

INFORM

International News on Fats, Oils, and Related Materials

Manufacturing 4.0

ALSO INSIDE:

Cardiovascular benefits of pulses
Determining moisture in EVOO
Fallout from African swine fever

Innovating to Enhance Performance

We innovate to find technical solutions that improve yield and quality while reducing operating cost.

We also design robust solutions that maximize uptime.

Together, this helps our customers maintain profitability over time.

The experience of 9,000+ industrial references in the Oils & Fats Field.

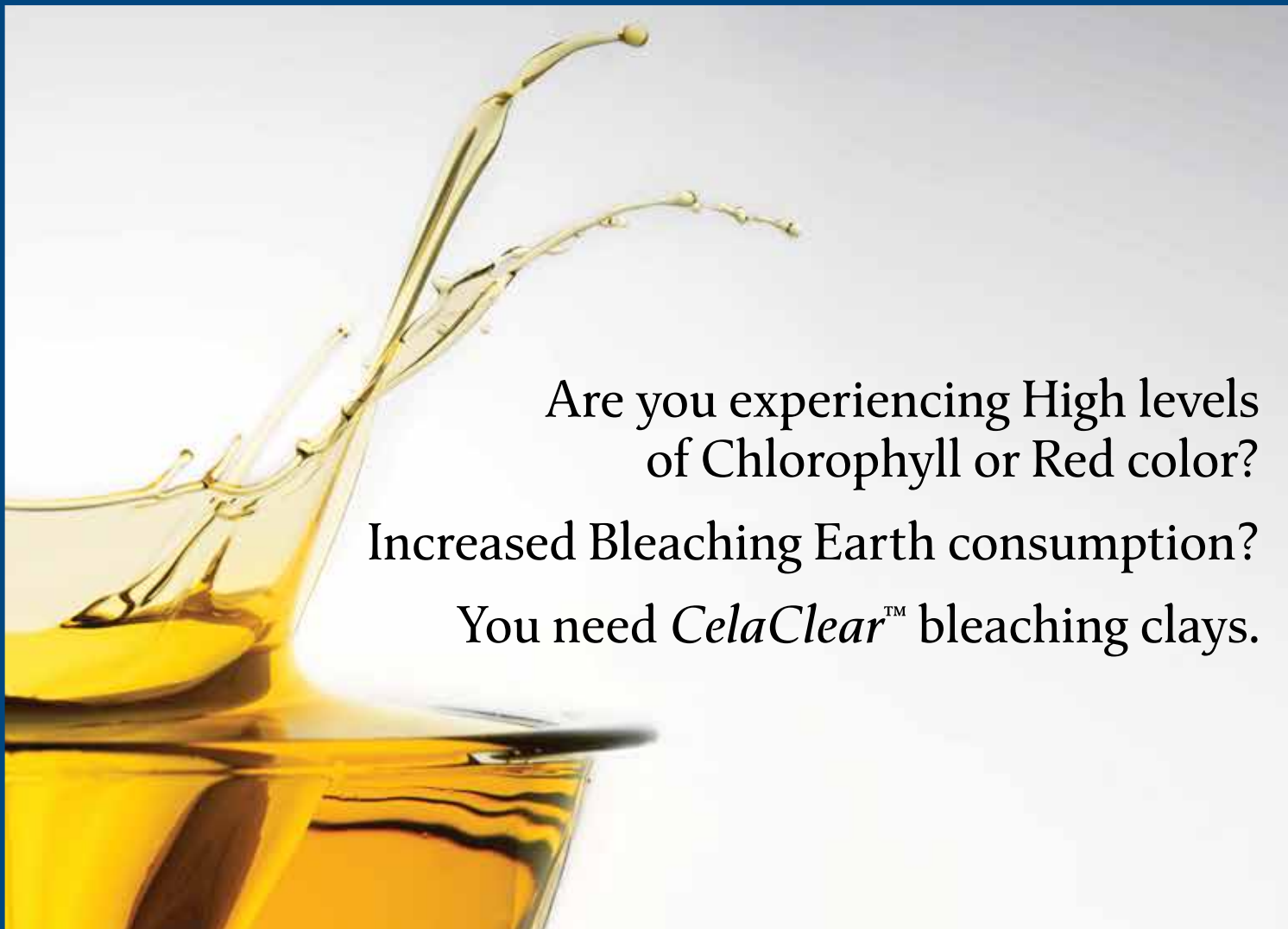
desmet ballestra



*Science
behind
Technology*

www.desmetballestra.com

The Difference is Clear



Are you experiencing High levels
of Chlorophyll or Red color?
Increased Bleaching Earth consumption?
You need *CelaClear*[™] bleaching clays.

CelaClear[™] bleaching clays can help you solve your toughest edible oil challenges – removing chlorophyll, dealing with red or dark oils, and improving oil stability. Our experienced technical team can also help you review your processes and provide the lowest cost solution to meet your goals.

Celatom[®] diatomaceous earth (DE) filter aids, works together with *CelaClear*[™] bleaching clays to remove particles and significantly improve oil clarity.

See the clear difference of *CelaClear*[™] bleaching clays and *Celatom*[®] DE filter aids. Contact us today.



Ep **ENGINEERED CLAYS[®]**
CORPORATION
A U.S. SILICA COMPANY

www.epengineeredclays.com | 800-714-1102

Celatom[®]

Ep **Minerals[®]**
A U.S. SILICA COMPANY

www.epminerals.com | 800-366-7607



CONTENTS

6 Digitizing manufacturing: how companies are using data to improve production

The latest production innovations do not just optimize manufacturing processes. They also help companies adjust to changing markets, serve as virtual factories that simulate workflows, map out the best operating conditions for new products and formulations, and model the outcome of any change in production or the supply chain

12 Beans and lentils: providing cardiovascular health benefits beyond nutrition

Pulses offer many health benefits, including the lowering of “bad” cholesterol, but did you know that certain varieties can also directly improve the functional properties of blood vessels?



16 **Rapid determination of moisture in olive oil: a proposed simple univariate FT-NIR procedure**

A simple univariate FT-NIR procedure was recently used to determine the moisture in 88 commercial products labeled as EVOO. Could it be a useful initial screening tool for rapidly determining the moisture content of commercial EVOO products?

19 **Focus on nutrition: moderate refining**

Better knowledge about processing and its effects on the nutritional quality of vegetable oils is motivating the industry to move toward refining methods that preserve instead of remove or destroy oil-soluble nutrients.

21 **Relationship between distance run per week, omega-3 index, and arachidonic acid (AA)/eicosapentaenoic acid (EPA) ratio: an observational retrospective study in non-elite runners**

An observational retrospective study of omega-3 fatty acids in non-elite runners yielded a surprising result: The omega-3 index decreased progressively with increased weekly running distance in a dose-response relationship, suggesting that regular distance running training induces undesirable changes in polyunsaturated fatty acid metabolism.

DEPARTMENTS

5 Index to Advertisers
15 AOCS Meeting Watch
28 Classified Advertising

Analysis/commentary
26 Olio
29 Regulatory Review
32 Latin America Update
35 Member Spotlight

Publications and more
36 Patents
38 AOCS Journals
40 Extracts & Distillates



DVC PROCESS TECHNOLOGISTS

Technology with Innovation

We are proud to be a partner in success stories of our clients

One Point Solution Provider
Design, Manufacture, Supply,
Install, Commission & After Sales

165 Global References
45+ Lecithin Plants
50+ Green Field Projects



Edible Oil Refining

- Degumming & Neutralization
- Bleaching
- Dewaxing / Winterization
- Deodorization

By-Product Processing

- Gums Drying (Lecithin)
- Soapstock Splitting (Acid Oil)

Seed Crushing

- Flash Desolventization (Soya White Flakes)
- Soapstock Desolventization

Fat Modification

- Fractionation
- Interesterification
- Hydrogenation

Biodiesel Production

Pilot Plant

Skid Mounted Plants

Customer Services

- Technical Audits
- Existing Plant Upgrade to improve
 - Efficiencies
 - Quality
 - Yield
 - Capacity
- Automation
- Products & Spares

DVC Process Technologists

Phone : +91 86699 56061 / 62 / 63 / 64 Fax : +91 21152 53970

E-mail : sales@dvcprocesstech.com, info@dvcprocesstech.com

www.dvcprocesstech.com

INFORM

www.aocs.org

AOCS MISSION STATEMENT

AOCS advances the science and technology of oils, fats, proteins, surfactants, and related materials, enriching the lives of people everywhere.

INFORM

International News on Fats, Oils, and Related Materials

ISSN: 1528-9303 IFRMEC 30 (10)

Copyright © 2013 AOCS Press

EDITOR-IN-CHIEF EMERITUS

James B.M. Rattray

CONTRIBUTING EDITORS

Scott Bloomer

Leslie Kleiner

Zong Meng

EDITORIAL ADVISORY COMMITTEE

Julian Barnes

Jerry King

Warren Schmidt

Gijs Calliauw

Leslie Kleiner

Utkarsh Shah

Fiona Case

Gary List

Ignacio Vieitez

Frank Flider

Khalid Mahmood

Bryan Yeh

Adeeb Hayyan

Jill Moser

Bart Zwijnenburg

AOCS OFFICERS

PRESIDENT: Eric Decker, University of Massachusetts, Amherst, USA

VICE PRESIDENT: Doug Bibus, Lipid Technologies LLC, Austin, Minnesota, USA

SECRETARY: Phil Kerr, SERIO Nutrition Solutions LLC, Dardenne Prairie, Missouri, USA

TREASURER: Grant Mitchell, Process Plus, LLC, Cincinnati, Ohio, USA

CHIEF EXECUTIVE OFFICER: Patrick Donnelly

AOCS STAFF

MANAGING EDITOR: Kathy Heine

ASSOCIATE EDITOR: Rebecca Guenard

MEMBERSHIP DIRECTOR: Janet Brown

PAGE LAYOUT: Moon Design

The views expressed in contributed and reprinted articles are those of the expert authors and are not official positions of AOCS.

2710 South Boulder Drive
P.O. Box 17190
Urbana, IL 61803-7190 USA
Phone: +1 217-359-2344
Fax: +1 217-351-8091
Email: publications@aocs.org

ADVERTISING INSTRUCTIONS AND DEADLINES

Closing dates are published on the AOCS website (www.aocs.org). Insertion orders received after closing will be subject to acceptance at advertisers' risk. No cancellations accepted after closing date. Ad materials must be prepared per published print ad specifications (posted on www.aocs.org) and received by the published material closing dates. Materials received after deadline or materials requiring changes will be published at advertisers' risk. Send insertion orders and materials to the email address below.

NOTE: AOCS reserves the right to reject advertising copy which in its opinion is unethical, misleading, unfair, or otherwise inappropriate or incompatible with the character of *Inform*. Advertisers and advertising agencies assume liability for all content (including text, representation, and illustrations) of advertisements printed and also assume responsibility for any claims arising therefrom made against the publisher.

AOCS Advertising:
Christina Morley
Phone: +1 217-693-4901
Fax: +1 217-693-4864
Christina.morley@aocs.org

Formerly published as *Chemists' Section*, *Cotton Oil Press*, 1917–1924; *Journal of the Oil and Fat Industries*, 1924–1931; *Oil & Soap*, 1932–1947; news portion of *JAOCs*, 1948–1989. The American Oil Chemists' Society assumes no responsibility for statements or opinions of contributors to its columns.

Inform (ISSN: 1528-9303) is published 10 times per year in January, February, March, April, May, June, July/August, September, October, November/December by AOCS Press, 2710 South Boulder Drive, Urbana, IL 61802-6996 USA. Phone: +1 217-359-2344. Periodicals Postage paid at Urbana, IL, and additional mailing offices. **POSTMASTER:** Send address changes to *Inform*, P.O. Box 17190, Urbana, IL 61803-7190 USA.

Subscriptions to *Inform* for members of the American Oil Chemists' Society are included in the annual dues. An individual subscription to *Inform* is \$195. Outside the U.S., add \$35 for surface mail, or add \$125 for air mail. Institutional subscriptions to the *Journal of the American Oil Chemists' Society* and *Inform* combined are now being handled by Wiley. Price list information is available at <http://olabout.wiley.com/WileyCDA/Section/id-406108.html>. Claims for copies lost in the mail must be received within 30 days (90 days outside the U.S.) of the date of issue. Notice of change of address must be received two weeks before the date of issue. For subscription inquiries, please contact Julie May at AOCS, julie.may@aocs.org. AOCS membership information and applications can be obtained from: AOCS, P.O. Box 17190, Urbana, IL 61803-7190 USA or membership@aocs.org.

NOTICE TO COPIERS: Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by the American Oil Chemists' Society for libraries and other users registered with the Copyright Clearance Center (www.copyright.com) Transactional Reporting Service, provided that the base fee of \$15.00 and a page charge of \$0.50 per copy are paid directly to CCC, 221 Congress St., Salem, MA 01970 USA.

INDEX TO ADVERTISERS

Bühler, Inc.	25
*Crown Iron Works Company	C3
*Desmet Ballestra Engineering NA	C2
DVC Process Technologists	4
*EP Minerals	1
*French Oil Mill Machinery Co.	C4
ICMS Australasia	33
Ingenieria Bernoulli S.A.	20
Koerting Hannover AG	15
Kumar Metal Industries Pvt. Ltd.	27
Myers Vacuum, Inc.	18
Pope Scientific, Inc.	9
Sharplex Filters (India) Pvt. Ltd.	11

*Corporate member of AOCS who supports the Society through corporate membership dues.

Digitizing manufacturing:

how companies are using data to improve production

Rebecca Guenard

There are certain tasks once deemed too delicate for computers, like blending whiskey (<https://tinyurl.com/y6mfd4jm>) or picking strawberries (<https://tinyurl.com/y5z66rqd>), but computers are fast learners; they achieved the ability to do both. Computers are also learning to predict a cow's milk production (<https://tinyurl.com/y63albyh>). They are monitoring soil nutrients, regulating moisture levels, and eradicating weeds. They are preventing crop loss by scrutinizing the weather. In fact, farmers are one of the fastest adopters of technology that combines data-collecting sensors with machine learning to automate and optimize the food production process (<https://tinyurl.com/yxtotf9r>).

- The internet of things (IoT) and data analytics are coming together to create a new, digitized way of manufacturing known as Industry 4.0.
- Companies are beginning to implement new technology platforms that integrate big data and artificial intelligence (AI) to create virtual factories that act as a proxy for the real thing.
- The latest production innovations are not just optimizing manufacturing processes; they bestow an agility on manufacturing that helps companies adjust to changing markets.

The agricultural industry is rapidly adopting automation, connectivity, and digitization to optimize its use of resources (<https://tinyurl.com/yxtotf9r>). The trend mirrors a similar overhaul in manufacturing across every industry sector, from plastics to pharmaceuticals, from cosmetics to beverages. Consumers expect technology to make their lives convenient. Unlocked cars ping cellphones so that owners can instantly remedy the oversight. These same technological conveniences are now being applied on a large scale to improve the efficiency of product development and production.

"The ubiquity of data is what is driving everything," says Jim Gavin, corporate accounts manager for food and beverages at Siemens, a global company specializing in digitization products headquartered in Munich, Germany. Like a Fitbit, which monitors and collects information about the human body to improve users' health, data collected during a manufacturing process is applied in a feedback to improve the process. Manufacturers can make or change a product faster and sell it to their customers sooner. The goal is to incorporate the convenience of modern technology into the manufacturing plant. "Everyone will be in the digital age before too much longer," says Gavin. "Like it or not, everybody is going to get there at some point."

INDUSTRY 4.0

The first industrial revolution began when man and animal power were replaced with steam. Production improved significantly by mechanizing processes that moved under steam power. Factories saw another bump in productivity nearly a century later when assembly lines running on



electrical power led to mass production. Computers and automation brought the next wave of production enhancements, speeding up manufacturing and reducing errors. Industry 4.0 represents industry's fourth revolution, in which computer networking and cloud computing enable a new level of comprehension for every aspect of a manufacturing process. With this level of knowledge, manufacturers hope to learn how their processes can be improved, how to maximize output, and how to make changes most efficiently.

Technology giants, like Google and IBM, are at the forefront of this revolution (<http://www.prnewswire.com>), but traditional and smaller companies are taking interest too. Industry 4.0 allows companies to link raw materials, components, manufacturing, and logistics using the computational power of AI and the networking capabilities of the IoT. Companies are not blind to the potential for profitability this technology could achieve (<https://tinyurl.com/yxma7qdn>). Fats and oils businesses are no exception. Siemens offers digitization products specifically designed for agribusinesses and edible oil producers that are prone to low profit margins and could benefit from the technology. And manufacturers that incorporate agricultural raw materials and edible oils into their processes, such as Procter & Gamble and Unilever, are also looking at ways in which digitization can reduce their bottom line.

"There is lots of potential in Industry 4.0 to provide continuous feedback and improvement loops," says Gavin. Siemens has linked their process control systems with an edible oils process library so that manufacturers can apply real world data

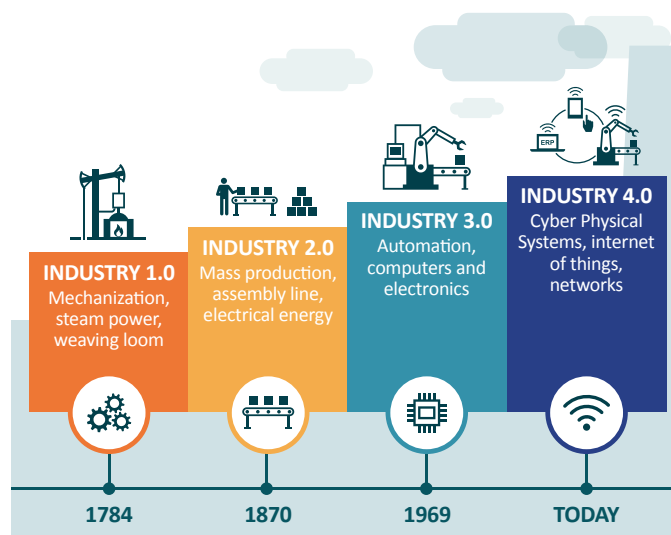


FIG. 1. Industry 4.0 indicates that manufacturing is undergoing its fourth revolution. First there was steam power, then electricity and computers. Now there is big data, AI, and the IoT.

to realize better plant performance. They have also designed products that assist with the handling and milling of grains. Sensors measure the amount of grain in silos and the weight of grain transported to hoppers and trucks. Digitizing this information can help oil and grain manufacturers track their inventory more efficiently. "That helps customers make decisions quickly and helps them make production changes they need in a timely manner that helps them perform better," says Gavin.

Mark Meili is the director of modeling, simulation, and digital innovation at P&G in Cincinnati, Ohio, USA. He is responsible for P&G's data infrastructure strategy for both R&D and product supply chain. Meili says his company is in various phases of implementing Industry 4.0. "Like many other businesses, we have some areas that are actively doing things today, a few places where we have been doing similar things for a number of years, and then some other areas where we are not very far," he says. "We are certainly getting more intentional about it, so there is more work under way than there was 12 or 18 months ago."

According to Meili, P&G's business areas are asking the questions that any industry should when considering Industry 4.0: What do we really need to measure? Can we measure that? Can we analyze the information from that measurement in real time? "We are doing a little bit of *So what?* analysis," says Meili. "We should not do this just because we can. We should do this because we know that we can use it to drive important decisions that enable the business."

Meili offers the example of P&G's surfactants business, where they mostly use their own chemical feedstocks to make products using a vertically integrated process. Industry 4.0 gives them the flexibility to consider how to utilize a raw material like palm kernel oil most profitably, and how to run processes in a way that takes optimization into account for a variety of feedstocks. "By collecting enough data, over long enough time, the information from the process gives me confidence that I actually understand all these interactions," says Meili.

Though optimization can lead to cost savings, another big buzz among manufacturers is how AI can use large data sets to teach them about their processes (<https://tinyurl.com/yxma7qdn>). AI tools, like machine learning, use processing data collected by plant instruments to develop a virtual version of the manufacturing operation. This faux factory is known as a digital twin. *The Wall Street Journal* predicts that in 2020, every major manufacturer will be using at least one digital twin (<https://tinyurl.com/y67w8ehh>).

DIGITAL TWINS

Gavin explains that before digital twins were invented, if a company wanted to reformulate their product, they would likely have to start over from scratch by redesigning their manufacturing plant and then working out the necessary specifications by building a pilot plant. Now, his company provides simulation tools that analyze every aspect of a plant before it is built. "If a company can get a plant sized right and the flow of the plant modeled correctly in simulation, it saves them a lot of cost, it saves them a lot of effort," says Gavin. "Ultimately, they can make a better product." He explains that digital twins help companies adapt to changes more quickly.

Digital twins can be intertwined in what Siemens calls a digital enterprise. The digital twin of a product can be run through the digital twin of a manufacturing plant. The product formulation and the source of the raw materials can be collected in a cloud computing data base where there is a digital twin of every step in a process needed to bring the product to

market. With this simulated workflow, if a company wanted to change a raw material supplier, for example, they can virtually change their digital twin first to identify any unforeseen production interruptions before committing.

Meili says that P&G would like to get to the point where they have digital twins across their businesses, because it makes sense. "We want to have as much information coming off of our manufacturing systems as we reasonably can," he says. "We want to know how we can make our systems smarter. How can we make ourselves smarter by getting much more information out of our manufacturing systems than we have today?"

INTERNET OF THINGS

One way to get more information out of manufacturing systems is to have them connected. Just as smart devices have become common in the home, companies are looking to networks for smarter manufacturing. Refrigerators now realize when a household is low on milk and instruct smart devices like Alexa to make a purchase. No one is forced to abandon a bowl of cereal for lack of milk. Thanks to these networked smart devices, there is always an ample supply.

Similarly, Meili says, P&G would like to take advantage of this type of technology in their manufacturing plant. They would like to switch from time-based maintenance to condition-based maintenance. In other words, instead of shutting down production at random times to perform maintenance, they want their factory equipment to act as smart devices and notify an operator when they need service. "If we could have the manufacturing system running more of the time, it would be more productive," says Meili.

The desire to have a manufacturing plant with this kind of connectivity and flexibility may seem decades away, but it is currently a reality. Unilever, based in London, United Kingdom, has eight digital twins of plants in North America, South America, Europe, and Asia (<https://tinyurl.com/yxsutfzd>). The company took three weeks to create its first digital twin of a facility in Valinhos, Brazil, that makes Dove soap. Sensors collected data, such as the temperature or motor speed of factory equipment, then sent the information to the cloud where advanced analytics mapped out the best operating conditions to produce Dove. The company reports that the digital twin saved them \$2.8 million by highlighting areas where they could lower energy costs and increase productivity.

Unilever's digital twins also give plant operators a means of testing quality without stopping production. Workers on site can track if process parameters are within specification using handheld tablets. If the production gets off track, they can quickly share data with other sites right from the production floor to save time as they and their colleagues work toward a solution.

Meili cautions that manufacturers will benefit most from Industry 4.0 if they truly understand their process. The technology should augment good science and engineering, but we need to remain in the driver's seat—just as we do when Google maps sends us on a circuitous route when we know a faster way out of town. "There is no substitute for understand-

DIFFICULT, COMPLEX DISTILLATION? CONTRACT WITH POPE SCIENTIFIC WE'RE UP TO THE CHALLENGE!

EXPERT TOLL PROCESSING SERVICES UTILIZING SHORT-PATH WIPED FILM MOLECULAR STILLS & EVAPORATORS, **PLUS** LATEST HYBRID FRACTIONAL COLUMN TECHNOLOGY.



- Highest possible purity and yield with heat-sensitive materials
- Newly expanded modern facility, GMP and kosher certified
- Long term contracting, short runs, pilot process development, lab services
- Equipment also offered for sale worldwide
- Global leaders in professional customer service, experience, and results with:

Edible & Essential Oils • Esters • Flavors
Fragrances • Foods • Pharmaceuticals
Biomaterials • Polymers • Extracts
Waxes • Vitamins • Nutraceuticals
Lubricants • Biofuels • Specialty
Chemicals • Others



www.popeinc.com
1-262-268-9300

PARTNER WITH AND OUTSOURCE TO POPE. MINIMIZE RISK, COSTS AND
TIME-TO-MARKET WHILE MAXIMIZING PRODUCT QUALITY, VALUE & SUCCESS!



FIG. 2. A Thorvald vegetable-picking robot. © University of Lincoln

ing what the manufacturing process is doing in the first place,” says Meili. “Then you can use these techniques to help you do it better.”

FARM TECH

When applied to the agricultural sector, these digital technologies are referred to as agri-food 4.0. As the agri-food industry is increasingly forced to respond to a growing number of challenges, such as extreme, unpredictable weather patterns and an expanding world population, they turn to technology for solutions (<https://tinyurl.com/y3qxhwsr>). In 2011, the European Union established the sensing, smart, and sustainable (S³) initiative to provide advice to industries on how to implement an efficient work process (<https://s3platform.jrc.ec.europa.eu/s3-platform>). The agri-food section of this initiative has funded the development of products to improve the food production process.

Just as companies like P&G and Unilever gather as much information from their manufacturing processes as they can, farmers seek similar data from their crops. Sensors located throughout fields and networked through the IoT assess molecular response of crops to water, fertilizer, and soil types. The data collected by the sensors not only signal when crops are running low on resources, but AI also evaluates the data to determine how to grow plants with a maximum amount of nutrients given their growing conditions. Imaging technology gathered by aerial drones assist farmers with monitoring their fields, but also provides AI with the directional data to instruct self-driving tractors and vegetable-picking robots. Farm technology is being designed to optimize every aspect of farm management. Experts believe finding better, smarter ways to grow food is essential for feeding the 9 billion people expected to inhabit the earth by 2050.

The changes that technology has brought to agriculture reiterate Gavin’s point that eventually everyone will enter the digital age. As the world begins to acknowledge the limitations of its resources, it is relying on our computational capabilities to calculate how best to use them.

Rebecca Guenard is the associate editor of Inform at AOCS. She can be contacted at rebecca.guenard@aocs.org.

References

- Sensing, smart, and sustainable technologies for agri-food 4.0, Miranda, J., *et al.*, *J. Comp. Ind.* 108: 21–36, 2019.
- How smart, connected products are transforming companies, Porter, M.E. and J.E. Heppelmann, *Harvard Business Review*, October 2015.
- Internet of things, big data, industry 4.0—innovative solutions in logistics and supply chains management, Witkowski, K., *Procedia Eng.* 182: 763–769, 2017.
- The role of additive manufacturing in the era of industry 4.0, Dilberoglu, U.M., *et al.*, *Procedia Manuf.* 11: 545–554, 2017.
- Guest Editorial Special Section on Advances and Applications of Internet of Things for Smart Automated Systems, Mitsugi, J., *et al.*, *IEEE T. Autom. Sci. Eng.* 13: 3, 2016.

Best In EDIBLE OIL FILTRATION



**VERTICAL
PRESSURE LEAF FILTER**



**HORIZONTAL
PRESSURE LEAF FILTER**



**CANDLE FILTER
BACK WASH TYPE**



**TUBULAR
CENTRIFUGE
FILTER**



**SINGLE &
MULTIBAG
POLISHING FILTER**



**FILTER
ELEMENTS**



SHARPLEX FILTERS (INDIA) PVT. LTD.

AN ISO 9001:2008, 14001:18001 COMPANY

R-664, T.T.C. Industrial Area, Thane Belapur Road, Rabale,
MIDC, Navi Mumbai - 400 701, India.

Tel: +91 9136921232 till 9136921239 / 022-27696322/31/39

Fax : 022-27696325 Toll Free No. - Spares Dept.- 1800226641

E-mail : sales@sharpfilters.com

www.sharplex.com



Beans and lentils: providing cardiovascular health benefits beyond nutrition

Peter Zahradka

- Besides being environmentally friendly and nutritious, pulses exhibit properties that could be helpful in the prevention and/or treatment of certain acute and chronic conditions.
- With respect to cardiovascular disease, pulses have been shown to lower low-density lipoprotein (LDL) cholesterol levels, but recent studies indicate certain pulse varieties can directly improve the functional properties of blood vessels.
- The lack of availability for consumers of ready-to-serve products containing an adequate amount of pulses, as well as the lack of information regarding the effects of processing methods on the beneficial health effects of pulses makes it difficult for the general public to utilize these foods.
- Our work indicates there is no magic bullet, and to get the maximum cardiovascular benefits from eating pulses you should include a mixture of different varieties in your diet, since each produces a different effect on the cardiovascular system.

In agriculture, the term “pulse” refers to plants belonging to the legume family that are cultivated for their seeds and harvested once they have dried. The typical North American crops are dried beans, dried peas, lentils, and chickpeas, which are primarily used as human and animal food. While pulses are utilized as a major food source in the Middle East, Central and South America, and Asia, there is limited inclusion of pulses in the diets of persons living in Europe, Japan, Australia, and North America. Historically, pulse crops were first domesticated about 5,000 years ago. Their cultivation has been a boon in arid regions, since these plants do not require as much water as many other food crops. Furthermore, their agronomic profile is excellent, as the plants belong to the legume family and thus are nitrogen-fixing and less dependent upon fertilizers. Another added benefit of pulses is their nutrition profile, which includes a high protein and fiber content, a low amount of fat, and essential micronutrients, such as folate and iron.

In addition to providing a basis for the preparation of nutritious foods, including pulses in the diet can be beneficial to health. For example, the abundance of complex carbohydrates rather than simple sugars means pulses have a low glycemic index and are therefore suitable for persons with diabetes. Similarly, pulses can be eaten by individuals trying to lower their cholesterol levels and those who have celiac disease or are gluten-sensitive. The nutritional properties of pulses make them ideal for the preparation of functional foods designed to combat certain acute and chronic diseases. However, to date, the development of commercially available food products containing pulses has been limited—even though there are many articles, both scientific and general, that advocate greater inclusion of pulse foods as part of our regular diet.

The preparation of functional foods with specific health benefits, or the formulation of a natural health product, is usually based on information about the proposed functional ingredient. For functional foods, two of the critical elements are the disease condition being targeted for improvement, and the amount of the ingredient per serving required to elicit a benefit. In selecting a target condition, verbal or written folklore or descriptions of herbal medicines utilizing the ingredient can provide some direction. It is interesting to note that while pulses have been a staple food for thousands of years, their use for medicinal purposes has been fairly limited, which contrasts markedly from many other plants found in the traditional pharmacopeia. While this is mostly the case for beans, which have received scant attention as a medicinal because they originated in South America (*Encyclopedia of Folk Medicine: Old World and New World Traditions*, ed. Hatfield, G., ABC-CLIO, Santa Barbara, California, USA, 2003; Camara, *et al.*, *Agriculture 3*: 90–111, 2013), the reported health improvements ascribed to the better-known lentil are likewise very general and apply to diabetes as well as skin infections and burns (Faris and Atlee, In *Exploring the Nutrition and Health Benefits of Functional Foods*, eds. Shekhar, *et al.*, IGI Global, Pennsylvania, USA, 2017).

To rectify this situation, in 2005, Pulse Canada put out a call for proposals to investigate the health benefits of pulses in a more systematic fashion, with the expectation that these studies be performed in humans. Based on reports in the scientific literature that soybeans, a non-pulse legume, contain phytochemicals that could decrease arterial stiffness, a key feature of atherosclerotic disease, my collaborator Carla Taylor, a professor in the Department of Foods and Human Nutritional Sciences at the University of Manitoba and Director of the Canadian Centre for Agri-Food Research in Health and Medicine, Winnipeg, and I proposed that a diet rich in pulses would reduce the stiffness of blood vessels. We were very appreciative when Pulse Canada awarded us the funding to perform this study.

To do it properly, we asked Randy Guzman, a vascular surgeon at St. Boniface Hospital, Winnipeg, to join us. He generously assisted with recruitment of patients from his clinic



who had been diagnosed with peripheral artery disease (PAD), one of the complications of atherosclerosis. The main feature of PAD is a decrease in blood flow to the foot because of lesions present in the blood vessels of the leg. This can lead to the onset of pain when walking, because the muscles do not receive enough oxygen to meet their needs during periods of exertion. The 26 study participants were provided with foods that contained one half cup of a mixture of cooked pulses (beans, peas, chickpeas, lentils), with one item to be eaten each day for a period of 8 weeks. Two significant changes were observed. First, the LDL-cholesterol of the participants was reduced, which is commonly seen with most pulses because of their high fiber content. Second, the ankle-brachial index (ABI),

Keep your finger on the pulse

The author of this article, Peter Zahradka, was one of 18 experts to present the latest advances in the analysis, nutrition, and applications of pulse proteins at the inaugural Pulse Science and Technology Forum (November 5–7 in Toronto, Canada). This unique forum was offered by the American Oil Chemists' Society (AOCS) in cooperation with the Global Pulse Confederation, Protein Highway, Protein Industries Canada, and Pulse Canada. The presentations will be made available on the AOCS website (aocs.org) so that busy professionals can keep up with the rapid developments in the science and technology of alternative proteins.

which is the gold standard for diagnosis of PAD, was improved. While no change in arterial stiffness was detected, the higher ABI indicated there was greater blood flow in the limbs (Zahradka, *et al.*, *Atherosclerosis* 230: 310–314, 2013), and this was supported by anecdotal comments made by some of the participants indicating they were able to walk further. Overall, it was concluded that pulses could provide a medicinal benefit for a disease that is currently not well managed by pharmacological means.

Starting with a human study to investigate health benefits is not the usual approach, however the foresight of Pulse Canada led to a finding that could otherwise not be obtained any other way. Furthermore, the information that was obtained this way was useful for guiding the design of additional studies that would examine how pulses produced these benefits. Thus, a series of animal studies were subsequently completed with the intention of defining how pulses caused these benefits (the composition of the blood vessel wall to make it more elastic—Hanson, *et al.*, *J. Nutr. Biochem.* 37: 30–38, 2016), which pulse variety had the greatest potency (green lentil—Hanson, *et al.*, *Br. J. Nutr.* 111: 690–698, 2014), what time frame was required to obtain (one to two months—Zahradka, 2013) and maintain (not yet tested) the positive effects, and what component(s) of the several thousand that can be detected are responsible for the benefits (still uncertain—Hanson, *et al.*, *Eur. J. Nutr.* 57: 297–308, 2018).

While green lentils produced the best result (Fig. 1), red lentils also were found to affect blood vessels (Hanson, 2014), although they did not have the same effect as the green variety. Comparisons of the various pulse varieties were then performed to determine what other medicinal effects they might have. This work has shown that black beans can cause blood vessels to relax over the six-hour period after they are consumed (Clark, PhD dissertation, 2019), while other varieties of beans do not have a similar effect. This contrasts markedly with other foods, such as fats, which induce the contraction of arteries after they are eaten (Vafeiadou, *et al.*, *Br. J. Nutr.* 107: 303–324, 2012). However, more studies are required to understand how pulses can affect blood vessels, and to do so properly requires the right types of equipment (Perrault, *et al.*, *BMC Cardiovasc. Disord.* 19: 190, 2019).

Based on the results obtained through the various studies that have been completed, we have become strong advocates for greater inclusion of pulses in our diets. Overall, pulses can be considered a natural way to prevent or even treat the development of arterial stiffness, which can be considered one of the first changes in our blood vessels leading to atherosclerosis or hardening of the arteries. Since atherosclerosis is the basis for most heart attacks and strokes, greater consumption of pulses may reduce the incidence of these deadly events, thus impacting positively on lifespan and quality of life and, in turn, decreasing the burden on our healthcare system.

The challenge then becomes how to convince more households to serve pulses on a routine basis so they can gain these benefits. Today's lifestyle does not favor longer cooking times; therefore, ensuring greater availability of ready-to-eat food products should be promoted. To achieve this goal, it will be necessary for the food producing and food service indus-

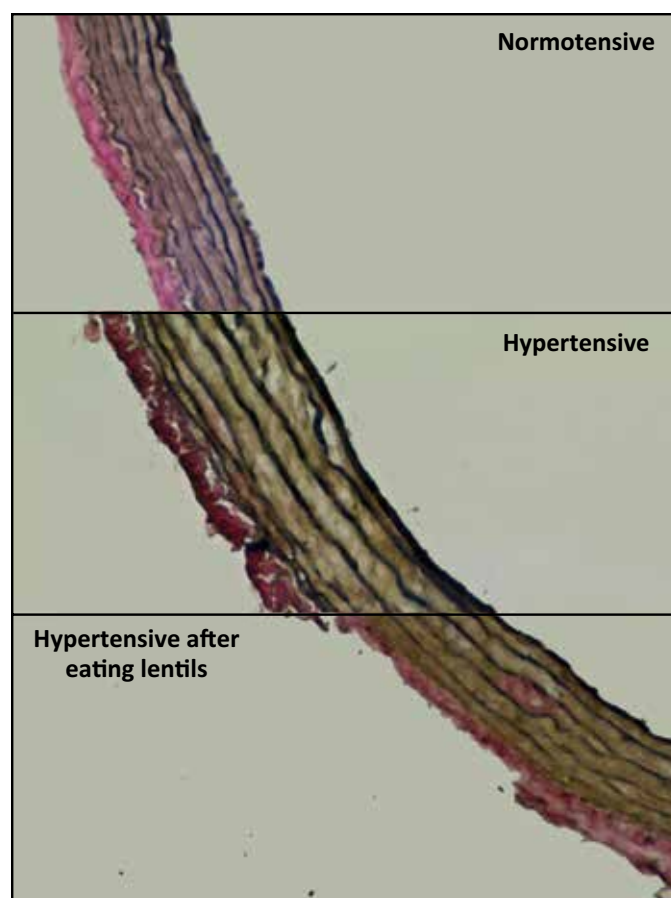


FIG. 1. Representative stained sections of rat aorta showing wall thickness, which increases as a result of high blood pressure compared to normal blood pressure, and can be reduced when animals with high blood pressure consume a diet containing green lentils. Further details regarding the study and its findings can be found in Hanson, *et al.*, 2014 and 2016.

tries to see that making these foods will be profitable. At the same time, it may require the pulse industry to benefit from developing local markets rather than exporting most of its product.

While there is strong evidence that pulses have beneficial effects, a variety of issues need to be resolved before pulses can be recommended as a means of controlling cardiovascular disease. For instance, the effect of processing needs to be established no matter what the intended use of the processed material by the food industry. At this time, we have obtained evidence that the ability to lower low-density lipoprotein (LDL) cholesterol levels is decreased by certain processing methods, similarly to what has been reported on glycemic index (Ramdath, *et al.*, *Foods* 7: 76, 2018). Another matter is to determine whether high levels of pulses in the diet might be detrimental.

Specifically, the US Food and Drug Administration recently decided to investigate reports that the pulses used in certain dog food formulations may be responsible for the development of dilated cardiomyopathy (<https://www.fda.gov/animal-veterinary/news-events/fda-investigation-potential-link-between-certain-diets-and-canine-dilated-cardiomyopathy>). While this story has become of concern

to pet owners, no one has yet questioned whether it is a concern for human health. At this time, however, the overall benefits associated with pulse consumption far outweigh any perceived problems. In my experience, having been involved in the preparation and testing of various foods containing all four of the major pulses, cooking with them is not really a tremendous burden and it is possible to incorporate several servings in a week. Furthermore, they are tasty and can be eaten routinely (Ramdath, 2018; Baldwin, *et al.*, *Can. J. Diet. Pract. Res.* 78: 187–191, 2017; Ryland, *et al.*, *Foods* 7: 129, 2018) if the recipes and the varieties are rotated. To many, this may not seem feasible, but a slight shift in our eating habits to include more pulse-rich foods in our diet can have a major positive impact on our health and well-being even if a suitable pharmacological intervention remains unavailable.

Peter Zahradka is a professor in the Division of Endocrinology and Metabolic Disease, Department of Physiology and Pathophysiology at the University of Manitoba, Winnipeg, Canada, and serves as Deputy Director of the Canadian Centre for Agri-Food Research in Health and Medicine at the St. Boniface Albrechtsen Research Centre. His lab has been engaged in the identification of novel bioactive compounds in various crops for the management of diabetes, obesity, and atherosclerosis, and uses clinical trials to translate animal and cell culture results to humans. This work has led to findings that are promoting the development of new functional food and nutraceutical products prepared from buckwheat and pulses. Zahradka can be contacted at PZahradka@sbr.ca.

AOCS MEETING WATCH

November 5–7, 2019. AOCS Pulse Science and Technology Forum. Courtyard by Marriott, Toronto, Canada.

November 8–10, 2019. 2nd AOCS China Section Conference: Health, Advanced Processing, and Value-Added Utilization, Zhujiang (Pearl River) Hotel, Guangzhou (Canton), China.

April 26–29, 2020. AOCS Annual Meeting & Expo, Palais des congrès de Montréal, Montréal, Québec, Canada.

May 2–5, 2021. AOCS Annual Meeting & Expo, Oregon Convention Center, Portland, Oregon, USA.

May 1–4, 2022. AOCS Annual Meeting & Expo, Hyatt Regency Atlanta, Atlanta, Georgia, USA.

November 17–19, 2020. Fabric and Home Care World Conference, Jing An Shangri-La Hotel, Shanghai, China

For in-depth details on these and other upcoming meetings, visit <http://aocs.org/meetings> or contact the AOCS Meetings Department (email: meetings@aocs.org; phone: +1 217-693-4831).

Clean and efficient vacuum systems

for refining
and deodorising

ICE

Ice condensation

ACL

Alkaline Closed Loop



www.koerting.de

+49 511 2129-253 • st@koerting.de

Rapid determination of moisture in olive oil: a proposed simple univariate FT-NIR procedure

Ali Reza Fardin-Kia, Sanjeewa R. Karunathilaka, Betsy Jean Yakes, Kyungeun Lee, Zachary Ellsworth, Lea Brückner, and Magdi M. Mossoba

- This invited report is based on an oral AOCS Olive Oil Workshop presentation that Magdi Mossoba gave during the 2019 AOCS Annual Meeting & Expo in St. Louis, Missouri, USA, and a manuscript that will soon appear in the *Journal of Oleo Science* 68 (11), 2019, <https://doi.org/10.5650/jos.ess19118>.
- The report describes a simple, univariate FT-NIR procedure for quantifying moisture in olive oil, which is a quality parameter according to the CODEX standard for olive oils and olive pomace oils.
- The new FT-NIR procedure is based on accurate measurement of the first derivative peak-to-peak (p-p) height of the band near 5260 cm^{-1} and was used to determine the moisture concentrations of 88 commercial retail products labeled as EVOO.

The US Food and Drug Administration (FDA) was directed by Congress to screen imported olive oils to determine if they are adulterated or misbranded. Therefore, there has been a need to develop rigorous analytical methods that can rapidly determine olive oil purity and quality. Near infrared (NIR) spectroscopy has been a useful screening tool used in food analysis. Variation in the intensity of a weak NIR band near 5260 cm^{-1} was first observed for olive oil by Christy, *et al.* (*Analytical Sciences* 20: 935–940, 2004), and we erroneously attributed it to volatile carbonyl overtone vibrations (✖ Mossoba, *et al.*, *Lipids* 52: 443–455, 2017). In the present study, we clearly demonstrated for the first time, based on gravimetrically determined spiking experiments, that this band (Figs. 1–3) is due to moisture (O-H combination band) in olive oil, which is a quality characteristic according to CODEX standard for olive oils and olive pomace oils (*Codex Alimentarius*, FAO/WHO, Stan 33–1981 (2013)).



We observed that the intensity of this weak, yet highly characteristic, band increased with the addition of water at concentrations of up to approximately 0.15% (w/w). See Figure 2.

A simple, univariate FT-NIR procedure for quantifying moisture in olive oil is proposed. It is based on the accurate measurement of the first derivative peak-to-peak (p-p) height of the band near 5260 cm^{-1} . This is illustrated in Figure 3 (page 18) for authenticated test samples of extra virgin olive oil (EVOO) and refined olive oil (ROO), which exhibited a clear difference in band intensity.

Since the solubility of water in edible oils is independent of the type of oil used when expressed in terms of mole fraction (Hilder, *J. Am. Oil Chem. Soc.* 45: 703–707, 1968), calibration test samples were prepared by using three reference EVOO and ROO olive oils. An exponential regression curve fit (Fig. 4, page 18) was used because it adequately described the physical dissolution of moisture in olive oil as it reached its saturation point. At a concentration of approximately 0.15% (w/w), the solubility of moisture in oil reached saturation, and the regression function leveled off, indicating that a water-in-oil emulsion had progressively formed.

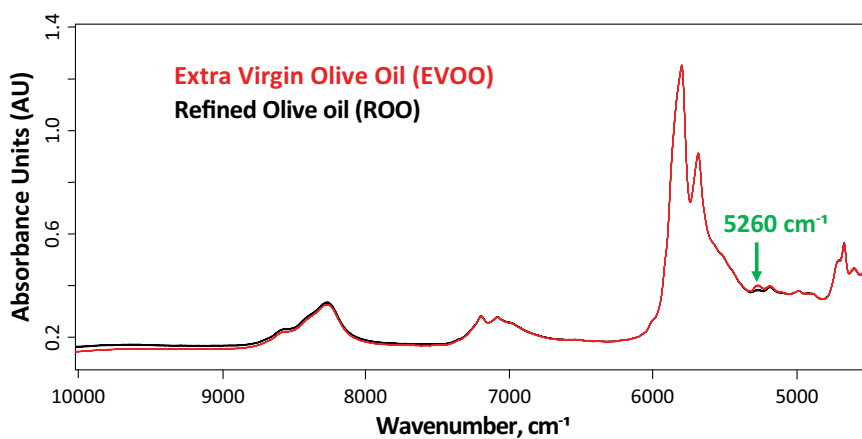


FIG 1. Typical near infrared spectra observed for extra virgin olive oil (EVOO) and refined olive oil (ROO)

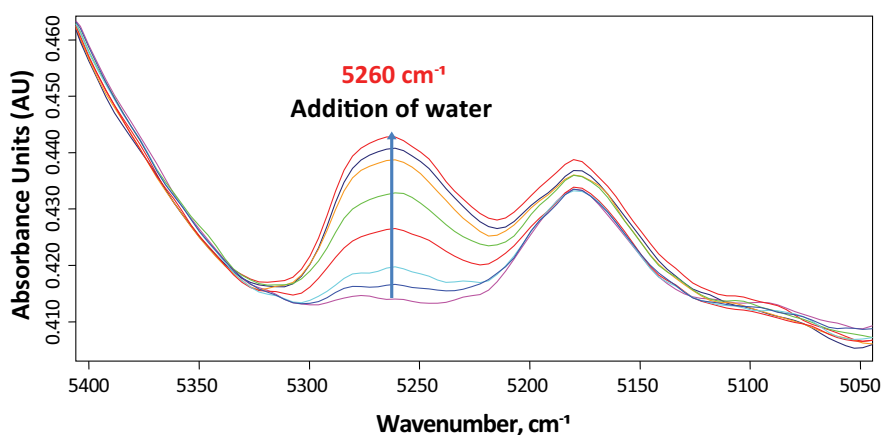


FIG 2. The NIR band near 5260 cm^{-1} is attributed to moisture in olive oil.

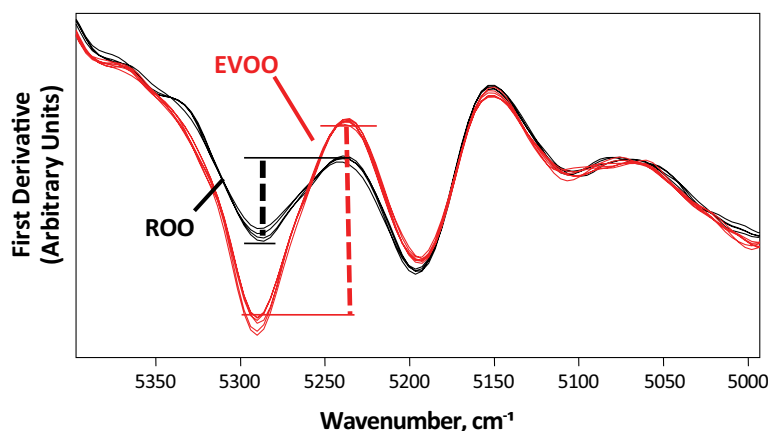


FIG. 3. First derivative bands observed for extra virgin olive oil (EVOO) and refined olive oil (ROO)

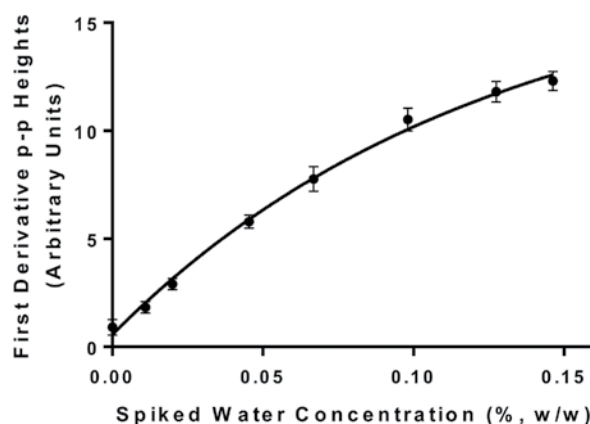


FIG. 4. Plot of exponential regression function for observed NIR intensity versus concentration of spiked water in olive oil

For a limited set of reference olive oils investigated, whose authenticity had been verified with official methods, the moisture concentrations were found to fall in the ranges of 0.098–0.12% H₂O (w/w) for EVOO, and 0.022–0.030% H₂O (w/w) for ROO. Eighty-eight commercial retail products labeled as EVOO yielded moisture concentrations between 0.026 and 0.13% (w/w). A universal threshold for establishing EVOO status has yet to be determined by considering all possible sources of EVOO variability, including processing factors such as filtration and soft deodorization. The correlation between moisture content and quality parameters has yet to be investigated. Once validated in comparison with the Karl Fisher reference method (AOCS Official Method Ca 2e-84. Moisture, Karl Fischer

Reagent. Reapproved, 2017) in a multi-laboratory collaborative study, this proposed FT-NIR procedure could potentially be a useful initial screening tool for rapidly determining the moisture content for commercial EVOO products.

Ali Reza Fardin-Kia, Betsy Jean Yakes, Kyungeun Lee, Lea Brückner, and Magdi M. Mossoba are with the US Food and Drug Administration, Center for Food Safety and Applied Nutrition. College Park, Maryland, USA. Sanjeewa R. Karunathilaka and Zachary Ellsworth are at the University of Maryland, Joint Institute for Food Safety and Applied Nutrition, also in College Park. Magdi Mossoba can be contacted at Magdi.Mossoba@fda.hhs.gov.



Vacuum Distillation for Processing Heat Sensitive Material?

Is Decomposition of product during processing a problem?

Now a unique alternative to wiped and falling film evaporators that utilizes centrifugal forces for product distribution across heaters. The Pilot 15 utilizes high vacuum chamber with heated residence time of less than 1 second!

This compact stand alone system has capacity to process up to 80 pounds per hour. Ideal for Pilot production.

Send us a sample and see the results of the amazing Pilot 15, a system that has been field proven for over 40 years.



MYERS VACUUM, Inc.

1155 Myers Lane • Kittanning, PA 16201 USA
888-780-8331 • 724-545-8331 • Fax: 724-545-8332
email: sales@myers-vacuum.com • www.myers-vacuum.com

Focus on nutrition: moderate refining

Tong Wang

The lipid processing industry is experiencing advances that improve not only the technological efficiency of the processing equipment, but also knowledge about processing and nutritional quality. Conventional refining has produced high-quality edible oils with desirable physical properties and increased shelf-life. However, over-processing and over refining of vegetable oils has resulted in serious safety concerns (Cheng, *et al.*, 2017). The concept of “moderate processing” was proposed in the mid-2000s by Xingguo Wang, professor of Jiangnan University in Wuxi, Jiangsu, China. In 2014, the research and validation of the concept was recognized at the National Food Science and Technology Conference in China as one of four major innovations in the food industry. For many years, Professor Wang’s team has advocated moderate processing to protect oil-soluble nutrients from being removed or degraded by harsh refining conditions, thereby enabling consumers to receive the potential health benefits of these compounds.

- Conventional refining produces high-quality edible oils with desirable physical properties and increased shelf-life.
- Meanwhile, there is increasing interest in the impact micronutrients within edible oil have on health outcomes.
- Moderate refining ensures maximum protection and retention of nutrients and removes potentially hazardous components; it is expected to eventually replace conventional refining.

The viewpoint now is that critical assessment of oil quality should be based on the relationship between lipid consumption and chronic disease. Cardiovascular diseases, obesity, diabetes, cancers, and other chronic conditions have been on the rise during the past 20 years, and threaten quality of life. Prevention strategies are urgently needed. Changes in dietary structure and lifestyle can significantly improve population health. Consuming healthful fats and oils—particularly those obtained from moderately processed oils that contain the oil’s naturally occurring nutrients—can be one strategy. A moderate degree of oil refining will ensure maximum protection and retention of nutrients while removing potentially hazardous components.

In recent years, there has been an increasing number of scientific publications on minor, but bioactive, components of oils and their nutritional impact (Yubero-Serrano, *et al.*, 2019; Perez-Jimenez, *et al.*, 2007; de la Torre-Carbot, *et al.*, 2010; Scoditti, *et al.*, 2012). Lipids as a macronutrient continue to be an important area of research, but there has been a transition toward studying the impact micronutrients within edible oil have on health outcomes. For example, a recent study by Arunima and Rajamohan (2014) compared virgin coconut oil with copra oil (which contains a lower quantity of polyphenols, tocopherols, and phytosterols) and showed that serum and liver cholesterol and TAG levels were dramatically reduced by the virgin coconut oil treatment. The results of this study contradict those of previous studies, and the belief that coconut and palm kernel oil increase cholesterol levels in liver and serum. In addition, the highly saturated cocoa butter is now believed to have no atherogenic properties due to the phytochemical content that counteracts the palmitic acid’s effect (Brenna and Kothapalli, 2014).

Since 2013, dietary guidelines for fat have been modified in the United States, Canada, and China. These new guidelines emphasize the importance of nutrient density and plant-derived compounds, including fat-soluble bioactive components, and suggestions related to daily intake on cholesterol and saturated fatty acids have been removed or modified. The expectation is that following such guidelines will prevent chronic diseases and public health. Moderate oil processing to retain the naturally occurring nutrients is in agreement with this principle.

INGENIERIA BERNOULLI

VACUUM AND THIN FILM TECHNOLOGY

AGITATED THIN FILM AND WIPED FILM EVAPORATORS

MOLECULAR DISTILLERS

VACUUM SYSTEMS (CLEAN) EJECTOR AND EDUCTORS

www.ibernoulli.com

+54 11 4792-0392 / ventas@ibernoulli.com

LECITHIN DRYERS

FATTY ACID DISTILLATION AND GLYCERINE

SCRAPED SURFACE HEAT EXCHANGERS

MULTI EFFECT EVAPORATORS

JET EQUIPMENT

Meanwhile, there is a need to conduct more basic research on how processing or refining impacts the nutrient content and nutritional quality of not only the existing wide array of fats and oils, but also oils from new sources. The importance of pre-treatment technologies, the modification of refining procedures and equipment, and the utilization of by-products should be thoroughly investigated. It is predicted that conventional lipid processing will gradually be replaced by moderate refining, which is essential for sustainable production, processing, and, ultimately, consumer health. Many of aspects of moderate refining are more fully discussed in the new book of Wang and Jin (2016).

Tong Wang is a professor in Food Science at the University of Tennessee in Knoxville (USA). She can be contacted at twang46@utk.edu.

References

- Arunima, S. and T. Rajamohan, Influence of virgin coconut oil-enriched diet on the transcriptional regulation of fatty acid synthesis and oxidation in rats—a comparative study, *Br. J. Nutr.* 111: 1782–1790, 2014.
- Brenna, T.J. and K.S.D. Kothapalli, Commentary on “Influence of virgin coconut oil-enriched diet on the transcriptional regulation of fatty acid synthesis and oxidation in rats—a comparative study” by Sakunthala Arunima and Thankappan Rajamohan, *Brit. J. Nutr.* 112: 1425–1426, 2014.
- Cheng, W., G. Liu, L. Wang, and Z. Liu, Glycidyl fatty acid esters in refined edible oils: a review on formation, occurrence, analysis, and elimination methods, *Compr. Rev. Food Sci. F.* 16: 263–281, 2017.
- de la Torre-Carbot, K., *et al.*, Elevated circulating LDL phenol levels in men who consumed virgin rather than refined olive oil are associated with less oxidation of plasma LDL, *J. Nutr.* 140: 501–508, 2010.
- Perez-Jimenez, F., *et al.*, The influence of olive oil on human health: not a question of fat alone, *Mol. Nutr. Food Res.* 51:1199–1208, 2007.
- Scoditti, E., *et al.*, Mediterranean diet polyphenols reduce inflammatory angiogenesis through MMP-9 and COX-2 inhibition in human vascular endothelial cells: a potentially protective mechanism in atherosclerotic vascular disease and cancer, *Arch. Biochem. Biophys.* 527: 81–89, 2012.
- Wang, X. and Jin, Q. (2016). *Theories and Practices of Edible Oil's Precise and Appropriate Processing*. China Light, Industry Press, Beijing, China, 226 pages, ISBN: 9787518411757.
- Yubero-Serrano, E.M., J. Lopez-Moreno, F. Gomez-Delgado, and J. Lopez-Miranda, Extra virgin olive oil: more than a healthy fat, *Eur. J. Clin. Nutr.* 72: 8–17, 2019.

Relationship between distance run per week, omega-3 index, and arachidonic acid (AA)/eicosapentaenoic acid (EPA) ratio: an observational retrospective study in non-elite runners

Davinelli, S., Corbi, G., Righetti S., Casiraghi E, Chiappero F., Martegani S., Pina R., De Vivo I., Simopoulos A.P. and Scapagnini G.

- An observational retrospective study in non-elite runners investigated the relationships between omega-3 index, AA/EPA ratio, and weekly running distance in a population of non-elite runners.
- The data demonstrated that the level of omega-3 index decreases progressively with increased weekly running distance in a dose-response relationship.
- This finding indicates that regular distance running training induces changes in polyunsaturated fatty acid (PUFA) metabolism and should thus be considered as a modulator of PUFA tissue composition.

The blood lipid concentration of polyunsaturated fatty acids (PUFA) have been widely used as biomarkers of intake and as surrogates of their enrichment in cellular membranes (Baylin and Campos, 2006). The fatty acids (FA) composition of the cell membrane reflects not only the dietary fat intake (Martorell, *et al.*, 2015), but is also influenced by several other factors, such as genetic variants and physical activity (Nikolaidis and Mougios, 2004; Rzehak, *et al.*, 2009).

Furthermore, it has been established that PUFA of whole blood (WB) and red blood cells (RBC) reflect the phospholipid (PL) PUFA composition of major organs and tissues (Rizzo, *et al.*, 2010; Fenton, *et al.*, 2016). PUFA may modulate the physical properties of biological membranes via alteration of membrane lipid composition, affecting numerous cellular events and physiological processes (Abbott, *et al.*, 2012).

The metabolic adaptations that occur in long-term and intense physical training may lead to changes in FA membrane composition, particularly long-chain (LC) omega-3 and omega-6 PUFA (Tepsic, *et al.*, 2009). The dietary supplementation with omega-3 LC PUFA (e.g., eicosapentaenoic acid [EPA; 20:5 ω -3] and docosahexaenoic acid [DHA; 22:6 ω -3]) has been shown to decrease the production of inflammatory eicosanoids, cytokines, and reactive oxygen species (ROS) in athletes who engage in high-intensity and long-duration exercise such as marathon or triathlon competitions (Mickleborough, 2013; Santos, *et al.*, 2013).

The anti-inflammatory nature of omega-3 LC PUFA has generally been attributed to the inhibitory effects of EPA on the synthesis of eicosanoids from the omega-6 LC PUFA arachidonic acid (AA; 20:4 ω -6) (Siriwardhana, *et al.*, 2012). While a number of studies have assessed the efficacy of omega-3 LC PUFA supplementation on oxidative stress, muscle damage, and inflammation during exercise, only a few have evaluated the impact of intense physical activity on WB PUFA profile without nutritional intervention. The regulation and metabolism of WB PUFA composition are not clearly understood in exercise-trained individuals, and conflicting results have been reported from several authors (Helge, *et al.*, 1999; Marini, *et al.*, 2011; Da Boit, *et al.*, 2017).

Furthermore, it is widely acknowledged that regular physical activity induces a healthy body adaptation against elevated levels of oxidative stress and inflammatory mediators (Petersen and Pedersen, 2005; Gomez-Cabrera, *et al.*, 2008). There is increasing demand to assess essential FA status using

References



- Aarsetoey, H., *et al.*, Low levels of the omega-3 index are associated with sudden cardiac arrest and remain stable in survivors in the subacute phase, *Lipids* 46: 151–161, 2011, doi: 10.1007/s11745-010-3511-3.
- Abbott, S.K., *et al.*, Fatty acid composition of membrane bilayers: importance of diet polyunsaturated fat balance, *Biochim. Biophys. Acta* 1818: 1309–1317, 2012, doi: 10.1016/j.bbamem.2012.01.011.
- Araujo, P., *et al.*, Evaluation of a rapid method for the quantitative analysis of fatty acids in various matrices, *J. Chromatogr. A* 1212: 106–113, 2008, doi: 10.1016/j.chroma.2008.10.006.
- Bailey-Hall, E., *et al.*, Validation of a rapid measure of blood PUFA levels in humans, *Lipids* 43: 181–186, 2008, doi: 10.1007/s11745-007-3140-7.
- Baylin, A. and H. Campos, The use of fatty acid biomarkers to reflect dietary intake, *Curr. Opin. Lipidol.* 17: 22–27, 2006, doi: 10.1097/01.mol.0000199814.46720.83.
- Bell, J.G., *et al.*, Using a fingertip whole blood sample for rapid fatty acid measurement: method validation and correlation with erythrocyte polar lipid compositions in UK subjects, *Br. J. Nutr.* 106: 1408–1415, 2011, doi: 10.1017/S0007114511001978.
- Da Boit, M., Hunter, A. M., and Gray, S. R. (2017). Fit with good fat? The role of n-3 polyunsaturated fatty acids on exercise performance, *Metabolism* 66, 45–54. doi: 10.1016/j.metabol.2016.10.007.
- Di Marino, C., *et al.*, Effects of dried blood spot storage on lipidomic analysis, *Molecules* 23: E403, 2018, doi: 10.3390/molecules23020403.
- Fenton, J.I., *et al.*, Red blood cell PUFAs reflect the phospholipid PUFA composition of major organs, *Prostaglandins Leukot. Essent. Fatty Acids* 112: 12–23, doi: 10.1016/j.plefa.2016.06.004, 2016.
- Helge, J.W., *et al.*, Regular exercise modulates muscle membrane phospholipid profile in rats, *J. Nutr.* 129: 1636–1642, 1999, doi: 10.1093/jn/129.9.1636.
- Johnston, D.T., *et al.*, Red blood cell omega-3 fatty acid levels and neurocognitive performance in deployed US Servicemembers, *Nutr. Neurosci.* 16: 30–38, 2013, doi: 10.1179/1476830512Y.0000000025.
- Liu, G., *et al.*, A method for long-term stabilization of long-chain polyunsaturated fatty acids in dried blood spots and its clinical application, *Prostaglandins Leukot. Essent. Fatty Acids*, 91: 251–260, 2014, doi: 10.1016/j.plefa.2014.09.009.
- Marangoni, F., *et al.*, A method for the direct evaluation of the fatty acid status in a drop of blood from a fingertip in humans: applicability to nutritional and epidemiological studies, *Anal. Biochem.* 326: 267–272, 2004, doi: 10.1016/j.ab.2003.12.016.
- Marini, M., *et al.*, Aerobic training affects fatty acid composition of erythrocyte membranes, *Lipids Health Dis.* 10: 188, 2011, doi: 10.1186/1476-511X-10-188.
- Martorell, M., *et al.*, Docosahexaenoic acid supplementation promotes erythrocyte antioxidant defense and reduces protein nitrosative damage in male athletes, *Lipids* 50: 131–148, 2015, doi: 10.1007/s11745-014-3976-6.
- Mickleborough, T.D., Omega-3 polyunsaturated fatty acids in physical performance optimization, *Int. J. Sport Nutr. Exerc. Metab.* 23: 83–96, 2013.

rapid, accurate, and cost-effective methods of blood analysis. To date, a small number of studies have investigated the use of finger sticks to measure PUFA composition in a drop of WB (Marangoni, *et al.*, 2004, 2007; Bailey-Hall, *et al.*, 2008).

Despite some concerns raised about the reliability of this sample type, several methods assessing blood FA status from a finger stick sample of WB have been developed and validated in different clinical settings (Bell, *et al.*, 2011; Montgomery, *et al.*, 2013; Liu, *et al.*, 2014; Pupillo, *et al.*, 2016; Wilson and Madrigal, 2017). Furthermore, the data obtained from FA of WB are very closely correlated with those obtained by the standard method from RBC membrane.

It should be also noticed that the simplicity of the assay is particularly useful to measure the FA status of large cohorts, is minimally invasive, and easily understandable to clinicians and general public.

Despite growing interest in measuring omega-3 LC FA, since higher levels of omega-3 EPA and DHA are associated

with anti-inflammatory properties, there is a paucity of studies on athletes concerning PUFA status indicators such as omega-3 index and AA/EPA ratio. The omega-3 index, which is the sum of the two omega-3 LC FA EPA and DHA, expressed as a percent of FA in RBC, has been used in several clinical trials as a biomarker for omega-3 LC PUFA exposure. Moreover, it has also been shown to be a reliable indicator of the omega-3 LC FA status in the human body (Sands, *et al.*, 2005; Von Schacky, 2010a; Aarsetoey, *et al.*, 2011).

The AA/EPA ratio has been proposed as a biochemical marker of cardiovascular events. Recently, higher levels of AA/EPA ratio were associated with a greater risk of cardiovascular disease (CVD) as well as higher prevalence of depressive symptoms in subjects with systemic inflammation (Ninomiya, *et al.*, 2013; Takahashi, *et al.*, 2017; Shibata, *et al.*, 2018).


To date, the associations between these indicators and running performances have not been fully evaluated in runners. In particular, there are no detailed data on the dose-re-

Montgomery, P., *et al.*, Low blood long-chain omega-3 fatty acids in UK children are associated with poor cognitive performance and behavior: a cross-sectional analysis from the DOLAB study, *PLoS ONE*. 8: e66697, 2013., doi: 10.1371/journal.pone.0066697.

Nikolaidis, M.G. and V. Mougios, Effects of exercise on the fatty-acid composition of blood and tissue lipids, *Sports Med*. 34: 1051–1076, 2004, doi: 10.2165/00007256-200434150-00004.


Ninomiya, T., *et al.*, Association between ratio of serum eicosapentaenoic acid to arachidonic acid and risk of cardiovascular disease: the Hisayama study, *Atherosclerosis* 231: 261–267, 2013, doi: 10.1016/j.atherosclerosis.2013.09.023.

Petersen, A.M. and B.K. Pedersen, The anti-inflammatory effect of exercise, *J. Appl. Physiol.* (1985), 98: 1154–1162, 2005, doi: 10.1152/japplphysiol.00164.2004.

 Pupillo, D., *et al.*, Short-term stability of whole blood polyunsaturated fatty acid content on filter paper during storage at –28°C, *Lipids* 51: 193–198, 2016, doi: 10.1007/s11745-015-4111-z.

Rzehak, P., *et al.*, Evidence for an association between genetic variants of the fatty acid desaturase 1 fatty acid desaturase 2 (FADS1 FADS2) gene cluster and the fatty acid composition of erythrocyte membranes, *Br. J. Nutr.* 101: 20–26, 2009, doi: 10.1017/S0007114508992564.

Rizzo, A.M., *et al.*, A rapid method for determining arachidonic:eicosapentaenoic acid ratios in whole blood lipids: correlation with erythrocyte membrane ratios and validation in a large Italian population of various ages and pathologies, *Lipids Health Dis.* 9: 7, 2010, doi: 10.1186/1476-511X-9-7.

 Sands, S.A., *et al.*, The impact of age, body mass index, and fish intake on the EPA and DHA content of human erythrocytes, *Lipids* 40: 343–347, 2005, doi: 10.1007/s11745-006-1392-2.

Santos, V.C., *et al.*, Effects of DHA-rich fish oil supplementation on lymphocyte function before and after a marathon race, *Int. J. Sport Nutr. Exerc. Metab.* 23: 161–169, 2013.

Shibata, M., *et al.*, Association between the ratio of serum arachidonic acid to eicosapentaenoic acid and the presence of depressive symptoms in a general Japanese population: the Hisayama study, *J. Affect. Disord.* 237: 73–79, 2018, doi: 10.1016/j.jad.2018.05.004.

Siriwardhana, N., *et al.*, Health benefits of n-3 polyunsaturated fatty acids: eicosapentaenoic acid and docosahexaenoic acid, *Adv. Food Nutr. Res.* 65: 211–222, 2012, doi: 10.1016/B978-0-12-416003-3.00013-5.

Takahashi, M., *et al.*, The ratio of serum n-3 to n-6 polyunsaturated fatty acids is associated with diabetes mellitus in patients with prior myocardial infarction: a multicenter cross-sectional study, *BMC Cardiovasc. Disord.* 17: 41, 2017, doi: 10.1186/s12872-017-0479-4.

Tepsic, J., *et al.*, Plasma and erythrocyte phospholipid fatty acid profile in professional basketball and football players, *Eur. J. Appl. Physiol.* 107: 359–365, 2009, doi: 10.1007/s00421-009-1131-5.

Von Schacky, C., Omega-3 index and sudden cardiac death, *Nutrients* 2: 375–388, 2010b, doi: 10.3390/nu2030375.

Wilson, P.B. and L.A. Madrigal, Associations among omega-3 fatty acid status, anxiety, and mental toughness in female collegiate athletes, *J. Am. Coll. Nutr.* 36: 602–607, 2017, doi: 10.1080/07315724.2017.



sponse relationship between distance run per week and changes of these indices. Using a cross-sectional design, we aimed to explore whether the levels of the omega-3 index, as well as of the AA/EPA ratio, were affected by running distance in a population of non-elite athletes runners. Participant characteristics are displayed in Table 1.

Briefly, the mean age was 40.85 ± 12.17 years; 190 (73.9%) were male, 67 (26.1%) were female, and the average BMI was 21.81 ± 2.30 kg/m². The mean of weekly training kilometers (Km) and weekly running hours (h) was 50.77 ± 26.56 and 7.36 ± 4.17 , respectively. The subjects had an average activity history of 8.63 ± 8.17 years. The WB compositions of EPA, DHA, and AA are presented in Table 2. In the overall population, the mean value of omega-3 index was 3.37 ± 1.65 , whereas the mean value of AA/EPA ratio was 18.4 ± 10.24 .

Finger sticks were used to obtain dried whole blood spot samples, which were pretreated with an antioxidant blend to prevent oxidative loss of PUFA. Blood spot cards were dried at room temperature in the dark for 2 weeks and subsequently stored in a -80°C freezer until shipment. Samples were sent in batches to a clinical laboratory to quantify whole blood PUFA. For the analysis of whole blood FA, paper punches of dried blood were first transferred into reaction vials. FA methyl esters (FAME) were generated via boron trifluoride transes-

TABLE 1. Characteristics of subjects (n = 257) included in this study

	Study population
Gender (M/F)	190/67
Age (years)	40.85 ± 12.17
Weight (kg)	66.11 ± 10.75
BMI (kg/m ²)	21.81 ± 2.30
Years of experience	8.63 ± 8.17
Hours per week (h/week)	7.36 ± 4.17
Kilometers per week (km/week)	50.77 ± 26.56

M, male; F, female; BMI, body mass index.

Values are presented as mean \pm SD, except for gender.

TABLE 2. Percentage of fatty acids of interest in the whole blood of the study group

	Mean
EPA (20:5 ω -3)	0.61 ± 0.63
DHA (22:6 ω -3)	1.85 ± 0.99
AA (20:4 ω -6)	6.95 ± 1.94
omega-3 index	3.37 ± 1.65
AA/EPA	18.4 ± 10.24

EPA, eicosapentaenoic acid; DHA, docosahexaenoic acid.

ω -3, omega 3; AA, arachidonic acid.

Values are presented as mean \pm SD.

terification (12%; 45 min at 100°C), and FAME were extracted with 1 ml of hexane and analyzed by gas chromatography with a GC-2010 gas chromatograph. A known standard mixture (Supelco® FAME Mix, Supelco, Bellefonte, PA, USA) of FAME was used as a comparison to identify FA. This procedure is highly reliable to quantify whole blood FA and results in minimal PUFA degradation (Marangoni, *et al.*, 2004; Araujo, *et al.*, 2008; Johnston, *et al.*, 2013; Di Marino, *et al.*, 2018). The omega-3 index, defined as the sum of EPA and DHA content in erythrocytes as a percent of the total amount of FA, was determined. In addition, the omega-6 PUFA AA was also quantified. The AA and EPA concentrations were expressed as ratio between area under-the-curve of each selected methyl-ester peak and the sum of all measured methyl-ester peaks. We analyzed FA that were $<0.01\%$ of peaks detected.

EFFECT OF RUNNING DISTANCE ON THE OMEGA-3 INDEX

A multivariate backward stepwise analysis was performed with selected independent variables such as age, BMI, AA/EPA ratio, years of running training, weekly training frequency, and weekly running distance and using the omega-3 index as dependent variable. The multivariate regression model revealed a significant correlation between omega-3 index and Km run per week. In particular, higher weekly running distance represented the best predictor associated with

low omega-3 index ($\beta = -0.033$; 95% CI -0.039 to -0.026 ; $R^2 = 0.447$; $p < 0.0001$). Thus, compared with runners who ran less, the levels of the omega-3 index decreased with the distance run per week. No other significant associations between the omega-3 index and any of the other variables were found.

IMPACT OF RUNNING DISTANCE ON THE AA/EPA RATIO

In a multivariate model, the potential associations between the AA/EPA ratio and a set of predictor variables were investigated among the overall study group. We found no evidence of significant associations with age, gender, BMI, number of years of running, and weekly training frequency. However, we observed that higher weekly running distance was a good predictor variable associated with a significant increase of the AA/EPA ratio in this population of runners ($\beta = 0.092$; 95% CI 0.038 to 0.146 ; $R^2 = 0.320$; $p = 0.001$). The progressive increment of the AA/EPA ratio in individuals who ran greater weekly distances suggests that the metabolism of AA/EPA in WB is closely correlated with high-intensity running activity.

CORRELATIONS BETWEEN OMEGA-3 INDEX AND AA/EPA RATIO

Because the omega-3 LC FA EPA is a shared component and an essential driver of these ratio-based metrics, we were next

interested in whether omega-3 index was correlated with AA/EPA ratio. According to this analysis, the above-mentioned independent variables were included in a multivariate regression model, in which the omega-3 index as independent variable was also introduced. Statistical analysis revealed a significant inverse correlation between omega-3 index and AA/EPA ratio ($\beta = -2.614$; 95% CI -3.407 to -1.821 ; $R^2 = 0.336$; $p < 0.0001$) in the WB of the study population. The overall decrease of the omega-3 index with AA/EPA ratio increase suggests that a high level of AA/EPA ratio is associated with low omega-3 index.

Our findings suggest that distance running training and its weekly volume may negatively contribute to changes of the omega-3 index and AA/EPA ratio. Further studies with greater sample size will be required to replicate and extend these data.

Sergio Davinelli is with the Department of Medicine and Health Sciences at the University of Molise, Campobasso, Italy.

This article was originally published in Davinelli, S., G. Corbi, S. Righetti, E. Casiraghi, F. Chiappero, S. Martegani, R. Pina, I. De Vivo, A.P. Simopoulos, and G. Scapagnini, Relationship between distance run per week, omega-3 index, and arachidonic acid (AA)/eicosapentaenoic acid (EPA) ratio: an observational retrospective study in non-elite runners, Front. Physiol. 10: 487, 2019. doi: 10.3389/fphys.2019.00487, Copyright © 2019. It has been republished under a Creative Commons Attributions License (CCBY).

**The smart
new choice.**

A revolutionary roller exchange system cuts roll change time by up to 75%, fully electronic roll adjustment, automatic roll disengagement as well as new bearing temperature and belt slip sensors: The OLCC cracking mill is the smart choice for unrivaled operational efficiency and equipment availability.

Learn more at:
buhler.minneapolis@buhlergroup.com



Innovations for a **better world.**

BUHLER

The spread of African swine fever

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

Rebecca Guenard

The world's largest pork producer and consumer, China, is experiencing an epidemic of African swine fever (ASF), a highly contagious hemorrhagic viral disease that affects only pigs. During the past year, the country that produces and consumes half of the world's annual expenditure of pork has had to cull millions of infected animals (<https://tinyurl.com/y25cqhx7>). A report released in July 2019 by the US Department of Agriculture–Foreign Agriculture Service (USDA-FAS) described the epidemic as a dire animal health crisis (<https://tinyurl.com/yyvmeyxx>).

Fallout from China's crisis is affecting feed manufacturers and influencing trade agreements between China and the United States. These overlapping issues have turned a situation that should be advantageous for US pork producers into an environment of economic uncertainty. Though the potential exists for trade disputes to be resolved, a lack of transparency regarding the extent of swine fever in China is causing anxiety across the industry. Pork prices are rising in response to lowering supply, prompting US regulators to fear that some Chinese farmers could be tempted to resupply their herds and risk resurgence of the disease.

China first reported an outbreak of ASF in August 2018. Since then, Mongolia, Vietnam, Hong Kong, Cambodia, Laos, and North Korea have all documented pigs dying from the disease. Dead pigs with the virus have washed up on the shores of Taiwanese-controlled islands. And Australia has lost livestock that are believed to have contracted ASF from the clothes of travelers from China (<https://tinyurl.com/yytjtnr5>).

ASF is an illness caused by a robust virus that survives in the environment for a long time (Penrith, M.L., 2009). There is currently no vaccine for the disease that causes nearly 100% mortality from a hemorrhagic fever. Scientists believe ASF evolved in southern and eastern Africa from warthogs. Warthog burrows are infested with ticks that feed on the animals' blood. Ticks can maintain and transmit the virus for several years and are likely the source of the disease among domestic pigs. In the 18 months since an ASF outbreak spread in China, the country has lost 21% of its herd.



The question that now concerns the international agricultural community is: Will China be able to get African swine fever under control? The disease has affected domestic feed production in China and adds to lower exports of feed from the United States, which has already seen an initial reduc-

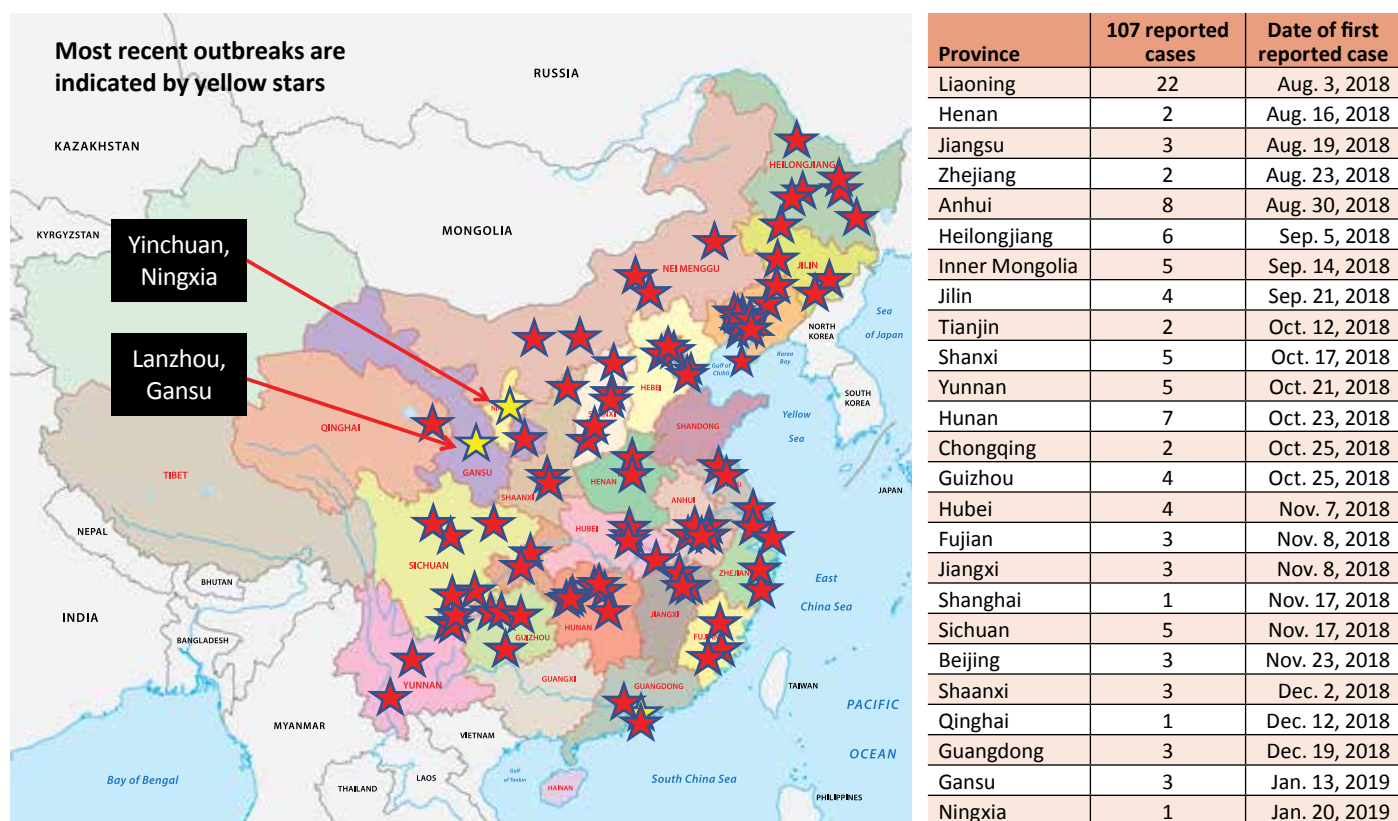



FIG. 1. A map of AFS outbreaks across China from August 2018–January 2019. Dr. Chris Rademacher - ISU Extension - IPIC

tion due to tariffs. The disruption of pork production in China has shifted the typical flow of animal protein worldwide, and experts say recovery will not occur for five to 10 years, depending on the extent of the problem in China.

The report by the USDA-FAS expresses concern that China will simply become accustomed to maintaining a pork industry that exists despite the disease, instead of taking the necessary steps to eradicate it. Several agencies have expressed concern that China is not releasing an accurate account of the disease throughout the country. Vietnam reports culling 3 million animals since ASF was confirmed in the beginning of 2019. China's herd is 10 times the size of Vietnam's, yet according

to figures given to the United Nation's Food and Agriculture Organization, they have exterminated only a small fraction of their herd.

In the summer of 2019, the Chinese Ministry of Agriculture and Rural Affairs (MARA) reported to the World Organization for Animal Health (OIE) that all the outbreaks in the country had been contained and no secondary outbreaks have occurred. But the lack of an epidemiological investigation or an effort to seek linkage information about how the disease may have spread concerns US officials. MARA continues to claim that ASF is under control, and that the number of outbreaks has decreased since its last report. "Absent significant policy




EST. 1939

Kumar Metal Industries Pvt. Ltd (Est. 1939)

In joint venture with Crown Iron Works USA Leaders in Seed Processing Technology






EXPORTER & MANUFACTURERS OF TURNKEY PROJECTS FOR OIL MILL, SOLVENT EXTRACTION & EDIBLE OIL REFINERY PLANT



CROWN

EST. 1978

Kumar has grown over generations by developing and establishing facilities & infrastructure for designing, Engineering, Manufacturing, project management, site Installation & commissioning. We have presence in more than 38 Countries with around 500 Installations located across Asia, Africa, Europe, Australia, the Americas, New Zealand and Pacific Island countries. Kumar has a dedicated state of art manufacturing facilities to produce quality products.

Office & Works1- Plot No. 7 Mira Co-op. Ind. Est. Mumbai – India, Ph. +91-22-28459100/8300. Factory: Manor, Dist –Palghar

Email: info@kumarmetal.com website: www.kumarmetal.com

changes by the Chinese Government, or the development of an effective vaccine, ASF could continue to circulate uncontrolled throughout China," the USDA-FAS report says.

Government agencies are not the only ones suspecting that it will take a long time before the current ASF epidemic is resolved. The disease is affecting companies like Cargill, Inc., which announced in July 2019, that it has closed its animal-feed mills in China. "This is not a six-month trend for China to recover," Chuck Warta, president of Cargill's animal nutrition and pre-mix business, said in an interview with Reuters (<https://tinyurl.com/y268wdy7>). "This is a 24-month, 36-month kind of resetting of the world's population of animals." Warta added that most of the Chinese mills will not re-open even if the country gets ASF under control.

The timing of the illness should be an advantage for US pork producers; however, trade conflicts between China and the United States mean that exports of pork incur a significant tariff. In the summer of 2018, US President Trump announced that he would impose \$50 billion in tariffs on imported Chinese products. The Chinese Department of Commerce responded by enacting \$50 billion in tariffs on a range of US products. In the year since, President Trump has added an additional \$200 billion in Chinese tariffs.

In an August 2019 interview with the website Food Ingredients First, a US National Pork Producers Council (NPPC) spokesperson said, "Were it not for the current trade dispute,

US pork producers would face an unprecedented sales opportunity in China as the world's largest pork-consuming nation contends with African swine fever and a major reduction in domestic production." The spokesperson explained that pork exports to China are tariffed at a 62% rate with China, which announced that an additional 10% percent increase is imminent. "To date, the dispute with China has cost US pork producers \$8 per hog, or \$1 billion on an annualized basis," says the NPPC spokesperson.

Recently settled trade agreements with other countries should provide US pork producers some relief. The United States has extracted itself from a trade agreement involving the EU which resulted in a 35% cut in pork exports to Japan in 2019. During the G7 summit held in France during the summer of 2019, Japan and the United States announced they had established a trade agreement that would reduce tariffs on pork (<https://tinyurl.com/y4noz3tx>). Exporting pork to Japan should compensate for the losses US producers suffered in Chinese trade.

By the end of September 2019, South Korea reported its first cases of the disease. The country reported killing thousands of pigs that are believed to have contracted ASF from five dead pigs found on a farm near the North Korean border. If the disease continues to spread to more Asian countries, pork consumption is likely to decrease—as has been the trend in China. Animal proteins like poultry and beef are becoming more popular in the wake of the ASF outbreak. However, Chinese New Year in January 2020, will likely bring an increase in demand for pork.

The USDA recently updated their rules on swine slaughter inspection for the first time in 50 years. The agency stated that the update is intended to eliminate some outdated procedures, but also to modernize the detection of pathogens and reduce the spread of disease. So far there have been no reports of ASF in the United States. The European Union has documented the illness in 10 countries, mostly in Eastern Europe where the disease spread from Russia (<https://tinyurl.com/yyfmm2lz>). Most outbreaks in the European Union have been contained, but ASF is still present among wild boar.

Commercial feed is a primary area of concern that the USDA describes as a blind spot in countries like China. ASF can spread to pigs through contaminated feed. "Corn and other feed grains are commonly dried on roadsides, which are also traversed by trucks carrying hogs," says the USDA-FAS report. The American Feed Industry Association released new biosecurity guidelines specifically for feed manufacturers to prevent contamination being spread through feed products in the United States (<https://tinyurl.com/y3o5yh2h>).

Despite international efforts over the past year, the spread of ASF has not been brought under control. Some reports express concern that it could take a decade to quell the current outbreak. Other analysts question if it is possible for China to ever fully recover. By the end of 2019, China will have lost half of its herd to ASF, that is a quarter of the world's pigs.

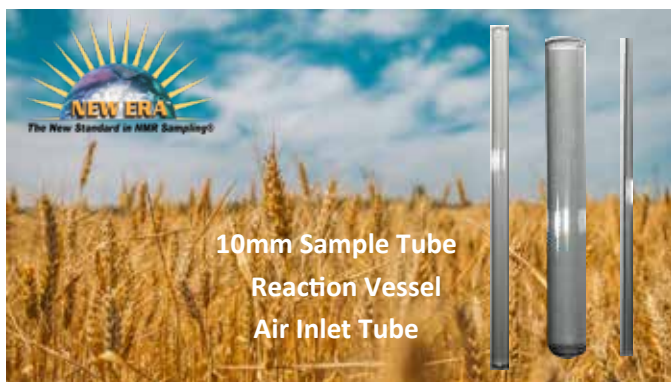
10mm OD TD Sample Tubes

10mm x 180mm, round or flat bottom, 220 tubes / pack

Reaction Vessels 24mm x 150mm long, 100 tubes /pack

Air Inlet Tube 4mm x 148mm long, 100 tubes / pack

**For Food Science, Medical, Polymer, Pharmaceutical,
Biodiesel applications and more**



New Era Enterprises, Inc.

cs@newera-spectro.com www.newera-spectro.com

Quality and value you can rely on!®

Olio is produced by Inform's associate editor, Rebecca Guenard. She can be contacted at rebecca.guenard@aocs.org.

China's evolving chemical regulatory regime: implications for businesses

Regulatory Review is a regular column featuring updates on regulatory matters concerning oils- and fats-related industries.

Tommy Beaudreau, Paul Davies, Andrew Westgate, and Stijn van Osch

Throughout 2019, China has been working to update its chemical regulatory regime, proposing far-reaching changes that would make China's regime resemble EU-REACH and TSCA in the United States.

In January 2019, China's Ministry of Ecology and Environment (MEE) published a Draft Regulation on the Environmental Risk Assessment and Control of Chemical Substances (Draft Regulation), a broad chemical regulatory proposal that has been dubbed "China-REACH" by some commentators. Then in July 2019, MEE proposed significant (some say dramatic) revisions to the current chemical regulation, the Measures for Environmental Administration of New Chemical Substances (MEP Order 7).

Although neither of these proposals has yet been finalized, they indicate the Chinese government's intent to more strictly regulate chemicals, especially those that pose the most significant environmental and health risks. Chemical companies that do business in China should continue to keep close track of these regulations, as they will have significant implications once finalized.

PROPOSED AMENDMENTS TO MEP ORDER 7—THE NEW CHEMICAL SUBSTANCES REGIME

MEP Order 7 is a ministerial order that was issued in January 2010. Although it too has been called China-REACH, it is significantly different. Most importantly, MEP Order 7 only regulates new substances and does not regulate existing chemicals. To comply with MEP Order 7, companies must submit new substance notifications to the Solid Waste and Chemicals Management Centre (which is part of MEE) if they wish to manufacture, import, or process chemical substances that are not on the Inventory of Existing Chemical Substances in China



(IECSC), or wish to use an existing chemical for a new use. (The remainder of this article refers only to "manufacturing" for ease of reading but includes all the covered activities.)

MEE released a significant amendment proposal to MEP Order 7 on July 9, 2019, with comments due August 16, 2019. The proposal's revisions, which MEE had been working on since late 2018, closely align with the new chemical substance (NCS) provisions of the January 2019 Draft Regulation. This alignment indicates that MEE prepared the revisions with the Draft Regulation in mind, and that the Chinese authorities are moving forward with the comprehensive reform envisioned in the Draft Regulation.

REGISTRATION PROCESS

The MEP Order 7 amendments would start the transition of the NCS regime, while streamlining the NCS notification and registration process. For example, proposed changes to the registration process would:

- Consolidate the various registration requirements for substances manufactured at a rate of over 10 tons per year ("tpy") into a single "regular registration" process, while providing a "simplified" registration process for substances between 1 tpy and 10 tpy;

- Require only a “record” notification for substances under 1 tpy, as well as certain polymers; and
- Exempt R&D chemicals in volumes up to 100 kg from the regulation entirely, contrary to previous rules which required record-keeping.

These changes broadly correspond to Articles 24, 27, and 43 of the Draft Regulation, which provide for a low-volume record notification and R&D exemption. The Draft Regulation does not provide for a simplified registration process. However, to ensure consistency with the MEP Order 7 amendments, the State Council may include such a process in the final version.

ENVIRONMENTAL PROVISIONS

MEE’s proposed amendments to MEP Order 7 focus on environmental risks from substances that are persistent, bio-accumulative, or toxic (PBT), or very persistent and very bio-accumulative (vPvB). Regardless of the type of registration required, companies will have to submit information on whether a new substance is PBT or vPvB. If the chemical is PBT/vPvB, only the regular registration process can be used, and the submitter must include a socioeconomic analysis to demonstrate the necessity of allowing the chemical’s manufacture.

Approval will depend on whether any risks found can be adequately controlled. Approval may be limited to specific uses, and registration can be denied if the substance poses uncontrollable, unreasonable risks. These proposed changes are in line with the Draft Regulation, which strongly focuses on determining and regulating the environmental and health risks of chemicals. For example, Article 25 of the Draft Regulation would allow authorities to impose strict risk-control measures on new substances, similar to the proposed MEP Order 7 amendments.

REPORTING AND ADMINISTRATIVE PROVISIONS

MEE’s proposed amendments to MEP Order 7 would make some changes to current reporting and administrative provisions. For example, substances would be added to the IECSC 5 years after their first registration, rather than 5 years after they are first manufactured. This proposed change corresponds to Article 26 of the Draft Regulation.

Moreover, annual reports would no longer be required after a first activity report was filed, unless the Chinese government specifically requested such reports for a substance. Article 13 of the Draft Regulation, by contrast, provides for annual reporting for existing substances. Thus, the proposed amendments may reflect a potential change in approach, including a recognition of the significant burden that annual reporting would impose, as business comments on the Draft Regulation had noted. Additionally, the proposed amendments may signal an intent to reduce burdens on manufacturers of low-risk chemicals.

CONFIDENTIAL BUSINESS INFORMATION PROVISIONS

Finally, as will be discussed further, MEE significantly weakened MEP Order 7’s confidential business information (CBI) provi-

sions. Companies would be required to substantiate the need for CBI protection by providing relevant documentation, and the period of protection would be limited to 5 years—a short period compared to regimes like TSCA or EU-REACH, which provide longer protection as well as the potential for extension. Moreover, no protection would be provided for health and safety data. Article 28 of the Draft Regulation similarly requires CBI substantiation, although it does not provide a specific duration.

Many of the proposed changes to the NCS are analogous to aspects of the US and EU regimes. For example, proposed use restrictions for new chemicals under the NCS are similar to significant new use rules (Snurs) under TSCA. Although certain features of the proposed regime will be familiar to businesses, some significant differences remain, (e.g., on CBI), and thus businesses registering new chemicals in China will need to keep a close eye on these changes.

HOW THE PROPOSED AMENDMENTS MAY IMPACT THE DRAFT REGULATION

The alignment of MEP Order 7’s proposed amendments with provisions of the Draft Regulation indicates that China is moving ahead in updating its chemical regulatory regime as proposed in January. Although the MEP Order 7 changes are significant, the Draft Regulation will have a far greater reach because it covers existing chemicals in addition to new ones. The potential impact of the proposed chemical regulatory regime has been widely analyzed this year, including on *Chemical Watch* and by Latham & Watkins, which has worked extensively with US businesses to comment on the Draft Regulation.

For existing chemicals, similar to MEP Order 7’s proposed amendments, the Draft Regulation focuses on the control of environmental and health risks of substances of concern such as PBT/vPvB substances. The proposed risk-evaluation and risk-control mechanisms have similar features to those of EU-REACH and TSCA, with which businesses are already familiar. The Draft Regulation (Articles 12-16) envisions a system of nationwide information gathering and risk assessments for existing substances, which would have a major impact on chemical companies operating in China.

Chinese regulators would collect information and data to create a priority list of chemicals that are PBT, vPvB, or otherwise pose a significant risk to human health or the environment. There is no REACH-like registration requirement obligating companies to create a dossier of studies and data, but Chinese regulators would appear to have the authority to require businesses to submit such data. This process looks akin to the US EPA’s efforts under TSCA, such as the 2014 TSCA Work Plan and the prioritization process required by the 2016 TSCA amendments.

For chemicals on the priority list, the Chinese regulators would monitor the substance in the environment and create risk assessments. Once a substance is prioritized, companies would be required to submit available data, including physical chemistry, health studies, and ecological toxicology, which the Chinese regulators would use in the risk assessment.

Following the risk assessment, the Chinese regulators would take measures to reduce any risks that are found through the risk-assessment process. Such measures can be taken under other laws—e.g., China’s air and water pollution control laws—but the Draft Regulation would also allow for the restriction or prohibition of chemicals following their inclusion on restricted/prohibited substance lists (Articles 17-22).

The information gathering, evaluation, and restriction aspect of the Draft Regulation will likely look familiar to US and EU companies. For example, TSCA’s prioritization process and REACH’s community rolling action plan (Corap) process already prioritize chemicals of concern for potential restrictions. Risk-management measures under the Draft Regulation are also similar to those found under TSCA (e.g., Section 5 rules) and REACH (e.g., the authorization listing process). Thus, China likely will look to existing efforts by the EPA and Echa to help inform its efforts following the anticipated changes to its chemical regulatory program.

BUSINESS IMPLICATIONS FOR FOREIGN CHEMICAL COMPANIES

MEE’s proposed amendments to MEP Order 7, especially when compared with the Draft Regulation, signals that China intends to continue to move in the same general direction as the TSCA and REACH regimes. The NCS likely will become relatively settled following adoption of the MEP Order 7 amendments. Assuming finalization of the Draft Regulation, the entire Chinese chemical regime will be significantly changed.

Chemical companies doing business in China can use familiar strategies to anticipate and adapt to these changes once they occur. Given that prioritization processes have already been taking place for years in the United States (e.g., the 2014 TSCA Work Plan) and the European Union (e.g., SVHC listings started in 2008), using the outcomes of processes such as TSCA prioritization, CoRAP evaluations, and SVHC listings as a crystal ball may help predict which substances Chinese authorities may prioritize. REACH registration dossiers likely already contain information that companies may be required to submit in China for prioritized existing chemicals. Companies may be able to form REACH-like consortia to share compliance costs and to coordinate data access and compensation, should that become necessary.

MEP ORDER 7: WEAKENING OF CBI

The proposed Chinese chemical regulatory regime presents certain notable concerns. A significant issue is that CBI protection under the MEP Order 7 proposal would be significantly weakened. Although the proposal shares some features with other regimes—for example, the amended TSCA also does not protect health and safety studies from disclosure, and requires substantiation of CBI claims—the proposed five-year time limit for CBI is comparatively very short.

Even under the TSCA amendments, which significantly curtailed CBI protection and continue to cause controversy over CBI, protection lasts for 10 years and can be

renewed. In contrast, MEE’s proposed amendments to MEP Order 7 do not contain a renewal provision. To emphasize the importance of providing sufficient protection of sensitive information, companies may want to engage on the proposed amendments.

DRAFT REGULATION: EXPANSIVE LIABILITY PROVISIONS

The Draft Regulation includes broad liability provisions for companies. In addition to penalties for violations (such as importing a prohibited substance or failure to provide required information), the proposed law has a broad “public interest litigation” provision that allows any agency or organization to file a lawsuit if the production or import of a chemical substance “injures social public interest.”

The inclusion of specific authorization for public interest litigation is consistent with many recent Chinese environmental statutes (e.g., the Environmental Protection Law and the Soil Pollution Law). Moreover, the Draft Regulation explicitly imposes tort liability on “responsible parties” for any environmental pollution caused by the production, processing, use, import, or export of chemicals. Depending on how aggressively these provisions are implemented, companies may face significant liability, including liability for the manifestation of risks that were not known at the time of production of the chemical.

BUSINESSES CAN, AND SHOULD, STAY ENGAGED

Although the Draft Regulation and the MEP Order 7 proposed amendments set forth general rules, the relevant Chinese agencies will have authority to create implementing regulations. Depending on how the Chinese regulators decide to implement these laws, compliance could become significantly more complicated and expensive.

Companies likely will have the opportunity to provide comments and engage with Chinese authorities. One potential forum through which businesses can engage is the China International Business Dialogue on Environmental Governance (CIBDEG), which has been active in China’s chemical regulatory reform.

Meanwhile, businesses should continue to closely review the draft chemical regulations that are likely forthcoming over the next few years as China continues to develop its chemical regulatory regime.

Tommy Beaudreau and Paul Davies are partners, and Andrew Westgate and Stijn van Osch are associates at Latham & Watkins LLP, a global law firm with more than 2,700 lawyers in its offices located in Asia, Europe, the Middle East and the United States.

©2019. Text reproduced and modified from Chemical Watch by permission of CW Research Ltd. www.chemicalwatch.com.

Argentina strikes deal to export soy meal to China

Leslie Kleiner



After 20 years in the making, a historical agreement between Argentina and China was finally reached, enabling US\$1,600 million worth of soy meal business. The following information, in Q&A format, was extracted from *La Nación*, the local Argentinean newspaper.

Q: What does this agreement mean to Argentina?

The newly signed agreement allows Argentina to sell soy meal to China. This is an additional boost for Argentina's sales, since before the agreement was reached, Argentina was only selling soybean grain and soybean oil to China. China, which is the main global producer of soy meal, imports ~ 84 million metric tons (MMT) of grain, of which 73.2 MMT are milled to produce meal. China also uses 71 MMT of soy meal for animal feed (mostly pork and bovines) [1].

Q: Does Argentina export soy meal to countries other than China?

Argentina is the largest global exporter of soy meal, according to the Rosario, Santa Fe, Exchange Market in Argentina. The expectation is that Argentina will export 5 MMT tons to China, amounting to US\$1,600 million. Argentina also exports 60% of its exports to Asia (mostly Vietnam). Less than 40% of its exports to Europe, and there are also other buyers in North Africa [1].

Q: Did the uncertainty about tariffs between the United States and China have a role in the signing of this agreement?

The USA-China trade war may have increased the need for China to diversify its suppliers and, while doing so, to re-evaluate

Latin America Update is a regular Inform column that features information about fats, oils, and related materials in that region.

how much product to purchase as grain versus meal. This is despite China having a large internal infrastructure for milling, and despite having a high rate of porcine mortality due to African swine fever (see article on page 26). In addition, Argentina has built a deep relationship with China, and China is now the main commercial partner after the European Union [1].

Q: Is there going to be an auditing process prior to the first shipment?

Argentina is very proud of its soy meal, which is its main export. In an expression of trust, China will be performing an audit 24 months after the first shipment of soy meal. However, in August 2018, China's Department of Animal and Vegetable Customs Administration (as it translates from the Spanish description of the agency) audited the Senasa (Servicio Nacional de Sanidad y Calidad Agroalimentaria, Argentinean National Service of Agricultural Sanitation and Quality) as well as seven processing plants in the provinces of Santa Fé and Buenos Aires. It is worth noting that 80% of the soy meal is produced in Santa Fe province [1].

Q: When will the exports start?

It is expected that by January or February of 2020 there should be a final approval of the products and production plants involved in the process, and this would determine the contents of the first shipment. China and Argentina need

References

- [1] <https://www.lanacion.com.ar/economia/campo/la-argentina-podra-exportar-harina-soja-china-nid2286384>
- [2] <https://www.lanacion.com.ar/economia/campo/acuerdo-china-envian-156-bolsas-harina-soja-nid2286798>

to determine mutually satisfying requirements for transgenic materials. As of mid-September, 26, companies have shipped 156 bags of soy meal to China for quality testing at Chinese laboratories. Both countries agree that the process is not immediate, but it enables new opportunities for both parties and establishes a trustworthy between both countries [2].

Latin America Update is produced by Leslie Kleiner, a senior research scientist and contributing editor of *Inform*.



World Congress on Oils & Fats & ISF Lectureship Series in 2020

9-12 February 2020 | International Convention Centre | Sydney Australia

REGISTRATION NOW OPEN!

See you in
Sydney 2020!

Register online and view the Program at
wcfsydney2020.com

Learn. Connect. Collaborate.

Join professionals and researchers from all over the world to build connections, share scientific insights and explore the latest developments in oils, fats, proteins, surfactants and related materials. **Registration opens November 15!**



Analytical | Biotechnology | Edible Applications Technology
Health and Nutrition | Industrial Oil Products
Lipid Oxidation and Quality | Phospholipid | Processing
Protein and Co-Products | Surfactants and Detergents

Register today: annualmeeting.aocs.org/INFORM

2020
April 26–29



AOCS Annual Meeting & Expo

Montréal, Québec, Canada | Palais des Congrès de Montréal

A passion for learning

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



Many people, upon retirement, want nothing to do with either their former job or anything remotely resembling work ... which makes Paul Sharko both an exceptional employee and an outstanding AOCS volunteer.

He was still serving as a senior surfactants specialist for Shell Global Solutions well into April 2019, even though he had been scheduled for retirement at the end of March. "I'm supposed to be out of here already," he commented at the time. "But I've stayed on to ensure a smooth transition."

Sharko's heightened sense of responsibility also extends to his work as an associate editor of AOCS' *Journal of Surfactants and Detergents*, a volunteer position he has held since 2017, and one that he is the first to admit takes time to do well. "I personally feel that to do this job right you have to dig in deeply to the science," he says, adding that he would like to continue his editing role in retirement. While he was still employed, his editing work kept him technically sharp, he notes. "It's been interesting to read up on technologies that are well-known to colleagues but nothing I've encountered before. It opens you up technically to new areas. This is an advantage because all knowledge intrinsically has value," he suggests.

Sharko grows serious as he discusses the importance of the S&D Division to his former industry. "The Division is one of the few organizations that offers a place for both industrial and academic professionals to get together on an equal footing. It

Fast facts

Name	Paul Sharko
Joined AOCS	2009
Education	Ph.D., physical chemistry, University of Illinois (1980)
Job title	Senior surfactants specialist
Employer	Shell Global Solutions (US) Inc.
Role in AOCS	Associate editor, <i>Journal of Surfactants and Detergents</i>
High-fat Indulgence	Chocolate ice cream with nuts on top (pecans or wet walnuts)
Favorite Social Media	Yammer (a social networking service used for private communication within organizations)
Most memorable AOCS experience	A Surfactants and Detergents Division social hour for which a young marketing colleague was making a presentation. She was nervous; Division members rallied around her, providing a heartwarming level of support.
Other involvement	Surfactants and Detergents (S&D) Division member, technical session chair

is great to meet with academics to learn about cutting-edge research in a setting where we can let our hair down and talk about the things that are important to us and to the technology moving forward."

In recognition of his support and volunteer efforts, Sharko was the 2018–2019 recipient of the Surfactants and Detergents Division Distinguished Service Award. This award recognizes "outstanding and commendable service" to the surfactants, detergents, and soaps industries.

"I treasure the opportunities I've had," he concludes, "and I hope to find a way to continue my volunteer work with AOCS in retirement."

PATENTS

Enzyme detection device

Davis, P., *et al.*, Mologic Ltd., US10234457, March 19, 2019

Described herein is an enzyme detection device for use in the detection of enzyme activity in a test sample. Also provided are indicator molecules for use in the detection of enzyme activity, particularly enzyme cleavage activity, in a test sample, and to methods for detecting the presence of enzyme activity.

Composition and method of using the same

Rath, M.W., *et al.*, US10238619, March 26, 2019

A composition of a fatty acids, essential oils, plant extracts, phenols, and terpenoids and used for treating Lyme disease is disclosed. Compositions as a mix of ingredients was tested in various combinations and concentration against active (spirochetes), as well as persistent/latent forms, (knob-shaped/rounded-forms) and biofilm of the bacteria, i.e., *Borrelia burgdorferi* and *Borrelia garinii*. The results document pleiotropic effects of the tested combinations against all tested forms of *Borrelia* sp. and show their better efficacy than doxycycline—the current antibiotic treatment against Lyme disease.

Method for producing high-purity omega-3 fatty acid ethyl ester

Shimizu, Y., *et al.*, Bizen Chemical Co., Ltd., US10240172, March 26, 2019

The present invention relates to the field of methods for purifying fatty acid ethyl esters. According to the present invention, a method for obtaining an omega-3 fatty acid ethyl ester, such as EPA and DHA, each as a high-purity product at a high yield is provided. In the method according to the present invention, a raw material fat including EPA and DHA is treated with a lipolytic enzyme and ethyl-esterification is performed as needed; the treated substance is fractionated into a glyceride fraction and a free fatty acid fraction; a fraction comprising more EPA ester and a fraction comprising DHA ester are obtained from the respective fractions; the fraction comprising more EPA ester is purified to prepare a high-purity EPA ester; and the fraction comprising more DHA ester is purified to prepare a high-purity DHA ester.

Frying machine

Miyoshi, O., Foods Tec Ltd., US10244896, April 2, 2019

A frying machine for efficiently placing ingredients into a frying basket and removing fried food from the frying basket. Ingredients are placed into and fried food is removed from a frying basket by moving the frying basket and a frying tank cover to

above the frying tank using a first transfer mechanism, moving the frying basket and frying tank cover to a predetermined position using a second transfer mechanism, and causing the frying basket to descend to an ingredient input position or fried food output position using the first transfer mechanism. The ingredients are placed into the frying basket, and the fried food is removed from the frying basket efficiently at the ingredient input position or fried food output position separated in the horizontal direction from a position above the frying tank in a configuration equipped with the frying tank cover adapted to open and close the frying tank.

Method of treating cancer with edible-oil-derived excipients

Lele, B.S., US10245234, April 2, 2019

Present invention teaches an improved method of treating cancer comprising intravenously administering to a subject in need thereof substantially ethanol-free nanoparticles comprising an anti-cancer drug and a substantially hydroxyl free unsaturated edible oil saturated at least at one site of unsaturation by a covalently attached hydrogen atom and a covalently attached water-soluble polymer.

Plasticizer for color retention during heat aging

Mundra, M.K., *et al.*, Dow Global Technologies LLC, US10262767, April 16, 2019

The present disclosure is directed to a plasticizer, a polymeric composition containing the plasticizer, and conductors coated with the polymeric composition. The plasticizer includes a blend of an epoxidized soybean oil and a trans-esterified epoxidized fatty acid methyl ester. The transesterified epoxidized fatty acid methyl ester has an oxirane value greater than or equal to 6.8%. The plasticizer, the polymeric composition, and the coated conductor retain color during heat aging.

Acyltransferases and methods of using

Cahoon, E., *et al.*, NUtech Ventures, US10280431, May 7, 2019

Provided herein are novel acyltransferases and methods of using such novel acyltransferases in making medium-chain fatty acids.

Monoacylglycerols for use in conjunction with a lipase inhibitor and/or diets low in fat and/or calories

Cruz-Hernandez, C., *et al.*, Nestec S.A., US10285967, May 14, 2019

In an embodiment, compositions comprising monoacylglycerols (MAG), such as sn-1 MAG, are administered with a lipase inhibitor, such as tetrahydrolipstatin, and/or with a diet low in fat and/or calories. In another embodiment, compositions comprising MAG, such as sn-1 MAG, are administered concurrently with a lipase inhibitor, such as tetrahydrolipstatin, and/or with fat-soluble nutrients. The compositions and the methods of using the compo-

sitions enhance absorption of fatty acids and fat-soluble nutrients, such as fat-soluble vitamins and carotenoids, to address nutritional deficiencies due to a weight-loss diet used in association with a lipase inhibitor.

Triglyceride and use thereof

Yonejima, Y., *et al.*, Nitto Pharmaceutical Industries, Ltd. and Kyoto University, US10287234, May 14, 2019

The invention provides a HYA derivative having superior physiological functions intrinsic to HYA and permitting easy ingestion, easy handling, and use thereof. In particular, the invention relates to a triglyceride in which at least one fatty acid forming an ester bond with a hydroxy group of glycerol is 10-hydroxy-cis-12-octadecenoic acid, or an optical isomer thereof, and a composition (edible fat or oil, food, medicament, cosmetic etc.) containing same.

Enzymatic removal of steryl glycosides

Menzella, H., *et al.*, Keclon S.A., US10287521, May 14, 2019

The present invention provides compositions and methods related to the production and use of enzymes suitable for reducing the amount of steryl glycosides or saturated monoacyl glycerols in a lipid mixture.

Collector compositions and methods of using thereof

Heebner, G.W., *et al.*, Kraton Chemical, LLC, US10293345, May 21, 2019

A collector composition comprising (a) refined tall oil wherein the refined tall oil is any tall oil that has been subjected to one or more refining or processing steps that results in an increase in acid value; and (b) a fatty acid wherein the refined tall oil has an acid value of at least 90 mg KOH/g and a weight average molecular weight of at least 750 g/mol. A mineral slurry comprising (a) an ore comprising a mineral of interest; (b) a collector composition comprising (i) a refined tall oil; and (ii) a fatty acid; and (c) a liquid. A method for the beneficiation of an ore, the method comprising (a) preparing a slurry comprising the ore dispersed in a liquid; (b) contacting the slurry with a collector composition comprising a refined tall oil; and (c) recovering a beneficiated ore.

Composition comprising sophorolipid, physiologically active substance, and oil or fat, and method for producing the same

Suzuki, Y., *et al.*, Saraya Co., Ltd., US10307466, June 4, 2019

The present invention provides an orally administered composition comprising a sophorolipid, a physiologically active substance, and an oil or fat, wherein the physiologically active substance exhibits an improved bioavailability.

Lecithin and plasticizer compositions and methods

Baseeth, S., *et al.*, Archer Daniels Midland Co., US10294376, May 21, 2019

The present disclosure is directed to compositions having lecithin and plasticizer components and related methods. The disclosed compositions may also include one or more co-surfactants such as anionic surfactants and/or non-ionic surfactants.

Seed oil compositions

Makadia, V., *et al.*, Monsanto Technology LLC, US10,314,317, June 11, 2019

The present invention is directed to seed oil compositions that can be used for cooking and frying applications. These oil compositions of the present invention have advantageous stability characteristics. In some embodiments, the oil compositions have a low concentration of alpha-linolenic acid.

Powdered compositions containing an edible oil and their use in food products

van Seeventer, P.B., *et al.*, Stepan Specialty Products, LLC, US10314318, June 11, 2019

Compositions comprising: (i) from 25% to 90% by weight of an edible oil; (ii) one or more sugar alcohols; and (iii) one or more reducing sugars; wherein the oil comprises at least 20% by weight of one or more carboxylic acids containing at least 18 carbon atoms and at least 2 carbon-carbon double bonds, or an ester thereof, and the weight ratio of (ii) to (iii) is from 2:1 to 1:40, exhibit good stability and other advantages and can be used in food products.

Taste-masked oral pharmaceutical composition

Dandl, K., *et al.*, Hermes Arzneimittel GMBH, US10314801, June 11, 2019

The invention provides coated particles with a taste-masked drug substance. The particles comprise a core with the agglomerated active ingredient and a coating comprising a triglyceride and a surfactant. The particles exhibit rapid drug release and a stable release profile. Moreover, the invention provides a hot-melt coating method for manufacturing such particles, and pharmaceutical compositions comprising the particles. The method allows the coating of core particles at moderate temperatures, thereby preventing the degradation of the thermolabile active ingredient.

Patent information was compiled by Scott Bloomer, a registered US patent agent and Director, Technical Services at AOCS. Contact him at scott.bloomer@aocs.org.



Saturated fatty acids and the eats beat: an Editor-in-Chief's best dining options

Eric J. Murphy

For humans, eating is a social event. We like to eat with others, and what we eat brings a smile to our face and a sense of pleasure. But what is the impact of different dietary fatty acids on human health?

For the past five years, my research group at the University of North Dakota, USA, in collaboration with Matthew Picklo, research leader at Grand Forks Human Nutrition Center, US Department of Agriculture-Agricultural Research Service, has been addressing this question. We have examined the impact of dietary fatty acids on the elongation and desaturation of the essential fatty acids, 18:2n-6 (linolenic acid, LNA) and 18:3n-3 (alpha-linolenic acid, ALA). We found that in mice with a high-fat diet (50% fat energy), saturated fatty acids enhanced the elongation of 18:3n-3 to 20:5n-3 and to 22:6n-3 in the liver compared to mice fed an equivalent diet comprised of monounsaturated fatty acid (18:1n-9, 35% MUFA, 7% saturated fatty acid, SFA). Hence, in spite of the developed dogma that saturated fat is absolutely horrible, when we controlled for the amount of fat energy and held the ALA and LNA content constant between groups, a high-fat diet containing saturated fatty acids was more “healthy” than one comprised of an equal amount of MUFA (Picklo, M.J. and E.J. Murphy, *Lipids* 51: 537–547, 2016). Further, it appears that these mice on the high-fat diet containing a lot of saturated fatty acids (12:0, 14:0, 16:0, and 18:0), similar to a mix of coconut oil and butterfat oil, had “healthier” livers than the mice on a high-fat diet containing a high amount of 18:1n-9.

Other studies by the Picklo group and others have demonstrated that saturated fatty acids may not be as deleterious to our health as previously thought. The interplay between these fatty acids and expression of genes involved in fatty acid metabolism are just now being unraveled. Why is this important?

Well, what we eat is important to our health and well-being, but when it comes to dietary lipids, it is often the fatty acids that impart flavor and the key nutritional components needed to support health. A balanced diet is important, but



FIG. 1. Tucker Onion Burger with fries

one should not view saturated fatty acids as toxic chemicals that must be avoided since these fatty acids often give the food we eat flavor and texture that is appealing, thus pleasurable.

It should be no surprise that I like food and, more importantly, a variety of different cuisines—from what I'd call “high-brow” to the simple burger. When making dining choices, my number one rule is that not all food is created equal. This is true even for simple fare like burgers and pizza. Here are my top spots to enjoy some of the best.

BURGER



Hands down, the best burger is found in Oklahoma City, Oklahoma, a town known for its burgers. For the Murphy clan, every trip down Interstate 35 necessitates detailed planning to coordinate hunger with the hours **Tucker Onion Burgers** is

open (Fig. 1). I have not tried the Mother Tucker but usually tuck into a double onion burger with grilled onion, jalapenos, and the usual rabbit food toppings. Cooking the burgers over a bed of onions is the key, plus they cut their own fries, blanch them, and then put the blanched fries in the freezer prior to frying. Tasty for sure.

BRUNCH



Nothing is more satisfying and filling than a Sunday brunch buffet. The brunch at the **Hotel Del Coronado**, in San Diego, California, is hard to beat, but pricey. The smaller brunch at **The Orchids**, located inside the historic Hilton Cincinnati Netherland Plaza, is an outstanding display of artistically presented foods that are really good. For a cooked to order Sunday brunch in Grand Forks, North Dakota, go to **Sky's Fine Dining** for Joe's pecan caramel rolls. They are large and tasty, but he only makes 12, so check immediately on availability.

PIZZA



As beauty is in the eyes of the beholder, so is pizza. I don't like soggy pizza and certainly nothing super thick—although a good Chicago deep-dish pizza is both filling and tasty. No trip to Columbus, Ohio, is complete without a stop at **Tommy's Pizza** in Upper Arlington, Ohio, just to the west of the campus of The Ohio State University. The Murphy clan gets the same thing each time: a large pepperoni baked in the old oven for a crispier crust. The sauce is as homemade as the crust, and the cheese is Provolone. Simple, greasy, and wonderfully delicious!

FINE DINING



The Orchids, which is also a top pick for brunch, is a fancy Art Deco AAA 5-star gem of a restaurant with ambiance; they give diners a white or black napkin to match the clothes they are wearing. The price has increased over the past couple of years, but the food is worth every penny. My go-to place in New Orleans, Louisiana, is **Commander's Palace**. The entire menu is outstanding, but their bread pudding soufflé with whiskey sauce is a MUST. It needs to be ordered at the beginning of your meal, so save room. On the world scene, my number one restaurant is **Chateau Neercanne** in Maastricht, The Netherlands. This place is just outstanding, and the service is second to none. Cindy and I celebrated our 25th and my folk's 50th wedding anniversary there with a combined dinner that started with Champagne and

appetizers on the terrace overlooking a herd of cows grazing in a pasture adjacent the Jerker River. There was no children's menu, but the maître d' worked with our younger children to design a menu of lobster and filet mignon, and later they made their own desserts with the dessert chef! The entire meal lasted from about 7pm to 12:30 am. If you find yourself in Limburg, you need to go. Every trip to Helsinki, Finland, should include a stop at **Nooka**, which has the best selection of different breads I have ever found, from a fantastic rye to a lovely sweet bread, all made on site. They source locally and have a seasonal menu, plus great service and awesome chefs.

BBQ



For authentic Texas BBQ, I'm a big fan of **Southside BBQ** in Elgin, Texas. You eat at picnic tables with the locals, which is all part of the charm. As a friend from Boston noted, this is just like being in a movie set in Texas. **Montgomery Inn** is a popular institution for ribs in Cincinnati, Ohio. Order ribs, Saratoga chips, and the shrimp with the plum sauce, which also serves as a great dip for the chips. **Sky's Fine Dining**, which is also a top pick for brunch, serves the best brisket north of Oklahoma. Their wet and dry brisket is outstanding. I have eaten a ton of brisket over the years, so take my word on this one. They also have the best soups around, carefully concocted by the longtime chef, Joe. My top five: Cajun clam chowder, Japanese clam chowder, New England clam chowder, corn chowder, and bean soup.

GERMAN/DANISH



I am a bratwurst snob, so the Murphy brat vault is filled only with **Carle's** bratwurst and mettwurst from my hometown, Bucyrus, Ohio. These delectable sausages are prepared by first boiling them in beer, then grilling them to a fine golden brown. They are generally accompanied by Cindy's hot German potato salad and her incredible caramelized red cabbage. I'll put her German meatballs and Spätzle against anyone's. But, if you're in Winnipeg, Manitoba, Canada, the desserts at **Café Dansk** are top-notch, the mushrooms to die for, and the Schnitzel is second to none. **Haus Murphy** in Glendale, Arizona, makes a great sauerkraut cake. Yes, it sounds horrible, but it is moist, full of chocolate flavor, and really doesn't taste much like sauerkraut. They also serve traditional and well-prepared German food and have a great selection of authentic German beers.

Eric J. Murphy is Editor-in-Chief of Lipids, and a tenured associate professor in the Department of Pharmacology, Physiology, and Therapeutics at the University of North Dakota, USA. He can be contacted at eric.murphy@med.und.edu.

EXTRACTS & DISTILLATES

The full version of all AOCS journal articles are available online to members at www.aocs.org/journal. This column builds on that member benefit by primarily highlighting articles from other journals.

ANA Analytical	BIO Biotechnology
EAT Edible Applications	LOQ Lipid Oxidation and Quality
H&N Health and Nutrition	IOP Industrial Oil Products
PRO Processing	PCP Protein and Co-Products
S&D Surfactants and Detergents	

Review Articles

ANA **H&N** Chemical composition and health effects of maca (*Lepidium meyenii*)

Wang, S. and F. Zhu, *Food Chem.* 288: 422–443, 2019, <https://doi.org/10.1016/j.foodchem.2019.02.071>.

Maca (*Lepidium meyenii* Walpers) has emerged as a popular functional plant food due to claimed health benefits. This review details the major and minor constituents of the plant's root and aerial parts. Its diverse health effects are also summarized. Various bioactivities include enhanced reproductive health, antifatigue, antioxidation, neuroprotection, antimicrobial activity, anticancer, hepatoprotection, immunomodulation, and skin health and digestive system function improvement. Plant genetics, botanical parts, processing, extraction, and experimental protocols represent the major factors affecting the chemical composition, physicochemical attributes, and health effects of maca-based products. However, clinical studies to support the claimed health effects of maca and related mechanisms appear to be lacking. It is suggested that such non-food uses for different parts of the maca plant could help maximize its value.

EAT Ingredient functionality during foam-type cake making: a review

Godefroidt, T., et. al. *Compr. Rev. Food Sci. F.* 18: 1550–1562, 2019, <https://doi.org/10.1111/1541-4337.12488>.

Foam-type cakes are complex food systems. Their main ingredients are wheat flour, hen eggs, sugar, leavening agent, and, in some cases, oil and/or surfactants. In contrast to the vast amount of research outcomes on the contribution of ingredients to the quality of batter-type cake systems, information on the functionality

and importance of the ingredients and their constituents in foam-type cake systems is lacking. This review defines foam-type cakes, describes how they are made, summarizes the current knowledge of factors determining their quality, and identifies the current knowledge gaps.

EAT **ANA** Rheo-NMR in food science—recent opportunities

Galvosas, P., et. al., *Magn. Reson. Chem.* 57: 757–765, 2019, <https://doi.org/10.1002/mrc.4861>.

For over 25 years, nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI) techniques have been used to study materials under mechanical deformation. Collectively, these methods are referred to as Rheo-NMR. In many cases, it provides spatially and temporally resolved maps of NMR spectra, intrinsic NMR parameters (such as relaxation times), or motion (such as diffusion or flow). Therefore, Rheo-NMR is complementary to conventional rheological measurements. This review briefly summarizes current capabilities and limitations of Rheo-NMR in the context of material science and food science in particular. It reports on recent advances, such as the incorporation of torque sensors or the implementation of large amplitude oscillatory shear, and points out future opportunities for Rheo-NMR in food science.

EAT **IOP** **PRO** Studies on factors governing quality of food emulsions

Matsumura, Yasuki, *J. Jpn. Soc. Food Sci. Technol.* 66: 271–289, 2019, <https://doi.org/10.3136/nskkk.66.271>.

Food emulsions are thermodynamically unstable systems due to destabilization processes such as flocculation, creaming, and coalescence. Thus, the maintenance of kinetic stability is critically important to obtain high-quality commercial products. Yasuki Matsumura and his team at Kyoto University have been studying the adsorption behavior and interaction at the interface of several components in oil-in-water emulsions, particularly, the two major components, i.e., proteins and low-molecular-weight surfactants (emulsifiers) to understand the factors governing quality of food emulsions. In this review, Matsumura describes the main results of their studies on food emulsions over the past 30 years. The topics are as follows: 1) the interaction of proteins and emulsifiers, particularly the displacement of proteins from the interface by emulsifiers; 2) fat crystallization as a cause of partial coalescence of oil droplets; 3) emulsion formation and stabilization by adsorption of fine particles; 4) rapid evaluation of long-term stability of emulsions.

H&N Role of food phytochemicals in the modulation of circadian clocks

Liu, F., et al., *J. Agric. Food Chem.* 67: 8735–8739, 2019, <https://doi.org/10.1021/acs.jafc.9b02263>.

Circadian rhythm is a complicated process by which biological systems maintain a balance with their environment. There is cur-

rently no effective remedy to fix the clock once it is disturbed, but a better understanding of how natural products interact with the Circadian clock is a step in the right direction.

The circadian clock is an intrinsic mechanism of biological adaptation to the cyclical changes of the environment. The circadian rhythm disorders affect the life activities of organisms. A variety of phytochemicals (e.g., polyphenols, flavonoids, alkaloids, and melatonin) reportedly can regulate the expression and rhythm of circadian clock genes and stabilize the internal environment. This perspective focuses on the relationship of circadian clock genes with oxidative stress, inflammatory response, and metabolic disorders, and emphasizes the regulation of phytochemicals on the circadian clock. Potential mechanisms and applications of supplemental phytochemicals to improve metabolic disorders and circadian rhythm disorders are also discussed.

S&D Consumer safety considerations of skin and oral microbiome perturbation

McBain, A.J., *et. al.*, *Clin. Microbiol. Rev.* 32: e00051-19, October 2019, <https://doi.org/10.1128/CMR.00051-19>.

Microbiomes associated with human skin and the oral cavities are uniquely exposed to personal care regimes. Changes in

the composition and activities of the microbial communities in these environments can be utilized to promote consumer health benefits, for example, by reducing the numbers, composition, or activities of microbes implicated in conditions such as acne, axillary odor, dandruff, and oral diseases. It is, however, important to ensure that innovative approaches for microbiome manipulation do not unsafely disrupt the microbiome or compromise health, and where major changes in the composition or activities of the microbiome may occur, these require evaluation to ensure that critical biological functions are unaffected. This article is based on a 2-day workshop held at SEAC Unilever, Sharnbrook, UK, involving 31 specialists in microbial risk assessment, skin and oral microbiome research, microbial ecology, bioinformatics, mathematical modeling, and immunology. The first day focused on understanding the potential implications of skin and oral microbiome perturbation, while approaches to characterize those perturbations were discussed during the second day. This article discusses the factors that the panel recommends be considered for personal care products that target the microbiomes of the skin and the oral cavity.

AOCS Thomas H. Smouse Memorial Fellowship

Major Contributors:

AOCS
AOCS Foundation
Archer Daniels Midland Foundation

Benefactors:

American Fats and Oils Association
Mr. and Mrs. Edward Campbell
Dr. Stephen S. Chang
Fabrica De Jabon la Corona, S.A. DE C.V.
National Institute of Oilseed Products
Mrs. Bernetta Smouse
Mrs. Elizabeth Smouse and children
Thomas, Deirdre, and Robert
Unichema North America



Call for Nominations for the 2020–2021 Academic Year

Nominations for the Smouse Fellowship must be submitted using the official application. The application is available at aocs.org/awards.

Completed applications must be returned to AOCS by **February 1, 2020**.

Do you know an exceptional graduate student?

The purpose of this graduate fellowship is to encourage and support outstanding research by recognizing a graduate student pursuing an advanced degree in a field of study consistent with the areas of interest of AOCS. Thomas Smouse was President of AOCS in 1983 and a noted industrial researcher into the flavor chemistry of fats and oils.

The award consists of a US \$10,000 Fellowship and up to US \$5,000 for travel and research related expenditures related to the student's graduate program.

Eligibility

This award is open to graduate students with a strong aptitude for research, who are scholastically outstanding, and have additional interests and involvement outside the academic discipline. *Student and major professor must be current members of AOCS to be eligible.*

For more details on eligibility requirements, please visit aocs.org/awards.



Original Articles

ANA PRO Characterization of quinoa defatted by supercritical carbon dioxide: starch enzymatic susceptibility and structural, pasting, and thermal properties

Solaesa, Á.G., *et al.*, *Food Bioprocess. Technol.* 12: 1593, 2019, <https://doi.org/10.1007/s11947-019-02329-4>.

Quinoa has recently been considered as an alternative oil-seed crop due to the quality and quantity of its lipid fraction. Supercritical fluid extraction (SFE) was used as a green process to extract quinoa oil without solvent residues. Defatted quinoa flour is a potentially valuable raw material whose performance as food ingredient needs to be established. Structural, physicochemical, pasting, and thermal properties of quinoa (cv. Titicaca) defatted by supercritical CO₂ extraction (DQ-SCCO₂) were characterized. *In vitro* starch enzymatic susceptibility was also evaluated. Full-fatted quinoa (NDQ) and quinoa defatted by hexane extraction (DQ-HX) were also evaluated in parallel. DQ-SCCO₂ showed a disrupted and microporous structure due to the pressurization/depressurization of CO₂ in SFE. However, its viscometric profile was very similar to that of NDQ, while that of DQ-HX was significantly lower. This denotes a physical/thermal modification of the flour as a result of the higher temperature applied during hexane extraction, 68°C, versus 40°C in SFE. Defatted samples showed lower pasting temperatures (4–5°C) and higher amylopectin retrogradation extent than NDQ. Quinoa showed a very high enzymatic susceptibility regardless its lipid content; 90% of the starch was hydrolyzed by digestive enzymes in 20 min in the three samples. However, defatted quinoa had lower slowly digestible starch content than NDQ, being the lowest value for DQ-SCCO₂ sample. The work confirms the feasibility of using DQ-SCCO₂ as a raw material in food applications, free of solvent residues, and with a technological quality superior to that obtained by extraction with organic solvents.

ANA S&D Combined use of streaming potential and UV/Vis to assess surface modification of fabrics via soil release polymers

Valentini, A., *et al.*, *Ind. Eng. Chem. Res.* 58: 14839–14847, 2019, <https://doi.org/10.1021/acs.iecr.9b02604>.

Polymers have become a widespread part of laundry detergent formulations because of their benefits, which are usually delivered via surface modification of fibers. Therefore, there is a growing interest in understanding their deposition on fabrics. In this work, the authors used streaming potential to assess changes in surface charge of polyester and knitted cotton after modification via soil release polymers (SRPs). Results identify a relationship

between the measured zeta potential for the modified fabrics and the charge of the polymer. The effects of parameters, such as agitation speed and bulk concentration during deposition, were investigated. Streaming potential data were then correlated to adsorption isotherms from UV absorbance data, and a Langmuir-Freundlich model was proposed to describe the isotherms for polyester. The stain removal index for some common hydrophobic stains was determined via image analysis. A link between SRP deposition efficiency and their effectiveness on greasy soil removal was observed.

ANA S&D PRO Rheo-physical characterization of microstructure and flow behavior of concentrated surfactant solutions

Caicedo-Casso, E.A., *et al.*, *Rheologica Acta* 58: 467–482, 2019, <https://doi.org/10.1007/s00397-019-01147-x>.

Processing-relevant relationships between the microstructure and flow behavior of concentrated surfactant solutions were determined by a combination of basic rheological experiments, rheo-flow velocimetry tests, and flow birefringence measurements. The most common surfactant microstructures found in liquid soaps and other consumer care products—spherical, worm-like, and hexagonally packed micelles and lamellar structures—were recreated by varying the concentration of sodium laureth sulfate in water from 20 to 70 wt% and adding salt in some cases. It was found that common features of flow curves, such as power-law shear thinning behavior, resulted from a wide variety of material responses including shear-induced wall slip in micellar samples and plug flow in lamellar samples. Knowledge of key processing-structure-property relationships for concentrated solutions will allow engineers to develop more efficient industrial workflows for the scalable manufacturing of materials and feedstocks with reduced economic and environmental costs.

ANA H&N Constituents of the edible leaves of *Melicope pteleifolia* with potential analgesic activity

Lee, B.-W., *et al.*, *J. Nat. Prod.* 82: 2201–2210, 2019, <https://doi.org/10.1021/acs.jnatprod.9b00224>.

Use of natural products in cosmetics and personal care products has increased to meet consumer demand. Many natural products also have the potential to deliver benefits for over-the-counter (OTC) indications, such as pain and fever.

Melicope pteleifolia has long been consumed as a popular vegetable and tea in Southeast Asian countries, including Malaysia and southern mainland China, and is effective in the treatment of colds and inflammation. In the search for active metabolites that can explain its traditional use as an antipyretic, six new phloroacetophenone derivatives along with seven known compounds were isolated from the leaves of *M. pteleifolia*. Their chemical structures were confirmed by extensive spectroscopic analysis including NMR, IR, ECD, and HRMS. All compounds isolated from the leaves of *M. pteleifolia* have a phloroacetophenone skeleton. Notably, one of the



Stay connected. Share your work. Grow professionally.

Renew your AOCS membership today to maintain exclusive access to the AOCS Premium Content Library on inform|connect and enjoy discounted registration for the 2020 AOCS Annual Meeting & Expo.

“The AOCS Annual Meeting provides us avenues for exploring groundbreaking research, the exchange of innovative ideas and fertile ground for professional networking.”

— Dilip K. Nakhasi, Senior Director of Research, Development & Innovation, Stratas Foods LLC

Renew your AOCS membership today.

Go to aocs.org/renew2020 to enjoy uninterrupted access to your member benefits.

**Registration
opens
November 15!**



As a member you have special savings for the 2020 AOCS Annual Meeting & Expo, April 26–29, in Montréal, Québec, Canada. Renew now and save your seat at a discounted rate.

AOCS 
Your Global Fats and Oils Connection

new compounds contains an additional cyclobutane moiety in its structure. The bioactivities of the isolated compounds were evaluated, and three compounds inhibited tumor necrosis factor- α -induced prostaglandin E2. Moreover, the major constituent, 3,5-di-C-beta-d-glucopyranosyl phloracetophenone of one compound, was found to be responsible for the antipyretic activity of *M. pteleifolia* based on *in vivo* experiments.

BIO PRO Bioprocess development for the production of novel oleogels from soybean and microbial oils

Papadaki, A., *et al.*, *Food Res. Int.*, September 14, 2019, 108684, <https://doi.org/10.1016/j.foodres.2019.108684>.

This study presents the production of novel oleogels via circular valorization of food industry side streams. Sugarcane molasses and soybean processing side streams (i.e., soybean cake) were employed as fermentation feedstocks for the production of microbial oil. Fed-batch bioreactor fermentations carried out by the oleaginous yeast *Rhodospiridium toruloides* led to the production of 36.9 g/L total dry weight with an intracellular oil content of 49.8% (w/w) and 89.4 microgram/g carotenoids. The carotenoid-rich microbial oil and soybean oil were evaluated as base oils for the production of wax-based oleogels. The wax esters, used as oleogelators, were produced via enzymatic catalysis, using microbial oil or soybean fatty acid distillate as raw materials. All oleogels presented

a gel-like behaviour ($G' > G''$). However, the highest G' was determined for the oleogel produced from soybean oil and microbial oil-wax esters, which indicated a stronger network. Thermal analysis showed that this oleogel had a melting temperature profile up to 35°C, which is favorable for applications in the confectionery industry. Also, texture analysis demonstrated that soybean oil-microbial oil wax oleogel was stable (1.9–2.2 N) within 30-days storage period. This study showed the potential of novel oleogels production through the development of bioprocesses based on the valorization of various renewable resources.

BIO PRO Achieving a high-density oleaginous yeast culture: comparison of four processing strategies using *Metschnikowia pulcherrima*

Abeln, F. and C.J. Chuck, *Biotech. Bioeng.* August 20, 2019, <https://doi.org/10.1002/bit.27141>.

Microbial lipids have the potential to displace terrestrial oils for fuel, value chemical, and food production, curbing the growth in tropical oil plantations and helping to reduce deforestation. However, commercialization remains elusive partly due to the lack of suitably robust organisms and their low lipid productivity. Extremely high cell densities in oleaginous cultures are needed to increase reaction rates, reduce reactor volume, and facilitate downstream processing. In this investigation, the oleaginous yeast

Our strength lies in our foundation—be a part of it!

The AOCS Foundation raises funds to support the development of new products and services for AOCS. Support from the Foundation is integral to the advancement and continued growth of AOCS, and donations from members such as you make all of this possible. As 2019 draws to a close and you start thinking about your year-end donations, please consider sending a gift to the AOCS Foundation. To invest in the future of our society, please send a donation today!



**AOCS
Foundation**

aocsfoundation.org | patrick.donnely@aocs.org | +1 217-693-4838

All donations made to the AOCS Foundation count towards your Century Club membership. For more information on the Century Club, or how to donate, please visit the website.



Metschnikowia pulcherrima, a known antimicrobial producer, was cultured using four different processing strategies to achieve high cell densities and gain suitable lipid productivity. In batch mode, the yeast demonstrated lipid contents more than 40% (w/w) under high osmotic pressure. In fed-batch mode, however, high-lipid titers were prevented through inhibition above 70.0 g L⁻¹ yeast biomass. Highly promising were a semi-continuous and continuous mode with cell recycle where cell densities of up to 122.6 g L⁻¹ and maximum lipid production rates of 0.37 g L⁻¹ h⁻¹ (daily average), a nearly two-fold increase from the batch, were achieved. The findings demonstrate the importance of considering multiple fermentation modes to achieve high-density oleaginous yeast cultures generally and indicate the limitations of processing these organisms under the extreme conditions necessary for economic lipid production.

BIO H&N Omics analyses of gut microbiota in a circadian rhythm disorder mouse model fed with oolong tea polyphenols

Guo, T., *et al.*, *J. Agric. Food Chem.* 67: 8847–8854, 2019, <https://doi.org/10.1021/acs.jafc.9b03000>.

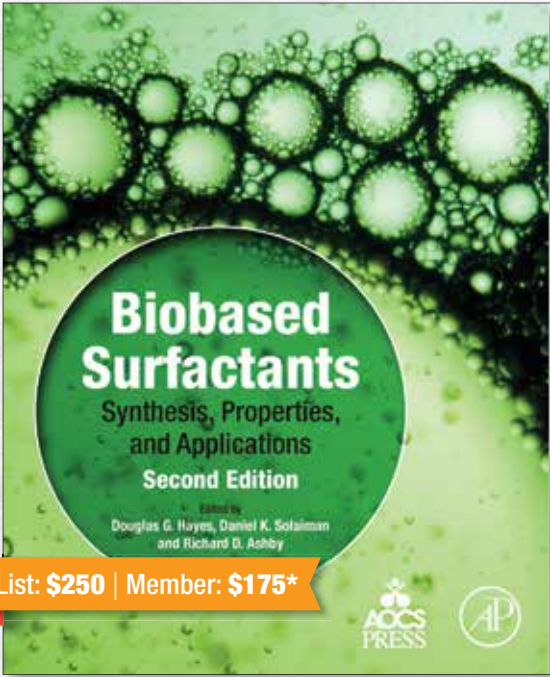
The microbiome has been revealed as a key element involved in maintaining circadian rhythms. Oolong tea polyphenols (OTP) have been shown to have potential prebiotic activity. Therefore, this study focused on the regulation mechanisms of OTP on

host circadian rhythms. After 8 weeks of OTP administration, a large expansion in the relative abundance of Bacteroidetes with a decrease in Firmicutes was observed, indicating a positive modulatory effect of OTP on gut flora. In addition, Kyoto Encyclopedia of Genes and Genomes pathways of ATP-binding cassette transporters, two-component system, and the biosynthesis of amino acids enriched the most differentially expressed genes after OTP treatment. Of the differentially expressed proteins identified, most were related to metabolism, genetic information processing, and environmental information processing. It underscores the ability of OTP to regulate circadian rhythm by enhancing beneficial intestinal microbiota and affecting metabolic pathways, thus contributing to the improvement of host microecology.

EAT LOQ Harnessing slaughterhouse by-products: from wastes to high-added-value natural food preservative

Przybylski, R., *et al.*, *Food Chem.* 304: 125448, 2020, <https://doi.org/10.1016/j.foodchem.2019.125448>.

Blood from slaughterhouses is an inevitable part of meat production, causing environmental problems due to the large volumes recovered and its low valorization. However, the alpha137–141 peptide, a natural antimicrobial peptide, can be obtained after hydrolysis of hemoglobin, the main constituent of blood red part. To recover it at sufficient concentration for antimicrobial applications, a new sustainable technology, called electrodialysis with ultrafil-



Biobased Surfactants

Synthesis, Properties, and Applications

Second Edition

Edited by Douglas G. Hayes, Daniel K. Solaiman and Richard D. Ashby

May 2019 | 512 pages | ISBN: 9780128127056
Available in softcover and eBook

Biobased Surfactants: Synthesis, Properties, and Applications, Second Edition, covers biosurfactant synthesis and applications and demonstrates how to reduce manufacturing and purification costs, impurities and by-products. Fully updated, this book covers surfactants in biomedical applications, detergents, personal care, food, pharmaceuticals, cosmetics and nanotechnology. It reflects on the latest developments in biobased surfactant science and provides case scenarios to guide readers in efficient and effective biobased surfactant application, along with strategies for research into new applications. This book is written from a biorefinery-based perspective by an international team of experts and acts as a key text for researchers and practitioners involved in the synthesis, utilization and development of biobased surfactants.

Key Features:

- Describes new and emerging biobased surfactants and their synthesis and development
- Showcases an interdisciplinary approach to the topic, featuring applications to chemistry, biotechnology, biomedicine and other areas
- Presents the entire lifecycle of biobased surfactants in detail

List: \$250 | Member: \$175*

Available for purchase at store.elsevier.com/aocs

*AOCs Members use code **AOCs30** at checkout to receive 30% discount and free shipping worldwide.

tration membrane (EDUF), was investigated. The alpha137–141 concentration was increased about 4-fold at a feed peptide concentration of 8% with an enrichment factor above 24-fold. This feed peptide concentration also needed the lowest relative energy consumption. Moreover, this peptide fraction protected meat against microbial growth, as well as rancidity, during 14 days under refrigeration. This peptide fraction was validated as a natural preservative and substitute for synthetic additives against food spoilage. Finally, producing antimicrobial/antioxidant peptide from wastes by EDUF fits perfectly with the concept of circular economy.

IOP EAT ANA Selective oil-phase rheo-MRI velocity profiles to monitor heterogeneous flow behavior of oil/water food emulsions

Serial, M.R., *et al.*, *Magn. Reson. Chem.* 57: 766–770, 2019, <https://doi.org/10.1002/mrc.4811>.

In this application note (a companion paper to Petrik Galvosas' review), the authors describe a method to acquire chemically selective oil concentration and velocity profiles of an oil/water emulsion under shear. The technique has been validated for commercial mayonnaise under constant shear rate conditions, showing a good suppression of chemical shift artifacts and quantitative assessment of local oil concentration. The method demonstrated that shear-induced migration of oil droplets can be monitored in a quantitative manner.

IOP PRO Improved transesterification conditions for production of clean fuel from municipal wastewater microalgae feedstock

Kialashaki, M., *et al.*, *J. Clean Prod.* 241: 11838, 2019, <https://doi.org/10.1016/j.jclepro.2019.118388>.

Microalgae have great potential to be used as feedstock for biofuel production. Municipal wastewater is an economically appealing culture medium to produce microalgae. Downstream processing of wastewater-adapted microalgae (i.e., transesterification of extracted lipid), needs to be investigated more due to the difference between lipid profile of pure culture microalgae and wastewater-adapted microalgae. Based on quantitative parameters of acidity, acid value, and triglyceride content it was indicated that free fatty acid and triglyceride contents of wastewater-adapted algal lipid were between the two limits (i.e., pure microalgal lipid and vegetable oil). Optimal transesterification conditions for wastewater-adapted algal lipid were investigated in terms of acid-catalyzed versus alkaline-catalyzed reactions, temperature and reaction time, and the type of catalyst. It was found that acid-catalyzed transesterification at 70°C for 35 h using sulfuric acid as the catalyst is required to achieve the highest percentage of fatty acid methyl esters of 53.9 ± 9.6% in the end product. This is quite different from reaction conditions recommended for pure microalgal lipid and vegetable oil transesterification. These operating condi-

tions resulted in a dominant fatty acid methyl ester profile of palmitic acid, stearic acid, oleic acid, linoleic acid, and linolenic acid in the product that satisfied international standards specified for biodiesel. The results of this study customizes the transesterification reaction conditions for wastewater-adapted algal lipid and is one step forward towards commercial production of clean fuel from microalgae feedstock obtained from wastewater.

LOQ EAT Characterization of bioactive compounds and antioxidant activity of fruit beers

Nardini, M. and I. Garaguso, *Food Chem.* 305: 125437, 2020, <https://doi.org/10.1016/j.foodchem.2019.125437>.

Total polyphenols and flavonoids content, phenolics profile by HPLC, and antioxidant activity of 10 fruit beers produced adding fruits during the fermentation process were analyzed. The fruits were: cherry, raspberry, peach, apricot, grape, plum, orange, and apple. Antioxidant activity, total polyphenols, and flavonoids content were considerably higher in most of the fruit beers in respect to conventional, non-fruit, beers. Cherry beers exhibited the highest values, followed by grape, plum, and orange beers. An enrichment was observed in catechin and quercetin content in all fruit beers examined. Myricetin and resveratrol were also detected in most of the fruit beers. Among phenolic acids, an enrichment in chlorogenic, neochlorogenic, p-coumaric, and caffeic acids was measured in most of the fruit beers over that of conventional beers. Our findings show that fruits addition during the fermentation process considerably increased the antioxidant activity of beer and qualitatively and quantitatively improved its phenolics profile.

LOQ EAT Effect of drying temperatures and storage on chemical and bioactive attributes of dried tomato and sweet pepper

Kaur, R., *et al.*, *LWT–Food Sci. Technol.* 117: 108604, 2020, <https://doi.org/10.1016/j.lwt.2019.108604>.

In this study tomato (Punjab Ratta) and sweet pepper (Indira) were subjected to three different drying temperatures (40, 50 and 60°C) to examine the effect of drying temperatures and storage period (180 days) on the chemical and bioactive parameters of dried tomatoes (T) and sweet peppers (SP). The drying of T and SP at 60°C results in better retention of phenolics (738.44 ± 0.10 and 593.78 ± 0.09 mg/100 g db), antioxidant activity (42.79 ± 0.11 and 27.56 ± 0.07%), and flavonoids (499.56 ± 0.04 and 286.31 ± 0.07 mg/100 g db), respectively; however, chemical parameters significantly ($p < 0.05$) decreased at 60°C except for lycopene. Better retention of color was observed in T samples dried at 60°C and SP samples dried at 40°C. Storage studies revealed that powders retained polyphenols in T (736.88 ± 0.08 mg/100 g db) and SP (591.85 ± 0.09 mg/100 g db) even after 90 days of storage that were dried at 60°C. Significant loss of chemical and bioactive constituents was observed in stored samples dried at 40°C due to high initial water activity of T (0.562 ± 0.02) and SP (0.611 ± 0.01) pow-

Thank you for supporting and partnering with AOCS



Join these
prestigious
companies
as a
Corporate
Member
today.

AOCS Corporate Members: innovators and influencers — supply chain authorities for fats, oils and surrounding markets.

Platinum

AAK
Archer Daniels Midland Co
Cargill Inc
Bunge Loders Croklaan
Louis Dreyfus Co
Novozymes
Richardson International

Gold

Artisan Industries Inc JET-VAC Technologies
Clariant (Mexico) SA de CV
Colgate-Palmolive Co
Crown Iron Works Co
Dallas Group of America Inc
Desmet Ballestra
Kao Corp
Oil-Dri Corp of America
Organic Technologies
Solex Thermal Science Inc
Stratas Foods

Silver

Aboissa Commodity Brokers
Ag Processing Inc
Alfa Laval Inc
Anderson International Corp
Arisdyne Systems Inc
Barrow-Agee Laboratories LLC
BASF Corp

Bruker Scientific, LLC
Buss ChemTech Ag
Canola Council of Canada
Catania Oils
Church & Dwight Co Inc
CI SIGRA SA
Clorox Co
Colonial Chemical Inc
Corbion
Corteva Agriscience
DuPont Nutrition & Health
EFKO
EP Minerals LLC
Eurofins
Evonik Corp - Household Care
Farmet AS
French Oil Mill Machinery Co
Hershey Co
HF Press + LipidTech
Huntsman Corp
Intertek USA Inc
Kalsec Inc
Kemin Industries Inc
KeyLeaf
LEEM Filtration
Lion Corp
Lipsa SA
Nisshin OilliO Group Ltd
Plus Group
PQ Corp
Procter & Gamble Co
Spectral Service AG
Viterra Inc
Young Living Essential Oils

Bronze

American Emu Assn
American Lecithin Co
ANKOM Technology Corp
Arkema Inc
Avanti Polar Lipids Inc
Avatar Corp
Bioriginal Food & Science Corp
Botanic Innovations LLC
Caldic Canada Inc
Canadian Food Inspection Agency
Carbon Chemistry Ltd
Caribbean Products Co Ltd
Carribex SA
Center for Testmaterials BV
Complejo Agroindustrial Angostura SA (CAIASA)
Croda Leek Ltd
Croll Reynolds Co Inc
Crystal Filtration Co
Darling Ingredients Inc
DuPont Co
DuPont Nutrition & Health
Epax Norway AS
Fuji Vegetable Oil Inc
GC Lipids, LLC
Golden Agri-Resources Ltd
Goulston Technologies
Haarslev
Hudson Tank Terminals Corp
Industrial de Oleaginosas SA de CV

Integro Foods Australia Pty Ltd
Intermed Sdn Bhd
Iranian Vegetable Oil Industry Assn
ITS Testing Services (M) Sdn Bhd
Kuala Lumpur Kepong Bhd
Larodan AB
Liberty Vegetable Oil Co
Lovibond North America
Lovibond Tintometer
Modern Olives
MSM Milling PL
Myande Group Co Ltd
Nippon Yuryo Kentei Kyokai
Nutriswiss AG
Pattyn Packing Lines NV
Peerless Holdings Pty Ltd
Perimondo LLC
Perry Videx LLC
Pompeian Inc
Puerto Rico Dept of Agriculture
Rothsay
Sanmark Ltd
SGS South Africa (Pty) Ltd
Silverson Machines Inc
Simmons Grain Co
Sunset Olive Oil LLC
Testfabrics, Inc
Thanakorn Vegetable Oil Prods Co Ltd
TMC Industries Inc
Tsuno Food Industrial Co Ltd
Wilmar International Ltd



Your Global Fats and Oils Connection

aocs.org/corporate | membership@aocs.org

ders. This study concluded that samples dried at a higher temperature (60°C) showed effective retention of the bioactive components after drying and during the storage period

LOQ EAT Effect of tomato (*Solanum lycopersicum* L.) lycopene-rich extract on the kinetics of rancidity and shelf-life of linseed (*Linum usitatissimum* L.) oil

Varas Condori, M.A., *Food Chem.* 302: 125327, 2020, <https://doi.org/10.1016/j.foodchem.2019.125327>.

The effect of tomato lycopene-rich extract (TLE) addition on shelf-life of linseed oil was evaluated. Linseed oil was extracted by cold pressing and TLE by supercritical CO₂. Linseed oils with and without TLE addition were characterized for moisture, color, refractive index, fatty acid composition, and antioxidants. Adding TLE to 80 mg lycopene/kg oil improved linseed oil stability, showing the same induction time at 110°C (by Rancimat) of control linseed oil with 200 mg/kg butylhydroxytoluene. The increase of free fatty acid, peroxide value, p-anisidine value, K232, and K268 at 40, 50, and 60°C until 90 days followed first-order kinetics. Rancidity rate augmented with temperature. TLE addition slowed oil degradation without changing the mechanism since the Arrhenius lines were parallel. Mean E_a were respectively 38.2, 24.7, 38.0, 38.2, 41.5 kJ/mol. TLE addition increased linseed oil shelf-life by 31% (Rancimat) and by 42% (stability kinetics during storage).

LOQ H&N Polyphenols from thinned young kiwifruit as natural antioxidant: protective effects on beef oxidation, physicochemical and sensory properties during storage

Jiao, Y., *et al.*, *Food Control* 108: 106870, 2020, <https://doi.org/10.1016/j.foodcont.2019.106870>.

For the first time, polyphenols extracted from deseeded thinned young kiwifruits were studied as natural antioxidant and assessed for their preservative effects on beef quality during 7 days

of refrigerated storage. Young kiwifruit polyphenols (YKP) displayed high phenolic content (0.53 g epicatechin equivalent/g) and strong antioxidant activity (0.54 g epicatechin equivalent/g) with major constituents identified as epicatechin, quercitrin, and catechin. Compared to control, epicatechin and potassium sorbate, YKP application was found to be able to inhibit TBARS and TVB-N formation, reduce fatty acid oxidation, alleviate discoloration, and stabilize textural properties of beef. At day 7, YKP-treated beef exhibited marked PUFA increment of 1.77-fold (0.88-fold in control) without significant alteration of sensory properties, evidenced by the overall sensorial score of 5.6 in YKP group and 5.1 in control. Our results provide theoretical support for the realistic application of YKP as natural replacer for synthetic preservatives in maintaining beef freshness.

PRO Quality preservation of orange concentrate by using hybrid ohmic—vacuum heating

Darvishi, H., *et al.*, *Food Chem.* 289: 292–298, 2019, <https://doi.org/10.1016/j.foodchem.2019.03.043>.

Combining hybrid ohmic and vacuum heating to preserve orange juice quality is a perfect example of using existing methods and models to design a new process that helps solve a common problem.

The effect of ohmic-vacuum heating conditions (OHVC) was evaluated on quality parameters during concentration process of orange juice and compared with ohmic heating process under atmospheric conditions (OHAC) and conventional vacuum heating (CVH). The decline of vitamin C in OHVC treatments (10–29.2%) was lower than the OHAC (18.0–38.8%) and CVH (47.4%). Changes of pH for OHVC were lower than OHAC and CVH. The difference in total phenol content of fresh and concentrated juice was 8.0–21.3% for OHVC and 18.5–42.8% for OHAC and 49.6% for CVH. Antioxidant capacity of treatments was lower than the fresh sample at same water content. Increasing of voltage gradient had a positive effect on the saving of vitamin C and total phenol and processing time. Finally, it can be resulted that the combination of vacuum treatment with ohmic heating (as hybrid ohmic-vacuum heating) could maintain food quality parameters.

Inefficiency is your enemy.



CONQUER IT.

Minimize downtime with equipment that's built to last.

Unleash the power of reliability when you partner with Crown. As the world leader in oilseed processing solutions, our equipment is backed by proven technology, superior design and more than a century of engineering expertise. Crown helps you minimize downtime and overcome inefficiencies, allowing you to consistently honor customer commitments with more confidence and control.

It's time to lead your operation into victory. Crown shows you the way.



Contact Crown today **1-651-639-8900** or visit our website at www.crowniron.com



French Achiever presses offer outstanding features and reliability for full pressing to produce full press cake and crude oil. The press design yields high quality oil and cake with residual oils among the lowest in the industry when using the single pressing process. The Model 44, 55, and 66 presses can also be supplied for prepressing oilseeds to produce prepress cake prior to solvent extraction.

Since 1900, we have supplied durable equipment and systems for most commercial food and industrial uses. Our process solutions have a worldwide reputation for years of reliable operation with low life cycle costs.

Let us be Your Partner in Processing. Contact us for more information.



French Oil Mill Machinery Co.
Piqua, Ohio, U.S.A. · 937-773-3420
www.frenchoil.com