (measured via rheo-SAXD) and the development of a local yield stress (measured via rheo-MRI). In the first stage, shear-enabled mass transfer induces rapid recrystallization of randomly distributed MFC nanoplatelets, which is reflected in a rapid increase in ACT (rheo-SAXD). The formation of a space-filling weak-link MFC network explains the increase in yield stress (assessed in real time by rheo-MRI). In this second stage, recrystallization slows down and yield stress decreases as a result of the formation of MFC aggregates in the weak link network, as observed by confocal Raman imaging. The high fractal dimension of the weak-link network indicates that aggregation takes place via a particle-cluster mechanism. The effects of oil type and shear on the recrystallization rate and network strength could be reproduced in a stirred bowl with a heterogeneous shear stress field, which opens perspectives for the rational manipulation of MFC thickness and network strength under industrial processing conditions.

**Effectiveness of proteolytic enzymes to remove gluten residues and feasibility of incorporating them into cleaning products for industrial purposes**


The development of protocols for efficient gluten elimination is one of the most critical aspects of any allergen management strategy in the industry. The suitability of different proteolytic enzymes to be included in a cleaning formulation that allows the effective elimination of gluten residues was studied. Alcalase (ALC), neutrase (NEUT) and flavourzyme (FLAV) were selected from *in silico* suitability of the enzymatic cleaning formulation developed. The effectiveness enzymatic cleaning formulation to hydrolyze gluten after 37 days at 4°C and 25°C (under dark). Preliminary validation of the proteolytic activity was maintained above 90% in the cleaning formulation, where its proteolytic activity was maintained above 90% for a duration of 37 days. The gluten content decreased to values below 0.125 μg/g/100 cm(2) when the cleaning formulation was tested on different regions where the soil is located (inter-yarn and intra-yarn porosity). The location of the soil affects its exposure to the hydrodynamic forces and surfactant system resulting in a more challenging removal for the portion of the soil located in the inner area of the textiles. Good agreement between the experimental and predicted stain removal by the proposed mathematical model has been observed for the range of variables considered.

**Potential natural food preservatives and their sustainable production in yeast: terpenoids and polyphenols**


The lack of an efficacious natural preservative system for personal care products is a big challenge. The cataloging of natural antimicrobial compounds and their biosynthesis may lead to new analogs with improved preservative efficacies. A successful natural preservative system for personal care products could also pave the way to more effective natural anti-infective molecules.

Terpenoids and polyphenols are high-valued plant secondary metabolites. Their high antimicrobial activities demonstrate their huge potential as natural preservatives in the food industry. With the rapid development of metabolic engineering, it has become possible to realize large-scale production of non-native terpenoids and polyphenols by using the generally recognized as safe (GRAS) strain, *Saccharomyces cerevisiae*, as a cell factory. This review will summarize the major terpenoid and polyphenol compounds with high antimicrobial properties, describe their native metabolic pathways as well as antimicrobial mechanisms, and highlight current progress on their heterologous biosynthesis in *S. cerevisiae*. Current challenges and perspectives for the sustainable production of terpenoid and polyphenol as natural food preservatives via *S. cerevisiae* will also be discussed.

**Modelling the kinetics of stain removal from knitted cotton fabrics in a commercial front loader washing machine (FLWM)**


The kinetics of stain removal from knitted cotton textiles during the washing process in a front loader washing machine (FLWM) has been investigated as a function of the ballast load, agitation, drum rotational speed, and washing time, which result in different levels of mechanical action during the wash. The study was conducted using a set of stains comprising grease, enzymatic, particulate, and colored beverage-type soils that are representative of typical domestic washing loads. A mechanistic model has been developed to describe the stain removal process which takes into consideration the dual porosity of the textiles by allowing two different regions where the soil is located (inter-yarn and intra-yarn porosity). The location of the soil affects its exposure to the hydrodynamic forces and surfactant system resulting in a more challenging removal for the portion of the soil located in the inner area of the textiles. Good agreement between the experimental and predicted stain removal by the proposed mathematical model has been observed for the range of variables considered.
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S&D EAT An evaluation of *in-silico* methods for predicting solute partition in multiphase complex fluids—A case study of octanol/water partition coefficient


Solute partition in multiphase fluids is an important thermo-dynamic phenomenon and performance attribute for a wide range of product formulations of foods, pharmaceuticals, and cosmetics. Experimental evaluation of partition coefficients in complex product formulations is empirical, difficult, and time-consuming. *In-silico* methods, such as fragment constant method and group contribution method, require parameter fitting to the experimental data and are limited to relatively simple fluids. Recently, a method combining molecular dynamics (MD) and quantum chemical (QC) calculation of screening charge density function has been reported. The method does not only use fundamental properties of intermolecular force and charge density function, which does not require parameter fitting to the experimental data, but also applies to complex fluid structures such as micelles. In this work, the predictive accuracy of the combined method of MD and QC is evaluated. Using widely available octanol-water partition coefficients as a case study, the performance of the combined MD and COSMOmic for predicting octanol/water partition coefficients has been compared with those of the EPI Suite’ fragment constant method, UNIFAC group contribution method and COSMOtherm. The prediction of the combined MD/COSMOmic method is the closest to the best performing fragment constant method which was specifically designed for the octanol-water system. The combined MD/QC method proves to be the most promising and robust method applicable to a wide range of complex structures of multiphase fluid systems.

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