

# 2019 CLEAN LABEL CONFERENCE

“SOPHISTICATED SOLUTIONS FOR SIMPLIFIED PRODUCTS”

## What's Inside on Clean Labels...

- Understanding the Clean Label Movement
- The Nutritional Downside to Clean Eating
- New Clean Label Emulsifier & Stabilizer Sources
- Clean Label Options for Pathogen Control
- Natural Flavor Selection in a Transparent World
- Color Impact on Flavor & Odor Perception
- Ingredient Supply-Chains & Clean Label “Musts”
- Defining Clean Label vs. Clean Eating for Marketability
- Label Claims vs. Litigation Risk
- Options for Clean Label Fats & Oils



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*hops*



*celery*

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# 2019 CLEAN LABEL CONFERENCE MAGAZINE

## *Sophisticated Solutions for Simplified Products*

Efforts to formulate packaged foods with consumer- and export-friendly ingredients continues to grow globally. Global Food Forums' 6th annual Clean Label Conference, held March 26-27, 2019, was an in-person product development event focused on providing practical, how-to formulation and other actionable advice to R&D and applied product development specialists working in this arena.

A robust audience listened to some 31 presentations and visited with a group of ingredient exhibitors who provided useful and insightful information.

Presentations and a digital copy of this magazine are available at [www.GlobalFoodForums.com/store/clean-label-conference](http://www.GlobalFoodForums.com/store/clean-label-conference). We'd love to see you at the 2020 Super Summit, beginning on March 24th with the Sweetener Systems Conference, immediately followed by the Clean Label Conference, March 25-26, at the Westin hotel, Itasca, Ill., USA.



📍 The successful Clean Label Conference will become part of 2020's Super Summit with the addition of the Sweetener Systems Conference.

CREDIT: PETER O'DONNELL, PHOTOGRAPHER, 2019 CLEAN LABEL CONFERENCE

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# The Global Food Forums Story

Welcome to the 6th post-conference magazine from our annual Clean Label Conference. When we incorporated Global Food Forums in 2012, our vision was to develop a family of in-person, niche product development conferences for the food, beverage and nutritional products industries

Each of our events, which also includes the Protein Trends & Technologies Seminars (<https://bit.ly/2xYcJgX>) and Sweetener Systems Conferences (<https://bit.ly/2LFjN3Q>), is tied to a significant, long-term consumer and industry trend in which applied food science plays a crucial role. The technology-based programs are designed to provide R&D and other food scientists with practical and impartial formulation advice, along with consumer

trend insights, emerging ingredients, nutritional and regulatory updates, and other factors impacting product formulations.

Food technologists are our core customers. All our company decisions are guided by how they impact this community's event experience. To date, our conferences have drawn more than 3,500 attendees. They range from bench-level food scientists to VP/Directors of R&D and also include those who interact with this technical community to better understand their needs, challenges and the changing business environment in which everyone must work.

We hope you'll attend some of our future events. We'll work hard to make them your best conference experiences ever!



Warm regards,  
**Peter Havens &  
Claudia O'Donnell**  
Co-owners, Global Food Forums, Inc.

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## The Clean Label Movement's Evolution Toward Sustainability

Innova's database contains 130 million records. Over 500,000 products from 90 countries are added each year. Using this tool, Mindy Hermann, MBA, RDN, Innova Market Insights, delved into the evolution of clean label, the results of which were revealed in her presentation titled "Understanding the Clean Label Movement & What it Means for the Industry."

The definition of clean label has evolved dramatically over the past several years, she said. Five years ago, organic, natural, vegan, and free-from additives and preservatives defined the category. For example, "If we look at a classic definition of clean, from 2014-2018, more than 25% of new product launches have the words 'natural,' 'organic,' 'no additives,' 'no preservatives' or 'GMO-free' on their labels."

As the classification of clean label became more well-defined, it expanded to include minimally processed, dairy alternatives, meat substitutes and sugar/salt/fat reformulations. Today, human and animal welfare, supply chain transparency, sustainably sourced and plant-based nutrition are top contenders that define this space, suggested Hermann. Ethical claims, including animal and environmental, also are rising in importance, and plant-based claims are up 68% from 2014-2018.

Six market categories accounted for greater than 50% of new food and beverage launches with clean label claims in 2018 (see chart "Categories as a % of New Clean Label F&B Launches, Global 2018"). Sauces and Seasonings is the largest of the six defined categories. Bakery followed by the Soft Drinks are the next two categories with the most claims. For example, Passage Foods' Passage to Asia Thai Basil and Sweet Chili Stir-Fry Sauce provides an insight into claims such as natural, gluten-free, BPA-free and non-GMO. "Consumers consider 'gluten-free' to be a clean claim, and 'BPA-free' is a clean claim in the environmental space," said Hermann.

The Sports Nutrition category is seeing 40% growth of clean label claims per year, 2014-2018, noted Hermann. Aside from ingredient integrity, companies are telling a relatable story. For example, Organic Valley Organic Fuel Whey Protein Powder builds a relationship with the consumer by claiming that it does not contain "unnecessary additives you can't pronounce, artificial flavorings or sweeteners, GMOs, pesticides, antibiotics or hormones."

Hermann also presented an example from the snack market. Billy Franks Hot n Spicy, British Beef Jerky's label indicated it had no artificial colorings, flavorings or preservatives. The label also claimed that the product was "air-dried grass-fed," which is "a newer clean claim," Hermann noted.



Brands are "greening up" their foods and beverages by adding plant-based ingredients to a variety of products.

Three in five consumers want to know the origin of the ingredients in products they purchase. No artificial flavors or colors; made with real ingredients; natural; and low/no/reduced sugar top the list of factors that influence purchasing decisions. And, consumers are adopting lifestyle diets, such as vegetarian/vegan, plant-based, keto, etc. But flavor is still the number one factor influencing food and beverage purchasing decisions, said Hermann.

Health is the biggest driver behind consumer purchases of alternatives to bread, meat or dairy. Research data reveals that dairy-free is growing at 18% per year, and meat substitutes are growing about 17% per year. "The plant-based marketplace shows no sign of slowing down," claimed Hermann. "Innova sees a 33% average annual growth in vegan claims from 2014-2018, and plant-based claims grew 60+% during that same time period." Brands are "greening up" their foods and beverages by adding plant-based ingredients to a variety of products, including dairy.

Animal welfare is growing in popularity, as well. Innova reports a 21% increase in annualized growth over the past five years. As an example, Prē Beef Ribeye Steaks' label claims: "Grass fed and finished. No added hormones. No added antibiotics." "Grass fed and finished" connotes a more natural and clean process.

Consumers' age comes into play when considering environmental, social and ethical factors. Regarding Gen Z, 50% are concerned about the sustainability of the planet. One in two Millennials are concerned about environmental impact. Baby Boomers (43%) feel that food waste and redistribution matter most. Gen X (58%) indicate that waste and pollution is a concern.

These trends are evidenced in Rubies in the Rubble Chipotle Mayo—a vegan product made with aquafaba, the water leftover



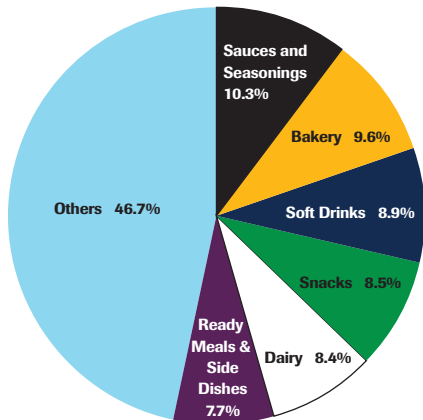
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## Categories as a % of New Clean Label F&B Launches – Global 2018



SOURCE: INNOVA MARKET INSIGHTS

Of all clean-type claims in 2018, 10.3% were on sauces and seasonings products.

from cooking chickpeas that is ordinarily waste. And Numi® Organic Tea is made with “compostable tea bags and use... post-consumer recycled packaging for improved sustainability.”

Hermann closed with these key takeaways. “Looking at growing expectations for clean label, the impact of food production on climate change is expected to drive food product development. On the consumer side, consumers expect clean labels to communicate trust, transparency and sustainability.”

*“Understanding the Clean Label Movement & What it Means for the Industry,” Mindy Hermann, MBA, RDN, Innova Market Insights*

## Do Clean Labels Have Unintended Health Consequences?

Dietary recommendations for clean eating are consumer-driven and not backed by science, according to Joanne Slavin, Ph.D., RD, Professor, Department of Food Science and Nutrition, University of Minnesota. Slavin’s presentation was titled: “Do Clean Labels Have Unintended Health Consequences?”

Clean labels are not based on decades of nutritional recommendations, which haven’t changed a great deal since first articulated in 1894 with a focus on protein and calories.

The Dietary Guidelines for Americans (DGA) have been published since 1980 and are developed by experts on the Dietary Guidelines Advisory Committees (DGAC). The U.S. Department of Health and Human Services, as well as the department of Agriculture, jointly publish the DGA every five years to provide

evidence-based recommendations to promote health, prevent chronic disease and maintain healthy weight.

The DGA are important, as they form the basis of federal nutrition policy and programs; help guide health promotion and disease prevention initiatives; and inform various organizations and industries. However, Slavin noted that some recommendations “are unrealistic, difficult to communicate to consumers and promote a ‘hit list’ of dietary components associated with disease.”

Slavin asked: “What is a clean label?” In his 2008 book *In Defense of Food*, journalist and activist Michael Pollan stated that consumers should “not eat anything with more than five ingredients or ingredients you can’t pronounce.” In 2014, one international ingredient vendor offered that “a clean label means the product can be positioned as natural, organic and/or free from additives/preservatives.” These definitions stress use of ingredients accepted by consumers. The ingredient list should be short, simple and feature minimally processed ingredients where possible.

In the pursuit of clean label, the ultra-processing of foods has been demonized by some. Ultra-processed has been defined as “made from processed substances extracted or refined from whole foods...with little or no whole foods. Products include burgers, frozen pizza and pasta dishes, nuggets and sticks, crisps, biscuits, confectionery, cereal bars, carbonated and other sugared drinks, and various snack products.” Ultra-processed foods are associated with for profit, big food and drink companies.

NOVA food classification, proposed by World Public Health Nutrition Association, is a four-tiered classification system ordered according to the extent of processing rather than nutrient content. NOVA Category 4, ultra-processed foods, includes industrial formulations with many ingredients, usually.

“Although public health advice of NOVA is that ultra-processed foods—with an emphasis on fat, sugar and salt—should be avoided to achieve improvements in nutrient intakes,” noted Slavin, “disease links between intakes of ultra-processed foods and health are lacking.”

There are nutritional and health challenges to clean eating, including Orthorexia Nervosa—a condition coined by Steven Bratman, M.D. in an essay published in the October 1997 issue of *Yoga Journal*. “Orthorexia Nervosa is defined as a fixation on the virtue of food or an unhealthy obsession with healthy eating,” in which people feel a sense of satisfaction and control with extremely restricted and ordered healthy eating.

“Required vitamins and minerals for enrichment cannot meet rules of clean label, as many view these as chemicals. Intakes of nutrients of concern—fiber, potassium, calcium and vitamin D—will only get worse by clean label ‘rules,’” explained Slavin. She



■ **Enrichment of foods, such as vitamin A and D in reduced-fat milk or dairy-alternatives, is needed to help consumers meet recommended levels of intake of these nutrients. However, their listing on labels as “vitamin A palmitate” and “vitamin D3” may be viewed as chemicals and not acceptable when clean label “rules” are followed.**

provided the example of protein quality for plant-based ingredients, such as soy, which has improved digestibility and absorption due to processing. The same is true for the addition of healthy ingredients—whole grains, vegetables, fruits, pulses—as well as the removal of added sugar, sodium, and saturated and trans fats in some processed foods.

Slavin concluded that the movement to greater support for plant-based diets over nutrient intake will continue. Ultra-processing is the new villain associated with a distrust of food technology as the solution for nutrition problems—even if that technology solves issues. She stressed, “It is critical to have those skilled in food technology and production on scientific panels that determine nutrition policy.”

*“Do Clean Labels Have Unintended Health Consequences,” Joanne Slavin, Ph.D., RD, Professor, Department of Food Science and Nutrition, University of Minnesota*

## **An Update on Label-Friendly Surfactants and Emulsifiers**

Surfactants and emulsifiers constitute probably the most technically complicated category of food ingredients, declared Peter Wilde, Ph.D., Research Leader, Quadram Institute of Bioscience,

University of East Anglia (UK), in his presentation “Challenges & Solutions: An Update on Label Friendly Surfactants and Emulsifiers.” Wilde laid down a foundational outline of emulsifier and stabilizer chemistry from which he launched an off-road overview of emerging clean-label alternatives.

“The magic of emulsions is illustrated in how the mixing of two liquids or a liquid and a gas can transform the mixture into a solid,” he began. The key is high-shear mixing. “When you create very small droplets of oil in water, they behave as hard spheres. If you get enough of them, they form a hard material with a solid appearance.”

The droplets must be stabilized against re-coalescence, however, which is where stabilizers and emulsifiers come in. Gums and thickeners stabilize the water phase. Emulsifiers stabilize the oil-water interface.

Recent consumer demands for clean labels have shifted the industry’s focus toward natural emulsifiers and stabilizers, such as phospholipids. “They are ubiquitous in nature, as every plant and animal cell are stabilized by phospholipids,” said Wilde. Phospholipids, such as lecithin, are naturally present in egg yolks and oil seeds. Some proteins, too, can function as natural emulsifiers and stabilizers.

In past decades, the focus was to chemically enhance natural ingredient materials (starches, fats) in order to improve their functionality. For example, natural triglyceride fats were enzyme-treated to create mono- and diglycerides. Unfortunately, this does not comport well with modern clean label expectations, so the focus today is on all-natural, minimally enhanced emulsifiers and stabilizers that are both label-friendly and effective.

“There has been a lot of recent work with saponins, such as quillaja extracts from soapbark,” said Wilde. However, the health effects of saponins are still being debated. Some exhibit anti-carcinogenic qualities at certain levels; some contain anti-nutrients, such as oxalic acid; while others are known to be toxic at high levels,” he explained. As with all bioactive materials, the dose makes the poison.

Also, ingredient label designations trump function, no matter how natural an ingredient may be. Pointing to a commercially available bile salt supplement, Wilde noted that, while he included it in his presentation as a bit of a joke, “(it) really is an excellent emulsifier. It is an approved supplement, so we know that it is safe. However, I do know that it would not be particularly label-friendly.”

Wilde also discussed ongoing research into plant chloroplasts, which contain huge amounts of tightly packed galactolipids. Although they require high levels of processing for extraction, they may also offer the added benefits of promoting satiety and aiding fat digestion.

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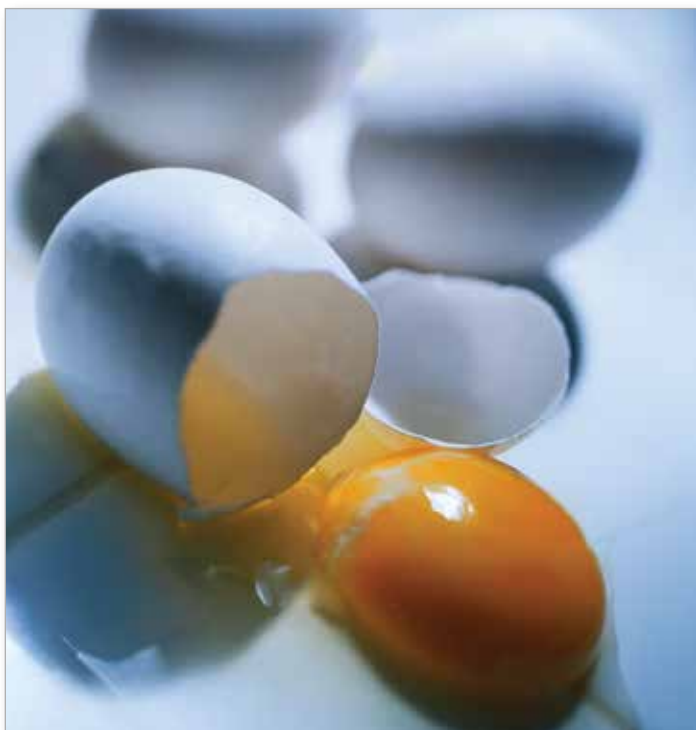
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■ **When searching for foods with clean labels, consumers prefer natural emulsifiers, such as lecithin derived from egg yolks and oil seeds—fearing chemical-sounding ingredient names of which they have no familiarity.**

“Hydrophobins, secreted from filamentous fungi, generated a lot of interest a few years back,” continued Wilde. Highly effective stabilizers, they have been shown experimentally to stabilize ice cream and the foam in beers. He added, however, “They remain difficult to extract and handle.”

Additional and ongoing research investigations include frog-hopper (spittlebug) excretions; tannins; galactomannans from spruce trees; prickly pear cactus extracts; and microbial fermentation extracts.

“Proteins and polymeric emulsifiers may not be as effective as synthetic emulsifiers, but they do provide additional functionality by forming thick layers at interfaces that impart long-term stability,” explained Wilde. Proteins, while not compatible with traditional surfactants, can form elastic films and incredibly strong and stable structures. They can also create unique mouth-feel sensations.

There are process innovations as well. While highly effective, mono- and diglycerides do not project a clean label image. However, they do not have to be listed on the label, if created in situ through the addition of lipase enzymes as processing aids, as is done in bread baking. Added to the dough, the lipase enzymes are destroyed during baking.

New sources of potential emulsifiers and stabilizers continue to be discovered, noted Wilde. “Understanding the structure-func-

tion-performance relationships of stabilization and emulsification is key to identifying candidates that, with some minor process modifications, can become viable clean label stabilizers and emulsifiers. Some might even come with added functional and health benefits,” he concluded.

“*Challenges & Solutions: An Update on Label-Friendly Surfactants and Emulsifiers*,” Peter Wilde, Quadram Institute of Bioscience/ University of East Anglia (UK)

## **Food Safety & Preservation of Clean-Labeled Foods**

Kathleen Glass, Ph.D., Associate Director of the Food Research Institute at the University of Wisconsin-Madison, is a self-professed “preservative fanatic.” Keeping food safe is her highest priority. However, she also respects consumer demands for clean labels. Glass highlighted clean label strategies for inhibiting *Listeria monocytogenes* growth in foods in her presentation titled “Challenges & Solutions for “Preservative-free, Microbial-safe Foods.”

In 1985, *L. monocytogenes* was the “newest bug on the block.” Following an outbreak of *L. monocytogenes* in cheeses, and not yet knowing the organism’s infectious dose, FDA and USDA took a zero-tolerance approach to the pathogen. The ready-to-eat (RTE) meat industry realized their products were also vulnerable, leading Glass and colleagues to test a variety of RTE meat products and identify pH, moisture, nitrite and competitive microbiota as critical factors for listerial growth.

The first listeriosis outbreak in an RTE meat (frankfurters) occurred in 1998-1999. In response, USDA fast-tracked the 2004 approval of lactate and diacetate to control *L. monocytogenes* in processed meats. In the meantime, however, a 2002 listeria outbreak associated with turkey caused 46 illnesses and ten deaths. Lactate and diacetate, often in combination with nitrite, became the gold standard for *L. monocytogenes* control, with propionate and benzoate added to the anti-listerial armamentarium in 2013. Unfortunately, *L. monocytogenes* outbreaks have continued to occur, particularly when antimicrobials are not used, as in the devastating 2018 South African polony outbreak: an RTE sausage product killed 216 people.

Glass compared using an anti-listerial in a product to that of wearing a seat belt: you don’t expect an accident, but you wear a seat belt, just in case. Using preservatives controls microbes throughout the food chain, providing insurance against improper holding temperature and protecting susceptible consumers.

Sometimes, protection against pathogens can be achieved simply by adjusting pH (<4.6) or water activity (<0.92). Combinations of

## Conventional vs. Clean Label “Preservatives” One solution to keeping foods safe for consumption

Synthetic/Conventional	Clean Label
NaCl	Salt (reduces available water, $a_w$ )
Lactate, propionate	Cultured sugar, cultured milk, cultured wheat*
Diacetate, acetic acid	Vinegar* (dry vinegar, buffered vinegar)
Nitrite	Cultured celery* (convert nitrate to nitrite)
Erythorbate, ascorbate	Acerola cherry powder*
Sorbic acid	None (derived from rowanberries)
Benzoic acid	Cranberries, prunes, plums, cloudberry, cinnamon
Nisin (bacteriocins)	Cultured sugar, dairy solids
Phenolics, flavonoids	Fruit/spice extracts
Lactic acid bacteria starter cultures	Protective cultures Competitive microflora <i>In situ</i> acid/bacteriocin production

\*Clean label substitute with documented efficacy

SOURCE: KATHLEEN GLASS, FOOD RESEARCH INSTITUTE AT THE UNIVERSITY OF WISCONSIN-MADISON/2019 CLEAN LABEL CONFERENCE

While clean label substitutes for conventional preservatives exist, some may require use levels above flavor threshold levels. Still, ingredient suppliers continue to seek alternative solutions with proven efficacy for these synthetic/conventional preservatives.

low pH and low water activity are even more effective. In the cases of moderate pH and water activity, however, additional hurdles, such as antimicrobials, are needed. The effectiveness of an antimicrobial in food depends on many factors such as fat content, salt concentration and more. Different acids may have different activities, even at the same pH; acids with higher pKas tend to be more effective against *Listeria monocytogenes* in cheeses. Because it is difficult to predict what will work in a particular food, validation testing in the food is essential.

Pathogens can be controlled while maintaining a clean label. Clean label substitutes with documented efficacy exist for some synthetic preservatives, including cultured sugar/milk/wheat for lactate or propionate; vinegar for diacetate or acetic acid; cultured celery for nitrite; and acerola cherry powder for erythorbate or ascorbate. However, not all preservatives have suitable clean label substitutes, particularly sorbate, which is effective against molds, yeast, *Listeria monocytogenes*, *Staphylococcus aureus* and *Clostridium botulinum*. Some clean label antimicrobials may also

be required at high levels, which may impact product flavor.

Commercial fermentates (proprietary, clean label mixtures of organic acids, vinegar and bacteriocins) can be effective antimicrobials but may exhibit variability between suppliers or even between lots.

Starter (protective) cultures are another clean label strategy to prevent listerial growth in some products. Glass showed how effective cultured milk solids can be at controlling *L. monocytogenes* growth in mozzarella cheese. She also described using protective cultures to prevent *L. monocytogenes* growth in cottage cheese and on apples, while highlighting the need for challenge studies to identify the most effective ways (temperature, application process/location) to use these antimicrobials in a specific food.

While there are no magic bullets, clean label options for pathogen control in foods exist, with ingredient companies actively developing new clean label alternatives. Clean label antimicrobials that are familiar to consumers have the potential to enhance the safety of foods while building consumer confidence.

“Challenges & Solutions for “Preservative-free,” Microbial-safe Foods,” Kathleen Glass, Ph.D., Associate Director of the Food Research Institute at the University of Wisconsin-Madison

## Flavor Use: Is Natural Necessarily Clean Label?

“All natural” and “clean label” do not necessarily equate with one another, began Deepthi K. Weerasinghe, Ph.D., Principal, dP3 Consulting, in his presentation “Formation of Flavor—Is Natural the same as Clean Label?”

In the absence of a regulatory definition for clean label and only vague guidance by FDA and USDA as to what constitutes “natural flavor,” such determinations are widely subjective. His presentation outlined a growing struggle between existing and evolving flavor production technologies and regulatory strictures working hard to keep up with shifting consumer expectations.

So, what constitutes natural? To begin, raw plant and animal products have generally been accepted as “natural.” However, their naturalness immediately becomes subject to interpretation, depending on whether genetically modified organisms, pesticides, antibiotics and/or other chemicals were used in their



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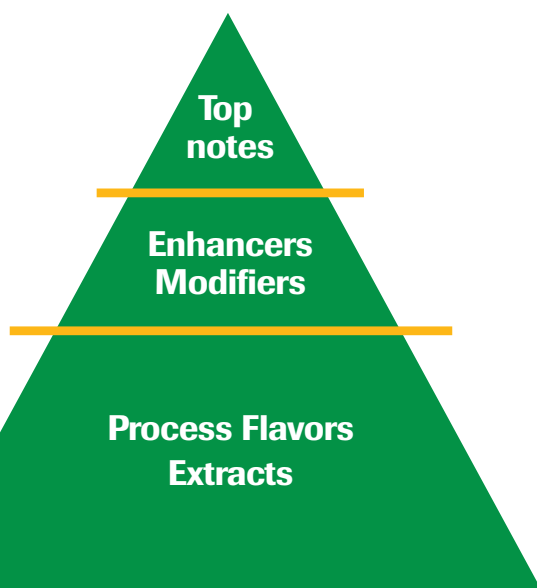
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## Flavor Scrutiny



SOURCE: DEEPTHI K WEERASINGHE, PH.D., dP3 CONSULTING/2019 CLEAN LABEL CONFERENCE

Each flavor system is made of a building block that should expect to come under scrutiny from regulatory authorities and “clean-label” and “natural” certification organizations, each with different standards. Such scrutiny applies not only to the building blocks themselves, but also the process components used in their development.

production and handling. *Aspergillus oryzae*, for example, is a filamentous fungus used to produce soy sauce, miso and sake. The growth media for *A. oryzae* cultures can be manipulated to create lactones as flavoring compounds.

“Since they are produced through natural fermentation, the lactones would be considered natural at that point, as they are not all that different from other products of fermentation, such as beer, yogurt, bread or cheese,” said Weerasinghe. But what happens when one starts genetically manipulating the enzymatic components of fermentative microorganisms?

Weerasinghe noted a patented process that converts kaurenoic acid into steviol and rebaudioside(s) (sweet components from the stevia plant) using genetically modified microorganisms. Companies need to be alert to such developments and their implications for clean and/or natural label designations.

It is also possible to manufacture colors through genetic modification. Weerasinghe cited a technical paper outlining how four bioengineered microbes could be used sequentially to transform glucose into callistephin, an anthocyanin color found in strawberries, pomegranate and blue corn. Would clean label consumers deem such an ingredient natural?

A demarcation between “soft” vs. “hard” chemistry may also define what is natural. Weerasinghe noted that the flavor in-

dustry had contended with this issue years ago with hydrolyzed vegetable proteins (HVP). While initially manufactured using “hard” inorganic chemicals to hydrolyze the proteins into amino acid-based flavor enhancers, consumer pressure shifted the industry toward using natural enzyme-catalyzed hydrolyses (i.e., “soft” chemistry).

This demarcation may not be quite so clear-cut today, especially under more restrictive EU regulations, said Weerasinghe. “Soft chemistry also refers to processing methods similar to common kitchen practices,” explained Weerasinghe, as in the use of juice concentrates and heat to manipulate pH conditions.

Weerasinghe pointed to a patent describing the production of aliphatic alcohols and aldehydes from vegetable oils using enzymes naturally present in guava juices and soy flour. But, even then, he said, “The methodology used to extract and purify such enzymes will factor into their regulatory and clean label designations.”

The types of flavor extraction processes used also impact natural label designations. It makes a difference, he noted, if flavors are extracted with water, with ethanol (tinctures), or with natural oils or organic chemical solvents (oleoresins). Vanilla extractions typically use ethanol and water. However, the U.S. Code of Federal Regulations (CFR) also allows the use of glycerin, propylene glycol, sugar, dextrose and corn syrup in such extractions. Even such minor extraction-process modifications that could ultimately affect label designations.

Processed flavors, which rely on Maillard reactions and Strecker degradations to produce savory flavors, are regulated in terms of process conditions (temperature, time, raw materials) to determine what constitutes natural. In the EU, they must be called “processed flavors.” But their appeal also lies in the ability to create vegan meat flavors from vegetable proteins. “You can make a wide range of chicken or beef flavors without using animal proteins,” said Weerasinghe.

Whether or not they qualify as natural or clean label will depend upon both regulatory authorities—and where vegan consumers are willing to accept trade-offs.

“Clean label folks don’t like black box ingredient designations like ‘natural flavors,’ because it doesn’t tell them what is in there,” concluded Weerasinghe. “Customers today are looking for safety; many are looking for comfort. Many customers have health challenges; they want protection from the unknown.”

The question remains: Are regulatory environments helping or hurting such aspirations?

*“Formation of Flavor—Is Natural the Same as Clean Label,”*  
Deepthi K. Weerasinghe, Ph.D., Principal, dP3 Consulting



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## Effective Use of Colors for Optimal Flavor Perception

Clean labeling efforts may mean colorants will be avoided, yet color may prove essential in capturing how consumers perceive a food product, noted Debra Zellner, Ph.D., Professor of Psychology at Montclair State University, and Affiliated Faculty Member at Monell Chemical Senses Center. Zellner provided an illuminating discussion of how the color of food (and its packaging) affects consumers' expectations for odor and flavor in her presentation: "The Effect of Color on Odor Perception: Toward More Efficient Ingredient Use."

The odor associated with food is perceived orthonasally (when detecting the food's aroma) or retronasally (when food is in your mouth, i.e., "flavor").

Food color affects the perceived intensity of orthonasal odor, with colored foods (regardless of color) rated as having more intense odors than clear foods. In contrast, colored foods were perceived retronasally as less intense than clear foods.

Food color also affects flavor identification, which in turn affects how well a consumer likes a food. "Most people are terrible at identifying flavors or odors," commented Zellner. If the flavor and color of a food are incongruent, subjects will perceive the flavor to be something congruent with color. For example, a clear cola soda might be perceived as lemon/lime rather than cola.

How well a color matches the flavor of a food also affects how well the food is liked, with foods less well-liked when their flavor and color are incongruent—unless it is apparent what the flavor is supposed to be. As explained by Zellner, "Green beer is still okay on St. Patrick's Day," because you know the beverage tastes like actual beer—not mint or apple.

Zellner detailed some of the psychology underlying these results. When stimuli are paired together repeatedly over time, an association between them develops. For example, if you are a coffee drinker, a brown-colored beverage will elicit the perception of coffee. The odor perception due to the color alone is similar but weaker than that produced by the actual stimulus [i.e., coffee aroma], but color can add to and enhance the actual odor.

One recent study tested how a raspberry/lemon-flavored beverage was perceived when colored yellow, red or left clear. When colored yellow, the soda had more of lemon aroma than did the same beverage when red or clear in color. The effect was limited to the scent, however, because the color did not influence the perceived taste of the beverage

Inspired by *New York Times* food critic Mimi Sheraton, Zellner's group also investigated whether packaging color provides a clue



**■ If the flavor and color of these popsicles are incongruent, consumers will identify the flavor to be more congruent with the color. For example, consumers will associate the red popsicle with flavors such as raspberry, strawberry or cherry—even if the red popsicle actually has a blueberry flavor.**

to the flavor of the food inside. Unflavored, neutral-colored hard candies were wrapped in various colored papers. When still wrapped, the color of the wrapper influenced what flavor the subjects believed the candies were. After unwrapping, however, the wrapper color did not affect the flavor subjects assigned to the candy. Most subjects predicted that unwrapped, neutral-colored candies were mint, vanilla or coconut in flavor. The perceived flavor when tasting the uncolored candy was often vanilla or butterscotch, flavors normally associated with neutral colors.

A similar study in potato chips (which looked alike, despite different flavors) found that packaging colors affected the perceived flavor of the chips, but only if the subject was already familiar with the packaging color scheme used for different flavors.

In summary, food or packaging color can influence odor or taste perception or expectation in a variety of ways. Food color increases orthonasal (sniff) but not retronasal (in the mouth) odor perception; color can intensify one odor component in a complex product with multiple odors; color does not increase flavor intensity, but color will change expectation, identification and enjoyment of a flavor; and food color matters more than the packaging color, especially when food color predicts flavor. However, when all flavors look similar, packaging colors can influence flavor expectations.

*"The Effect of Color on Odor Perception: Toward More Efficient Ingredient Use," Debra Zellner, Ph.D., Professor, Psychology, Montclair State University & Monell Chemical Senses Center*

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## 2020 Super Summit



### Sweetener Systems Conference

March 24, 2020 • Westin Hotel, Itasca, Illinois, USA  
[www.globalfoodforums.com/2020-Sweetener-Systems-Conference](http://www.globalfoodforums.com/2020-Sweetener-Systems-Conference)

Updates on consumer attitudes, sugar reduction formulations, nutritional aspects, emerging technologies, sensory, regulatory and analytical issues.  
Target audience: Food & Beverage R&D/Product Developers.

[Sweetener Systems Magazine](#)   [Sweetener Systems Library](#)



### Clean Label Conference

March 25-26, 2020 • Westin Hotel, Itasca, Illinois, USA  
[www.GlobalFoodForums.com/2020-Clean-Label-Conference](http://www.GlobalFoodForums.com/2020-Clean-Label-Conference)

The tagline “Sophisticated Solutions for Simplified Products” embodies the emphasis on food science-based answers to the formulation of “simple,” consumer- and export-friendly ingredient labels. Speakers deliver critical insights and hands-on technical advice on the use of emerging, “natural” and multifunctional ingredients supporting the development of clean label foods and beverages.   Target audience: Food & Beverage R&D/Product Developers

[Clean Label Magazine](#)   [Clean Label Library](#)



### Protein Trends & Technologies Seminar

May 19-20, 2020 • Westin Hotel, Itasca, Illinois, USA  
[www.GlobalFoodForums.com/2020-Protein-Seminar](http://www.GlobalFoodForums.com/2020-Protein-Seminar)

May 19<sup>th</sup> Pre-conference “*Business Strategies*”: Critical protein ingredient market and trend information for those making strategic business decisions in the protein ingredient industry.  
Target audience: Suppliers and Industry Executives

May 20<sup>th</sup> Technical Program “*Formulating with Proteins*”: Focuses on the development of protein-enhanced foods, beverages and nutritional supplements. Presentations on the food science behind protein ingredients. Consumer interests, emerging nutritional benefits and regulatory issues are also covered. Target audience: Food & Beverage R&D/Product Developers

[Formulating with Proteins Magazine](#)   [Protein Library](#)

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**Commitment to transparency involves establishing, documenting and guaranteeing traceability throughout the supply chain.**

## A Five-Step Approach to Certification of Food & Ingredient Supply Chains

Mincing no words, Steve Taormina, Business Manager, NSF International, warned of major battles brewing in the food certification arena in his presentation “Behind the Label: Clean Label ‘Musts’ for the Ingredient Supply-Chain.” NSF International is a not-for-profit organization focused on science-based health and safety services that operates independently and is committed to professional certification. He emphasized, “NSF does not take positions on the merits of perceived public health issues, such as GMO or clean label definitions.”

Taormina warned that science is losing its battle to influence public perceptions on food safety risks, putting added pressures on food and beverage companies to comply with ever shifting and sometimes vague consumer expectations.

Taormina cited a 2018 PEW Research Center survey of 2,537 U.S. adults regarding their perceptions of food and beverage risks. While 70% of respondents acknowledged that science had had a “mostly positive effect” on foods, nearly 50% also expressed fears about the safety of food additives and claimed that GMO foods could lead to health or environmental problems.

Science and industry have been trying to push back by promoting uniform certification standards, such as the federal National Bioengineered Food Disclosure Standards. Independent groups, like the Non-GMO Project (Bellingham, Wash.) are writing their own standards for GMO-free food certification, with the ultimate goal of revolutionizing how foods are produced and processed worldwide, noted Taormina. Referencing “non-GMO” and “gluten-free” certifications, Taormina proposed a five-step approach toward companies’ certifications of their ingredient and food supply-chains.

Step one is to commit to full supply-chain transparency. “In the context of non-GMO standards, it all comes down to DNA verification,” expressed Taormina. Full transparency anticipates consumer expectations that all that is hidden will become exposed.

Step two is segregation of high-risk inputs. “For non-GMO certification, we know that minerals (salt, baking soda) have no DNA, so they can be overlooked,” said Taormina. “‘Low risk’ applies to crops and other ingredients not currently available in genetically modified forms. Most fruits and vegetables fall in this category, as do herbs and spices. ‘High-risk’ ingredients, on the other hand, include corn, soybean, canola, alfalfa, sugar beet, papaya, potato, squash/zucchini and ‘arctic apple,’ all of which may or may not include GMO variants. These warrant scrutiny,” he added.

In order to comply with organizations such as the Non-GMO Project, one must be able to document the raw material sources of ingredients ranging from amino acids and flavors, to vitamins and the materials used in their processing. In the case of animal products, it also requires certifying the non-GMO status of feed ingredients...even the plants and flowers used to produce honey.

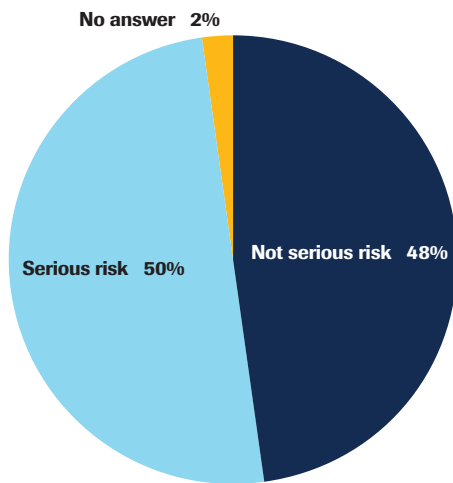
Step three is to establish, document and guarantee the traceability of ingredients all the way throughout the supply chain.

Pointing to the ingredient list for a raspberry filling as an example, Taormina asked, “If it is sugar, is it made from beet or sugarcane? If citric acid, what was its raw material source? If flavors, what are their origins and methods and materials used in their extraction, and was the extraction material non-GMO?”

Step four is to ensure that allergen-control systems are in place to eliminate allergen risks. “What are the traceability protocols and operating procedures necessary to prevent commingling or cross-contamination by allergen or gluten-containing ingredients?” he asked.

Step five is to determine third-party certifications or the proper certification agencies with which to work. While certain retailers such as Whole Foods make clear their expectations, manufacturers face a plethora of choices. NSF is also working with the Plant

## Consumer Perception of Food Additives % Who Say Food Additives are a ? Risk



SOURCE: ADAPTED FROM SOURCE: PEW RESEARCH CENTER, SURVEY CONDUCTED APRIL 23-MAY 6, 2018, "PUBLIC PERSPECTIVES ON FOOD RISKS"  
[HTTP://WWW.PEWRESEARCH.ORG/SCIENCE/2018/11/19/PUBLIC-PERSPECTIVES-ON-FOOD-RISKS/](http://www.pewresearch.org/science/2018/11/19/public-perspectives-on-food-risks/)

■ A 2018 Pew Research Center survey documents how government certification and the nutrition and food sciences are losing the battle for public opinion; half the population surveyed expressed fears over the safety of food additives and GMO foods.

Based Foods Association, an organization focused on providing vegan-friendly certification. Taormina anticipates some potential regulatory confusion regarding emerging plant-based products, given the liberal application of terms, such as “meat” and “milk” applied to plant-based products. Increasingly, companies must also deal with emerging consumer and retailer expectations regarding certifications pertaining to social justice issues, such as human and animal rights.

Remember, in the end, the goal of those seeking certification is not only about science, health or reason; it’s also about changing the face of global agriculture and the types of foods we eat.

*“Behind the Label: Clean Label “Musts” for the Ingredient Supply-Chain,” Steve Taormina, Business Manager, NSF International*

## Transitioning Omnivores Shift Toward Plant-Based Diets

“Where does ‘science’ meet a company’s marketing objectives?” And, what does ‘clean label’ mean?” So enquired Rachel Cheatham, Ph.D., Founder & CEO, Foodscape Group, LLC in her presentation titled “Delivering Clean Label to the Transitioning Omnivore.”

“There are a lot of words to describe clean labels ... ‘raw,’ ‘organic,’ ‘fresh,’ ‘natural,’ ... but there still exists no formal or reg-

ulatory definition of what it means,” she added. Cheatham cited a survey indicating that consumers generally associate clean label with organic labels (68%); with products found in the fresh foods sections of grocery stores (61%); and/or foods with ingredient labels containing only “recognizable” ingredients (58%).

Because the clean label term is not regulated, there are no fixed rules. This has spawned a wide variety of definitions and individual initiatives that can be contradictory and confusing. Major grocery (e.g., Kroger’s, H.E.B.) and restaurant (e.g., Panera) chains have responded by developing their own published definitions, listing ingredients that are either approved or not permitted in their categories.

The situation is further complicated by consumer confusion; Cheatham shared some outtakes from her LinkedIn commentaries. Some comments reflect fear and misinformation, such as: “Gums are lab formulated and come hidden in compound ingredients. Even a manufacturer doesn’t know of them.” Another comment was more ominously aimed at the processed foods industry: “Personally, I don’t care if a label is clean or not, because most of the food I buy has no label.”

Cheatham argued that the term clean label itself is too industry-focused. Consumers, she said, prefer to focus on “clean eating.” Citing a Nielsen study, she identified five label categories for foods: 1) conventional labels with no restrictions (a slightly declining category); 2) free-from labels, free of specific ingredients;



■ Consumers are seeking products containing simple, clearly identifiable ingredients that are free from artificial or other objectionable ingredients and are made with sustainable sources.



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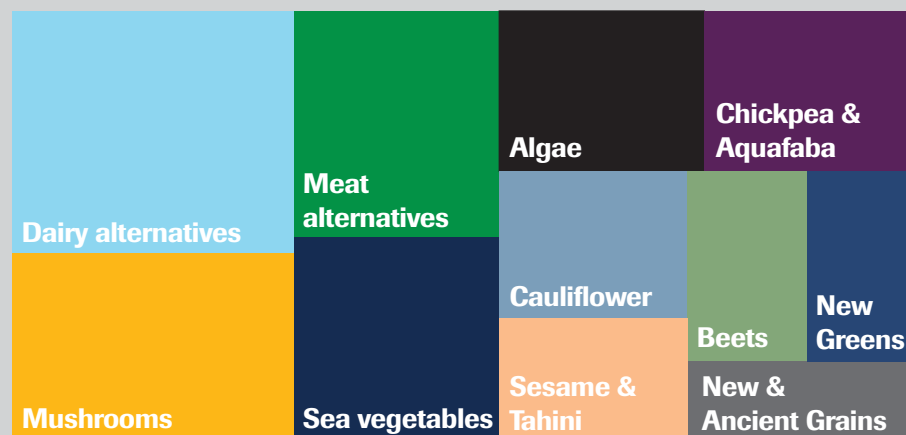


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## Plant Forward: Subtrends



SOURCE: RACHEL CHEATHAM, PH.D., FOODSCAPE GROUP LLC/2019 CLEAN LABEL CONFERENCE

More consumers are transitioning away from animal-based products to plant-based products that include innovative formulations containing novel ingredients.

3) clean, defined as “free-from artificial and other objectionable ingredients;” 4) simple, containing only recognizable ingredients; and 5) sustainable. Sustainability, she said, was the fastest growing category, encompassing a smorgasbord of social justice criteria, ranging from non-GMO to workers’ rights.

From this foundational analysis, Cheatham segued to her organization’s Top10 Metatrends Report, a meta-analysis that draws a picture of a global omnivore diet transitioning away from animal proteins to plant-based diets, the subject of her presentation. She claimed that, today, “2-10% of any developed country’s population” is vegetarian, while estimating that “0.5% of the global population is vegan.” These numbers grossly underestimate the overall trend toward increased plant-based food consumption, she argued, as even dedicated omnivores are replacing more meat products with plant-based products in their daily diets. This trend has spurred the development of new, technology-based alternatives to harvested animal proteins.

As examples, she pointed to the “Beyond Burger®,” a plant-based beef burger substitute previously featured at the Global Food Forums conference. Although 100% plant-based, the product’s ingredient statement might not, at first glance, be viewed as clean label, so there are label trade-offs. Ocean Hugger Foods, Inc. created Ahimi™, a tuna substitute made from non-GMO vegetables, soy, sugar and sesame oil.

She also cited growing interest in animal cell-based (i.e., laboratory grown) meat technologies, noting global animal-protein giant Tyson Foods’ 2018 investment in Memphis Meats, a San Francisco-based start-up focused on laboratory-grown animal

cell-culture products. In San Diego, BlueNalu is attempting to do the same with seafood proteins. There has also been a proliferation of dairy product knockoffs, beginning with a plethora of nut, legume and cereal-based milks, but also cheese and yogurt substitutes.

While concluding, Cheatham reminded audience members that there are always exceptions to ongoing trends: “Consumers make exceptions to their own rules and, sometimes, it is best not to tinker with proven-winner food products...clean label or no clean label. And, although clean label has no legal definition to date, this should not prevent companies from developing their own working definitions, thereof.”

It is complicated and challenging, she suggested, but “clean label efforts present an opportunity for greater internal alignment between Innovation/R&D and marketing communications.” Finally, she also proposed that company clean label policies be implemented enterprise-wide, rather than just at the SKU level.

*“Delivering Clean Label to the Transitioning Omnivore,” Rachel Cheatham, Ph.D., Founder & CEO, Foodscape Group LLC*

## Navigating Litigation Risk in an Uncertain Clean Label Regulatory Environment

Will FDA issue regulations defining natural and redefining healthy? Or will these claims become less common on food packages due to the risk of challenge? What are the implications for development of the clean label category, when ingredients disfavored by some consumers are important for taste, shelflife and even safety?

Leslie Krasny, Partner, Keller and Heckman, LLP, considered these questions in a riveting and information-packed presentation on clean label complexities. The title of her talk was “The Impact of Regulatory Requirements and Litigation Risk on Clean Label Product Development and Marketing.”

“As we know, the concept of clean labels for foods has expanded to cover transparency, essentially creating a right-to-know expectation among consumers regarding disclosure of almost any information they may consider to be important,” she began. And, label challenges can be very costly and disruptive to manufac-



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**Do your products truly meet one or more of the above label claims, or is your company risking costly litigation in an often ill-defined regulatory environment?**

turers. The stakes are high, but anticipating challenges can help mitigate or avoid such risks. Here are some highlights from her presentation.

At the Federal level, the FDA may cite label claims as violative in warning letters, which don't represent final agency action but can trigger class action lawsuits. And all states have food laws that either incorporate the FDA's labeling requirements or have similar requirements.

Regarding natural, the FDA's informal policy defines the claim to mean that nothing artificial or synthetic (including all color additives, regardless of source) has been added to a food that would not normally be expected in that food. "The definition is ambiguous, and we have no idea what the last part means," declared Krasny.

As for the USDA, meat, poultry and egg products typically have not been the subject of label claim challenges, because most claims must have prior approval from the USDA's Food Safety and Inspection Service (FSIS). Under the USDA's informal policy on natural, foods must contain no artificial or synthetic ingredients and also must be "not more than minimally processed."

Unfortunately, said Krasny, plaintiffs often seek to apply the USDA's "not more than minimally processed" criterion to FDA-regulated foods in challenging "natural" or "no artificial ingredients" claims. "Moreover," she continued, "these definitions are not regulations, so there is no clear Federal pre-emption."

Plaintiffs file lawsuits under state consumer protection laws for false, misleading or deceptive marketing, because there is no private right of action for consumers under the FDA and FTC regulatory frameworks. These federal and state laws apply a "reasonable person" standard. Some courts have opined that an interpretation of a claim may be considered "reasonable," if held by a significant minority of consumers (≥12%). Courts often substitute their own judgments regarding whether interpretations are reasonable, and many class actions proceed based on the subjective views of the named plaintiffs.

What about terms that are arguably similar to healthy? In the final rule regarding that claim (decades ago), the FDA declined to define "wholesome," "nutritious" and "good for you," but stated that if these terms appear in association with nutrient

content claims, the terms are implied nutrient content claims and unless defined by the FDA (which has not happened), could cause the products to be misbranded, Krasny stated. Plaintiffs have accused companies of creating misleading "healthy auras" through use of such terms when the healthy criteria are not met.

Class actions lawsuits for food labeling claims are trending upwards (a 9% increase in 2018 alone), but these statistics are just the tip of the iceberg, noted Krasny, because many challenges are settled privately for significant payments, often with label changes, with no complaints filed.

In her closing remarks, Krasny recommended making the legal review of label claims part of a company's product development strategy early in the conceptualization process. "That way, you can make informed decisions based upon a company's risk-management policy. Some companies are willing to assume high risks; others are very risk-averse."

Left unanswered was the question of whether it is better to avoid risky label claims altogether and just let clean ingredient statements do the talking. Cautioned Krasny: "Just be careful out there!"

*"The Impact of Regulatory Requirements and Litigation Risk on Clean Label Product Development and Marketing," Leslie Krasny, Partner, Keller and Heckman, LLP.*



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❏ **Fluid, pumpable shortenings lack the solids structure of solid shortenings and may not perform well in laminated doughs.**

## Unraveling the Science of Clean Label Fats & Oils

Selection of clean label alternatives for fat and oil ingredients depends on several factors. They include how the manufacturer defines clean label; the desired functionality of the ingredient in application; and physical properties, such as melting, crystallization or viscoelasticity. All of these factors are influenced by the ingredients' chemical properties, explained Neil Widlak, MSc, Consultant, Fats and Oil Technologies in his presentation, "Factors to Be Considered for Selecting the Best Fats & Oils to Meet Clean Label Requirements." Despite the considerations for use of such alternatives, from cost to quality to functionality, in the end, it all factors down to chemistry.

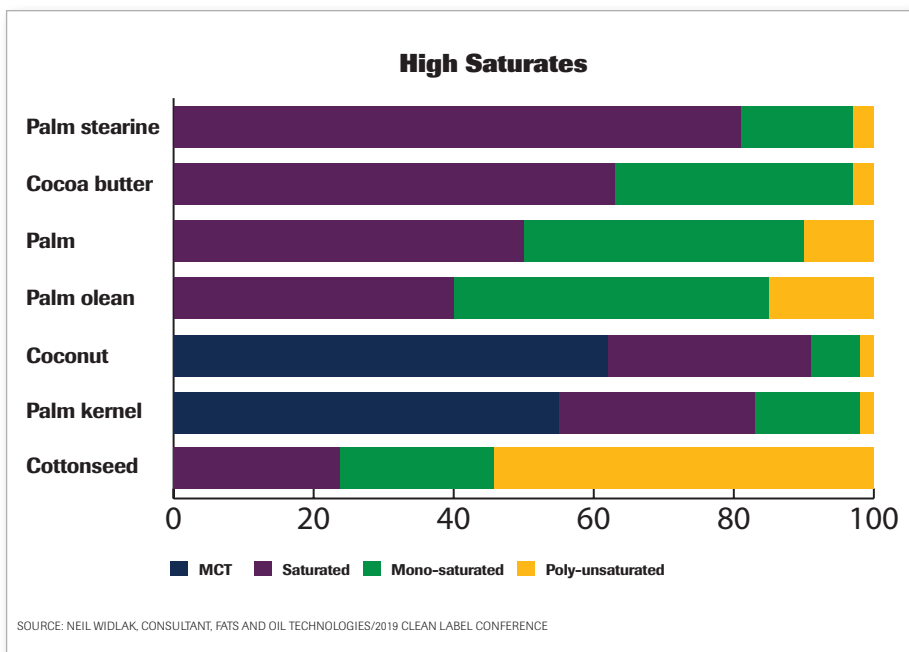
Triglycerides (TAG), esters of glycerol plus three fatty acids, form 98% of a fat's composition, noted Widlak. The type of fatty acid—short carbon chain or long; degree of saturation (the higher the saturates, the more solid the fat); position of the fatty acids on the TAG molecule; and diversity of the TAG population—determines a fat's properties and functionality. These properties can be changed through clean label process modifications, such

as fractionation (e.g., physical rather than use of potentially objectionable solvents) and interesterification (e.g., use of enzymatic versus chemical hydrolysis).

While clean label, cold-pressed and/or expeller-pressed soybean and canola are readily available, they're not available in the volumes (or prices) of commodity processed oils. And these alternatives may not be as easily interchanged, because of differences inherent in flavor and color—natural variances not removed during the "cleaner" extraction process. However, in terms of functionality, said Widlak, "Cold-pressed canola, expeller-pressed canola and organic canola have identical fatty acid composition vs. the commodity oil."

A wide variety of fats can be produced with palm and cottonseed oils through fractionation. "Clean label fluid shortenings, pumpable shortenings and oleogels can be used as alternatives for plastic/semi-solid fats in many baking applications, such as cakes, muffins, cookies, brownies. However, fluid, pumpable and oleogels lack the solids and structure of plastic shortenings and may not perform as well in applications where the plastic characteristics are essential to the distinct dough layers and volume found in puff pastries and Danish-type pastries," offered Widlak.

"Palm kernel and coconut lipids, high in medium-chain saturated fatty acids, impart desirable quick melting at room temperature, but must be supplemented by the addition and or interesterification of fats having a higher melting range to achieve the desired melting range ... to near body temperature to perform well in confections," he added.



❏ **These saturated fats, if processed within a food manufacturer's clean label requirements, can be used as base stocks with broad melting ranges to develop clean label plastic; pumpable, fluid shortenings; or base stocks with short melting ranges that can be used as confectionery fats.**

The goal of high performing shortenings or a confectionery shortening is dependent not only on its solid content and melting range, but also on the crystalline habit and behavior of the solid fats. All three characteristics must be examined and monitored throughout shelflife to ensure the shortening will meet a finished product's performance standards.

Polyunsaturated fatty acids (e.g., linolenic [C18:3]) are more prone to oxidation and polymerization and should be kept to a minimum in oils used for frying or roasting, noted Widlak. Common varieties of soybean and canola oil contain high levels (greater than 2%) of linolenic fatty acids. High oleic varieties of these oils have been developed to lower the linolenic content and raise the oleic content, thus improving the oils frying, roasting and shelf-stability.

"Research by the USDA indicates desirable fried food flavors are contributed from the partial decomposition of linoleic (C18:2) fatty acids. Therefore, it may be advisable for oils used for frying to contain a portion of linoleic fatty acids to impart a desired fried food flavor. The ideal level would need to be determined based on the frying methods, type of food being fried and shelflife expectations," Widlak noted.

Coconut oil does not form polymers/gums or an undesirable flavor from oxidation in popped corn because of its high levels of medium-chain saturated fat, which is very stable at high temperatures. Coconut oil is also an excellent oil for roasting, although foods with high moisture content could accelerate hydrolysis resulting in soapy off flavors in the roasted product and shorten shelflife, advised Widlak.

As he concluded, Widlak emphasized that oils, which are liquid at room temperature, cannot replace fats that are solid or plastic at room temperature and provide equivalent function/performance. It's all a matter of understanding your application—and the chemistry within.

*"Factors to Be Considered for Selecting the Best Fats & Oils to Meet Clean Label Requirements," Neil Widlak, MSc, Consultant, Fats and Oil Technologies*

**We at Global Food Forums want to thank this year's speakers, sponsors, tabletop exhibitors and attendees who have contributed their time and financial resources to make this event a success.**

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### 2020 Sweetener Systems Conference

- MaryAnne Drake, Ph.D., Dept. Food, Bioprocessing & Nutrition Sciences, North Carolina State University
- Elizabeth Sloan, Ph.D., CEO/Owner, Sloan Trends, Inc.

### 2020 Clean Label Conference

- Philippe Rousset, Nestlé Product Technology Center Beverage
- David Plank, Ph.D., Managing Principal/Senior Fellow Researcher, WRSS Food & Nutrition Insights/University of Minnesota
- Webb Girard, MSc, Director of Technology, CuliNex, LLC

### 2020 Protein Trends & Technologies Seminar

- Gary Reineccius, Ph.D., Professor & Interim Department Head, Dept. of Food Science & Nutrition, University of Minnesota
- Mian Riaz, Ph.D., Professor, Nutrition & Food Science/Dir. Process Engineering Research & Development Center/ Texas A&M University

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