

2020 CLEAN LABEL CONFERENCE

“SOPHISTICATED SOLUTIONS FOR SIMPLIFIED PRODUCTS”

What's Inside on Clean Labels...

- Shifting Consumer Perceptions on Clean Label
- Industry Perspective: Clean Label Transparency Across a Portfolio
- Risk-Based Process to Identify Food Contaminants
- Rethinking Reformulation of Traditional Processed Foods
- Hydrocolloid Solutions for Plant-Based Meat Alternatives
- Multifactorial Food Preservation for High Quality Foods
- Clean Label Ingredient Replacements in Baked Goods
- Innovative Dairy Based Ingredients for Clean Label
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2020 Clean Label Conference Magazine

Sophisticated Solutions for Simplified Products



📺 Video presentations from the 2020 Clean Label Conference were posted online for registered attendees as Covid-19 forced cancellation of the in-person event.

The clean label phenomenon influences all segments of the packaged foods industry. From evolving consumer interests in the nature of the food they eat to the nitty-gritty of ingredient selection and product formulation, food product developers have much on which to keep abreast.

The year 2020 brought a new challenge to professionals who find serendipitous meetings, in-person presentations and the ability to taste their way across exhibition floors beneficial. Covid-19 forced the cancellation of the March 2020 Clean Label Conference, along with many other in-person events.

Global Food Forums pivoted to video recording eight general session and 15 Technology Snapshot presentations along with PDFs. Some are only available to registered attendees, while others will be released publicly in the coming months. Updates will be posted at www.GlobalFoodForums.com/store/clean-label-conference.

On the pages of this *2020 Clean Label Post Conference Magazine*, we have summarized key points from these presentations. This publication will also be made available online at www.globalfoodforums.com/store/clean-label-conferences.

The 2021 Clean Label Conference has been scheduled for September 28-29, in the Chicago area. We hope to see you there!

Warm regards,

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

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Evolving Consumer Perceptions, Innovation and Clean Labels

CLEAN LABEL has been with us since early 2000s, said Lynn Dornblaser, Director, Innovation & Insight, Mintel, as she began her presentation “Clean Label: Shifting Consumer Perceptions,” which had been prepared for the 2020 Clean Label Conference. At that time, Mintel had noted the designation was closely aligned to “junk-free” foods and that they contained ingredients readily understood by consumers. Furthermore, in foods and beverages, clean label products had ingredient statements that read more like a list of ingredients in a home recipe than a chemist’s shopping list.

Free-from was the original clean label. “The launch of a ‘GMO-free’ cereal in 1999 was one of the earliest examples of the removal of ingredients that consumer didn’t like,” stated Dornblaser. Another was the relatively niche claim “no high-fructose corn syrup,” which was used in the introduction of a tea. This led to products with claims such as free of artificial, hydrogenated and/or preservative ingredients.

What has changed since 2010? Dornblaser noted that the use of “junk-free” and emotional claims (e.g., “none of the nasties”) are gone. The focus is now on hard facts. Even non-food, cleaner label products contain fewer ingredients that consumers might have difficulty understanding and/or are controversial (e.g., parabens). The function of unfamiliar ingredients also may be explained.

“The term ‘clean’ has infiltrated our everyday lives with many facets,” she said. “It has become an adjective with many meanings across industries, with countless brands using the term.”

For example, a 2017 Mintel/Lightspeed survey found that 41% of UK adults agree meat-free foods that have a short list of ingredients are more appealing than those with a longer list; 61% of U.S. adults agree whole-plant foods are healthier than processed meat substitutes; and 61% of Canadian adults agree plant-based meat alternatives are overly processed.

Dornblaser indicated that natural products are evolving to more clean label products, emphasizing free-from claims, minimal processing and wholesome, simple ingredient statements without artificial ingredients. Examples include RxBar, which showcases a label that is also the ingredient list. Pressed by Kind is a bar that contains only mango, apple and chia pressed together, and Siggi’s yogurt has straightforward packaging that offers consumers just what is necessary to inform their purchase decision.

Foodservice brands are also embracing clean eating. “Panera Bread was an early adopter, unveiling in 2016 its no-no list and Food Promise, which called for only ‘clean’ ingredients,” she explained. Chicago-based LYFE Kitchen is committed to “sourcing



■ “Free-from...” was the original clean label claim. Now, the focus is on “hard facts” and the function of unfamiliar ingredients is sometimes explained.

the cleanest ingredients possible” for the restaurant, while the first certified-organic fast food restaurant in the U.S., Nic’s, only uses “clean, wholesome ingredients.”

“Clean-related claims are often considered healthier by U.S. consumers, but brands should be cautious not to use too many claims, as ‘claim fatigue’ can hurt credibility,” Dornblaser said.

In a statistic that’s still relevant today, in 2017, 62% of U.S. consumers agreed that, the fewer ingredients a food has, the healthier it is—up from 55% in 2016. She joked that her favorite food comprised of only oil, potatoes and salt would be considered very healthy with these consumers! In addition, only 44% of U.S. consumers trust the health claims on food/beverage packages, and 54% agreed many “free-from” claims are not meaningful to most foods

Natural claims alone won’t be enough for future clean label product success. Environmental stewardship is being linked to clean label. Dornblaser advised that going forward, corporate social responsibility, as well as the 21st Century principles—people, produce and planet—will gain in significance.

Mintel data has found that “clean and simple” claims are perceived by consumers as “healthy,” and “better-for-you” is about wholesomeness, not restrictions.

“Clean label is important, but it must be paired with good taste,” stressed Dornblaser. “This is absolutely critical.”

She concluded with final thoughts regarding clean label opportunities. First, “clean and simple,” inside and out. A clean label formulation must be backed up by clear, simple, easy-to-understand

Chicory root fiber: the only plant-based prebiotic for clean label solutions



communication on pack as to what makes the product “clean.” Second, “Clean label alone is not enough,” as consumers want products that offer a range of benefits, “clean” being one of them. Add in additional attributes, such as convenience, unique flavors or formats, or functionality. And, most important is the positive focus on the goodness of products and how the ingredients can provide additional benefits.

“Clean Label: Shifting Consumer Perceptions,” Dornblaser, Director, Innovation & Insight, Mintel

Clean Label Product Innovation and Renovation

CONSUMER DEMAND FOR CLEAN LABEL has been growing for more than five years. In many countries, it has become the new normal for a majority of consumers, noted Philippe Rousset, Ph.D., Global Clean Label Strategic Network Leader at the Nestlé Product Technology Center Beverage, in Orbe, Switzerland, in his presentation titled “Successes and Challenges of Clean Label in Food and Beverage: An Industry Perspective.”

Initially, clean label merely corresponded to the request for products made with a few, familiar ingredients. “Consumers have started to look more in detail at the product labels and be concerned about long lists of ingredients whose names were unfamiliar to them,” explained Rousset. “And, the emergence of ‘food shopping’ smartphone apps, like Yuka or EWG, has allowed them to very easily know which ingredients are undesirable with a quick product barcode scan.” Now, consumers are, in addition, requesting “more naturality, more transparency in the manufacturing process,” as well as in the origin and sustainability of the ingredients, he added.

The process of creating clean label products is not so simple—especially when an entire food and beverage portfolio of existing products is considered. Customers expect clean products to conform to a company’s brand in sensory profile, cost, functionality and shelflife—albeit produced with traceable and sustainably sourced, recognizable ingredients.

Greater consumer demand for clean label food has prompted the entire industry to

🌍 Differences in consumer preferences and regulations from country to country pose a major set of challenges (since more customization is often needed).

develop or complete an offering: This includes grocery chains, food manufacturers, food ingredient suppliers, restaurants and other foodservice outlets. The number of clean label launches has doubled in the last five years and is expected to continue growing at a fast pace, Rosset averred.

On the retailer side, “Several grocery stores have developed a negative list of forbidden ingredients for all or a specific range of their private labels ranges,” explained Rousset. Kroger, for instance, has strict requirements for its line of natural and organic products sold under its private label brand, Simple Truth®, with more than 100 undesirable ingredients.

Food manufacturers, in a similar and more limited way, have committed to move towards cleaner label products. In this category, noted Rousset, there are a lot of small players that have started fully clean from the beginning.

Clean label demand has, of course, trickled down to the ingredient suppliers’ level. “Ingredient suppliers have started to develop a range of clean label ingredients and additives with the functionality needed to replace existing artificial additives,” said Rousset. It is particularly important for some suppliers to take action, in the event their non-clean additives become obsolete, he added.

Clean-by-design development of products typically poses less of a challenge than renovation of products, as there is no existing reference. Indeed, for the renovation of an existing product, consumers expect no change in sensory quality, whether in appearance, taste or texture—but they want a label improvement. The manufacturer wants to produce at a similar cost and with a similar shelflife.

“So, the key challenge is to be able to make the renovated product with the same sensory quality; with cleaner ingredients; at a

Challenges in Renovating Existing Products

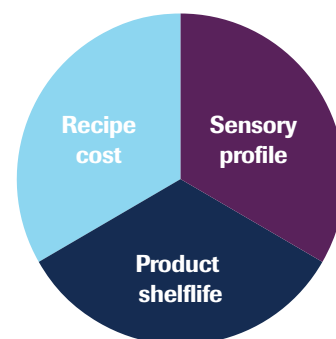
Deliver the same product with a different formulation.

Consumer

Taste	Clean Label
• No change in sensory	• Familiar ingredients • Shorter list

Manufacturer

Cost	Shelflife
• No change	• No change



SOURCE: PHILLIPE ROUSSET, PH.D., NESTLÉ PRODUCT TECHNOLOGY CENTER/2020 CLEAN LABEL CONFERENCE

competitive cost; and with a similar shelflife,” explained Rousset. “Sensory might be affected by all ingredients; shelflife by functional additives. Cost is potentially a big hurdle for colors and flavors. In the end, success or challenges will depend a lot on the consumer expectations for these products,” Rousset added.

Rousset described Nestlé’s strategy for renovating a portfolio of products as follows: 1) Obtain consumers’ insight as to which ingredient they value and which ingredient they reject; 2) Assess the status of the products portfolio to determine reformulation needs; 3) Identify replacement solutions—work with suppliers if necessary; and 4) Use these solutions to renovate portfolio, as needed.

Differences in consumer preferences and regulations from country to country also pose a whole new set of challenges—above and beyond sensory perception, quality, cost and functionality of reformulated products. Rousset presented an example of a company producing fruity-flavored cereals sold in the U.S. and Canada. While U.S. consumers of this product accept Red 40, Blue 1 and Yellow 6 artificial colors, as well as BHT for added freshness, Canadian consumers do not. The cereal made for Canada contains, instead, fruit and vegetable

juice concentrates, anthocyanin, turmeric and annatto as colorants, and no antioxidants—with an increased cost and possibly shorter shelflife.

Rousset concluded by reiterating that “clean label is a complex global trend, because it is a consumer perception, and because it encompasses several transparency aspects that the consumer wants to see more of in his products.”

Clean label has become mainstream in many countries, with demands for a simple label with fewer and recognizable ingredients. A lot of clean-by-design product launches are taking place, mainly in the premium range. The renovation of core products is key, yet difficult, depending on the iconicity of products and the consumer clean label expectations for a particular category, Rousset added. “A clear company strategy is helpful to define the roadmap to achieve the ambitious goal requested by our consumers,” he concluded.

“Successes and Challenges of Clean Label in Food and Beverage: An Industry Perspective,” Phillipe Rousset, Ph.D., White Coffee and Creamers Technology Lead, Global Clean Label Strategic Network Leader, Nestlé Product Technology Center Beverage

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Customized Chemical Risk Assessment

A CORE PRINCIPLE of the clean label movements is that consumers expect transparency in the foods they eat. This translates to expectations that the food will be safe in all aspects.

While food safety plans have always focused on microbial contaminants, the Food Safety Modernization Act identifies chemical hazards, including heavy metals and pesticides, as factors that now must be considered by food producers. As explained in her presentation, “Chemical Risk Assessment: A Tool for Determining Customized Contaminant Programs,” prepared for the 2020 Clean Label Conference, speaker Grace Bandong, MSc, Global Scientific Strategy Leader, Contaminants, Eurofins Food Integrity and Innovations, explained that chemicals in foods are clearly a problem.

According to the USDA Pesticide Database, 52% of food commodity samples contained a pesticide residue, with more than one pesticide identified in 32% of samples. The FDA is continuously issuing Import Alerts for pesticide and heavy metal

violations. A recent *Consumer Reports* study even found heavy metals in many baby foods.

In her role as Global Scientific Strategy Leader for Contaminants, Bandong hears several questions over and over: What chemicals should I test for? How do I test? How often do I test? To answer these questions, Eurofins developed a tool to help food companies, even those with limited budgets.

To control a chemical risk, you must identify, control and manage the hazard. The chemical risk-assessment process described by Bandong uses a phased approach. (See chart “Chemical Risk Assessment.”)

The first phase of chemical risk assessment includes identifying and characterizing hazards and exposures to those hazards. The data you must collect and review includes an ingredient list, along with a categorization and specification for each ingredient. Purchasing information, including supplier and audit records, are also required, as are the product formula and marketing information.

Identification of risk factors, starting with inherent risk factors, occurs next. To assess inherent risk factors, you need to know the incidence history and evaluate growing, harvesting, storage,

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processing and distribution practices for each ingredient. Is there potential for economic adulteration? The FDA's annual Pesticide Database Program Reports or FDA's Import Alerts are possible sources for this information, as are USP's Economic Adulteration Database and intra-company databases.

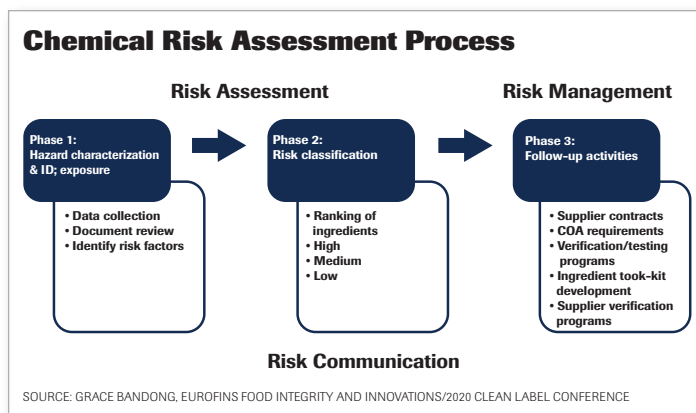
This information is then used to answer three questions: What is the likelihood of occurrence? What is the likelihood that the hazard will be removed by processing? Are multiple hazards present? Depending on the answers to these questions, an ingredient is given an inherent risk value of 1 (low) to 3 (high) risk.

Other characteristics of the ingredient that contribute to risk are similarly scored:

- **Volume driver:** The more of an ingredient you purchase, the greater the risk.
- **Percent of formula:** As the percentage of an ingredient within the formulation increases, so does risk.
- **Supplier history:** Do you trust them; do you audit them; are they compliant?
- **Targeted market:** Products marketed to infants, immunocompromised individuals or children are given higher scores.

• **Source geography** is also a consideration (evaluated on a scale of 1 to 5).

The scores for each risk factor are then multiplied together to calculate an overall risk classification for the ingredient.



Each company can then assign an overall risk classification for a range of scores. For example, if the ingredient score is greater than 100, that ingredient might be considered high risk; ingredients with scores less than 50 might be considered low risk. The testing

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program for each ingredient can then be tailored to these scores and your budget.

An unlimited budget may permit frequent testing for even low-risk ingredients. If the budget is more limited, you can allocate more testing to the higher risk ingredients and test lower risk products less frequently. For example, fruits may be at risk for pesticides, so you will screen them four-six times per year. Medium-risk ingredients might be tested twice a year, while low-risk ingredients might only be tested every other year.

A chemical risk assessment allows one to assign a risk value (high, medium or low) to every ingredient in a product. With risk values determined, more funds can be directed towards high-risk ingredients—so you can achieve excellent control and understanding of the materials; avoid surprises; and reduce customer exposure to contaminants, such as pesticides and heavy metals.

“Chemical Risk Assessment: A Tool for Determining Customized Contaminant Programs,” Grace Bandong, MSc, Global Scientific Strategy Leader, Contaminants, Eurofins Food Integrity and Innovations, GraceBandong@eurofinsUS.com

Methodology to Clean Label: Replace—Retool—Rebuild

ULTIMATELY, products have to be consumer acceptable in appearance, texture, flavor, cost and shelflife when developing any food or beverage, explained Webb Girard, MSc, Director of Research & Development, CuliNex, LLC, in his presentation titled “Rethinking Formulation Approaches for Simplified Ingredient Statement and Cleaner Labels,” prepared for the 2020 Clean Label Conference. Yet, the ill-defined and ever-expanding clean label market makes this goal even more challenging, he emphasized.

In determining what is clean, Girard posed various questions for consideration. “Is it the brand owner who determines what is clean? How much is consumer purchase intent driving the design of these products? Do the ingredients need to be found in a typical consumer’s kitchen? If an ingredient requires a lot of processing for extraction, whether fractionally or chemically, to achieve a desired functionality, is it clean? And, furthermore, how simple does a process have to be? These are questions that must be considered when making decisions about the clean label status of an ingredient,” he averred.

Once a clean label project has been initiated, it’s important to fully understand the project guardrails and parameters to be able to deliver on the brand promise. Girard provided a model example of a multi-component King Ranch Casserole and worked through each step, beginning with a Product Profile Sheet.

A well-written concept statement is key to understanding the individual components in the dish. In this case, it is a hearty, one-dish Southwest-inspired casserole with roasted chicken, Monterey Jack and Cheddar cheeses, onion/pepper blend and creamy sauce—layered between corn tortillas with a medium heat level from spices and green chilies. Other information provided in the Product Profile included key product attributes; target shelflife; packaging format, distribution (i.e., fresh, refrigerated); nutritional targets (i.e., excellent source of protein); free-from criteria (i.e., artificial color, no added sugar); ingredient restrictions (i.e., simple ingredients); and claims and certifications (gluten-free).

Girard described the goals of clean label product design as follows: Use whole food and naturally derived ingredients to create a culinary vision on the bench that is backed up by food science; balance flavor, function, cost and shelflife; map the translation of concepts across platforms; then translate those concepts into multi-component products.

The label clean-up development strategy involves taking each component and determining whether to replace, retool or rebuild. “Replace” entails a one-to-one ingredient swap, but it’s not always that easy, noted Girard. “Retool” requires cleaning up formula redundancies; adjusting a process step; or looking at different ingredient systems. A “rebuild” is the most complicated



Food components and processing of a King Ranch Casserole were replaced, retooled or rebuilt resulting in a prototype with 36 simple, transparent, easy-to-understand ingredients—down from 106 initial ingredients.

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choice, as it entails “taking the formula completely apart, down to its bare bones and reconstructing it with different materials...to get the same finished product,” explained Girard.

In the example above, beginning with the chicken, the development process follows each subsequent component, as the current ingredient statement is evaluated and decisions are made as to whether to replace, retool or rebuild in order to meet the requirements of the project as delineated in the profile sheet. It’s a complicated process, overall, with component rebuilds; shelf life, food safety and spoilage considerations; and packaging decisions to make.

“A rebuild may require capital investment—additional equipment, line extensions or other materials. Feasibility depends on return on investment, but you can’t rebuild or reformulate in a vacuum without understanding how that’s going to carry on to production processes,” said Girard. “You have to build the supply chain, which may not be there initially. Non-GMO Parmesan, for instance, has a 9- to 12-month aging cycle, so in order to use that in your production and meet all your volumes, you’re backtracking 9-12 months to get your supply built up, in order to get your product launched,” he added.

Clean label formulation can be a complex process from beginning to end. “The initial formula fits together in harmony. Every ingredient is balanced for form, function and flavor,” said Girard. The clean labeled product must do so, as well. But, will consumers accept the product as clean label? Therein lies the ultimate challenge.

“Rethinking Formulation Approaches for Simplified Ingredient Statement and Cleaner Labels,” Webb Girard, MSc, Director of Research & Development, CuliNex, LLC, webb@culinex.biz

Hydrocolloids as Plant-Based Clean Label Tools

HYDROCOLLOIDS ARE IMPORTANT components of many food products. With consumers demanding more clean label and plant-based products, what must a food manufacturer consider when choosing a hydrocolloid for a new plant-based product? Nesha Zalesny, MBA, Technical Consultant for the hydrocolloid market research company IMR International, provided practical

Hydrocolloids in Plant Based Milk

Hydrocolloid	Function	Type
Carrageenan	Suspension & mouthfeel	Kappa and iota type
High acyl gellan	Fluid-gel suspension, clean mouthfeel	Usually in combination with LBG
Locust bean gum	Mouthfeel, creaminess	
Alternate Ingredients		
Tara	Mouthfeel, creaminess	
Gum acacia	Emulsification, mouthfeel	Senegal
Oat fiber	Suspension (?), mouthfeel	
Citrus fiber	Mouthfeel	

SOURCE: NESHA ZALESNY, IMR INTERNATIONAL, NZALESNY@HYDROCOLLOID.COM/2020 CLEAN LABEL CONFERENCE

❏ **When using hydrocolloids in plant-based beverages, Nesha Zalesny advised to make sure the correct hydrocolloid level is used; ensure proper hydration and fill temperatures; and start with good-quality proteins.**

advice on this topic in her presentation “Hydrocolloids: Clean Label Tools for Plant-Based Formulating,” prepared for the 2020 Clean Label Conference.

With many choices of hydrocolloids available, Zalesny advised considering several key factors, easily remembered with the mnemonic TIPPS: Texture, (other) Ingredients in product, pH, Processing and Shelflife/storage. During her presentation, she applied the TIPPS approach to several plant-based product categories, including plant-based beverages, cultured products, frozen desserts and meat substitutes.

Plant-based “dairy” beverages include beverages that replace milk or milk products with almond, soy, cashew, coconut, hemp, oat and pea ingredients. These products require a texture that is light, creamy and drinkable. Other ingredients in these products include water, vegetable proteins and fats, and they usually have a neutral pH. The products are often ultra-high-temperature (UHT) processed and might be refrigerated or shelf-stable.

Hydrocolloids used in plant-based beverages include carrageenan, high-acyl gellan gum and locust bean gum. Alternative ingredients gaining momentum in this area include tara, gum acacia, oat fiber and citrus fiber. Carrageenan is used globally, although less so in the U.S., as a cost-effective way to provide suspension and emulsion stability. Carrageenan is very heat-stable, so it can be used in high temperature/short time (HTST) and UHT products, but it is not suitable for retorted beverages.

Because it is processed from an underutilized resource (seaweed), carrageenan may be attractive to consumers who appreciate a high employment factor. That is, carrageenan supports the financial well-being of industry workers—many in emerging economies. It's also of interest to note, said Zalesny, that “many seaweed farms are run by female entrepreneurs.”

Gellan gum, especially the high-acyl form, is a polysaccharide used in nearly all plant-based beverages. The steric hindrance of this polymer's side chains results in a more fluid gel, providing a clean mouthfeel and good suspension of proteins. The low levels needed compensate for its high cost. However, gellan gum cannot be retorted and, because it may be perceived to be “non-natural,” some consumers view it negatively.

Galactomannans are usually added with gellan gum when formulating plant-based beverages. Galactomannans are polymers with a mannose backbone and galactose side chains positioned along the backbone. Galactomannans with an increased galactose:mannose ratio have a more crystalline structure and lower solubility in cold water.

Locust bean gum works particularly well in plant-based dairy beverages but is relatively expensive. Tara gum is a good alternative as it has a similar chemical structure to LBG, but at less than half the price. For plant-based beverages with added fat, gum acacia can also be used to stabilize emulsions. This is because it has both hydrophilic and hydrophobic characteristics.

As an alternative to gellan gum, oat or citrus fiber are options for plant-based beverages, said Zalesny. Oat fiber especially “can do both,” meaning no additional stabilizers are needed, because manufacturers have “perfected Stoke's Law: the particle size and density are balanced by the viscosity of the beverage.”

Zalesny also provided troubleshooting tips when using hydrocolloids in plant-based beverages:

- Make sure you use the correct level of hydrocolloid.
- Ensure proper hydration and fill temperature.
- Start with good-quality proteins. Plant particles have a large distribution of particle sizes, so homogenization may be helpful.
- Buffer, buffer and buffer: It will help protect proteins during UHT.

The presentation also provided a description of TIPPS analyses for plant-based yogurts, frozen desserts and meat substitutes. Plant-based meat substitutes, a rapidly expanding market, includes cold cuts or hot products (burgers). For cold cuts, carrageenan (blended with xanthan, locust bean gum, proteins and starches) forms a gel and gives good bite and “slice-ability.” In contrast, plant-based burgers utilize methylcellulose, due to its unique characteristic of being insoluble in hot water; this allows a soft, uncooked product to become firmer during cooking, like

ground beef. Some plant-based burgers include carrageenan and other proteins (including potato protein) and starches to provide binding before the meat is cooked.

Consumers increasingly are embracing clean label foods, and plant-based foods score high in the “emotional” clean label area (cruelty-free, sustainable, etc.). The use of hydrocolloids is important in plant-based products, just as it is in traditional products. However, in many cases, different hydrocolloids or formulation strategies will be needed. Careful consideration of the product's desired texture; other ingredients in the formulation; pH of the final product; processing methods; and shipping and storage conditions will assist in choosing the best hydrocolloid for your product.

*“Hydrocolloids: Clean Label Tools for Plant-Based Formulating,”
Nesha Zalesny, MBA, Technical Consultant, IMR International,
nzalesny@hydrocolloid.com*

Multifactorial Food Preservation

CONSUMERS WANT LESS SEVERELY (in other words, minimally) processed foods. They also desire their foods to be formulated with clean label ingredients when possible, and they prefer packaging that is recyclable and sustainable. Jairus David, Ph.D., Principal Consultant, JRD Food Technology Consulting, LLC, provided a detailed overview of minimally processed foods and how hurdle technology can be used to ensure the safety and quality of these products—while still meeting consumers' demands. His presentation, “Hurdle Technology: Multifactorial Food Preservation for High Quality Foods,” was prepared for the 2020 Clean Label Conference.

The spectrum of food processing categories ranges from “Not Preserved, Raw” (fresh foods) to “Heat Preserved” (fully modified). Minimally processed foods fall just after “Not Preserved, Raw” in this continuum and are similar to fresh foods, in terms of product quality. USDA defines minimally processed products as those “processed in a manner that does not fundamentally alter the product,” while FDA does not define the term.

Four major design principles can be used when developing a minimally processed food. First, thermal or nonthermal processing may be applied to inactivate microorganisms. Thermal treatments may include pasteurization at 70°C for two minutes to control *Listeria monocytogenes* (“L. mono cook”) or at 90°C for 10 minutes to control non-proteolytic *Clostridium botulinum* (“non-prot bot cook”). Secondly, the food matrix may be formulated to maintain preservation by modifying the pH or water activity, or by the addition

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Food Processing Categories “Raw” to “Heat Preserved”

Preservation Category	Not Preserved, Raw (1)	Minimally Processed (2)	Cold Preserved (3)	Dehydrated (4)	Heat Preserved (5)
Product Quality	Fresh	Like fresh	Slightly modified	Slightly to fully modified	Fully modified
Process and Preservation Methods	Usually does not require processing or preservation method	Requires minimal processing and preservation methods – Clean label ingredients	Requires processing and cold preservation –Freezing or refrigeration	Requires processing and dehydration	Requires processing and heat preservation
Storage Shelflife	May or may not be refrigerated	Requires refrigeration temperatures. Not a kill step, but a hurdle when it is continuous without breaks –S&H and Retail	Requires frozen or refrigeration temperatures	Usually shelf stable at ambient temperatures	Shelf stable at ambient temperatures
Packaging	May or may not be packaged	Requires packaging – Sustainable	Requires packaging	Requires packaging	Requires hermetically sealed packaging

SOURCE: JAIRUS DAVID, JRD FOOD TECHNOLOGY CONSULTING/2020 CLEAN LABEL CONFERENCE

Four design principles can be used for minimally processed food including: 1) thermal or nonthermal processing; 2) the food matrix formulated to maintain preservative; 3) packaging use; and 4) continuous refrigeration.

of an antimicrobial. Next, packaging (which may contain a modified atmosphere to inhibit microbial growth) is used to prevent product contamination. Finally, the product will need to be kept continuously refrigerated, including during distribution and storage, to maintain safety and quality.

David reviewed the food poisoning microbes of concern in minimally processed refrigerated foods. *Listeria monocytogenes*, *Yersinia enterocolitica* and *Aeromonas hydrophila* can grow at refrigeration temperatures but are easily heat inactivated by an “L. mono cook” step. *Salmonella* spp., *Vibrio parahaemolyticus*, pathogenic *E. coli* strains and *Staphylococcus aureus* are also inactivated easily, and they cannot grow at refrigeration temperatures.

In contrast, non-proteolytic *Clostridium botulinum* and certain *Bacillus* spp. may grow at refrigeration temperatures and are heat-inactivated by “non-prot bot cook.” Finally, proteolytic *C. botulinum* and *C. perfringens* have higher heat resistance—but cannot grow below temperatures of ~10 C—which makes them of particular concern in temperature-abused products, due to their ability to produce toxins.

Combinations of different tools or “hurdles” are typically employed to control microbial growth in minimally processed foods. Many metaphors have been developed to illustrate the hurdle approach used in foods. David discussed the traditional “boiled egg” model, which describes each antimicrobial factor as a separate “boiled egg” obstacle of differing heights and widths, according to its individual strengths in controlling the pathogen. A weakness of this model is that it cannot account for synergies or interactions between the “eggs.”

In the hurdle race metaphor, the hurdles are of the same height and are equidistant from each other, suggesting that each antimicrobial or process must be used at full strength. However, each hurdle should be used at suboptimal levels for minimally processed foods—otherwise, they won’t be “minimally processed.” Redundant antimicrobials or processes will negatively impact product quality.

As an alternative, David Legan and Jairus David have proposed a “pole vault” model. The individual hurdles stack together on top of each other to create a high barrier for microbial growth. [Note: To see graphic representation of these models, search for this presentation online at GlobalFoodforums.com.]

Using another analogy, David compared the use of multiple antimicrobial processes to a radio. An old-school radio may have only a few dials, so fine-tuning is not possible. Processed foods which utilize only a few hurdles may end up being severely processed. In contrast, a modern synthesizer may have dozens of controls, each of which can be finely adjusted to provide exquisite sound quality. Multiple factors are used in minimally processed foods that are in the marketplace, with more than 10 “dials” used for some products. Adding multiple hurdles to a product will increase a product’s cost, but it also increases a product’s value and ensures product quality and safety.

“Hurdle Technology: Multifactorial Food Preservation for High Quality Foods,” Jairus R. David, Ph.D., Principal Consultant, JRD Food Technology Consulting, LLC

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■ **Concentrated fruit powders can work well as replacements to artificial flavors. Use gel versions of natural coloring products to avoid diluting a food system and impacting viscosity and flavor.**

“clean label” products, consumers are asking to buy them. So how do you, as a food innovator, approach this clean trend? Lin Carson, Ph.D., Founder and CEO of BAKERpedia, explored different solutions in her presentation titled “Innovative Clean Label Ingredient Replacement Technologies for Baked Goods.”

Before diving into solutions, however, Carson noted that at least 93% of U.S. households have purchased a clean label product at a grocery store. Half of all shopping trips now include the purchase of a clean label product, according to Nielsen (<https://bit.ly/3e00wZM>).

For a food producer, it means having a simple and short ingredient list that is easy to understand, as well as no chemicals, artificial preservatives, color agents or flavor agents. As Carson explained, it’s all about finding natural ingredients that create similar results. Here are some solutions for key aspects of the baking industry.

Colors and flavors: Artificial butter flavors are replaced by concentrated dairy products, buttermilk and even yeast-based extracts. For artificial fruit flavors, concentrated fruit powders work well. When using natural coloring products, gel versions work best to avoid diluting your system and affecting viscosity and flavor.

Emulsifiers: Mono- and diglycerides and PGME are the industry standard, and there is really no alternative yet that is as process-friendly. However, look into alpha-cyclodextrins for

frostings. For cakes, canola or soy lecithin and wheat protein isolates have been known to replace emulsifiers.

Dough conditioners: DATEM and SSL are another tricky thing to replace. Vital wheat gluten and enzymes, like glucose oxidase, xylanase and phospholipase helps. Or, you can try aging your flour for up to 14 days or longer fermentation times.

Anti-mold ingredients: The key elements to prevent mold are sanitation and water activity. So, if removing artificial preservatives, humectants—such as sugar, honey and other ingredients (like salt and gums)—decrease water activity, thus less water is available for mold growth. For bread, alternative mold inhibitors to try are cultured wheat, whey with vinegar, prune and raisin concentrates, rosemary extract, cinnamon and clove. In yeasted products, naturally-obtained, encapsulated sorbic acid can replace potassium sorbate.

Other ingredients to add: There are a few ingredients that fit well into multiple clean label applications. For example, enzymes can act as a natural alternative for many ingredients and functions. A few ways they help formulas include improving flour quality and emulsification; and increasing water absorption and the machinability of the dough. Enzyme and ascorbic acid blends have been used to replace potassium bromate, ADA, DATEM and SSL.

Starches are another option. Mechanically pregelatinized starch is used to replace chemically modified starch and dextrin. The various modifications also provide viscosity and, therefore, increase the stability of networks that were previously supported by emulsifiers. Fibers and gums also have a wide range of function roles and can be clean label.

While these ingredients are reliable short-term solutions, there are other ways to clean up your label through process, as well. A few options to look into are:

- Sponge and dough systems can naturally hydrate your dough to make it easier to machine.
- Stress-free dough-handling systems may be lower in speeds, but they are effective in eliminating many dough conditioners.
- Thermal profiling your system and targeting a longer bake-out will help dry out the baked product and reduce mold issues.

In the end, it’s all about knowing what role ingredients play in your formulas and finding natural alternatives that fill the same role. Pay attention to all aspects of your process and where other ingredients and adjusted ratios can carry the weight. It seems the clean label trend is here to stay. So, we’ll just keep finding innovative solutions.

“Innovative Clean Label Ingredient Replacement Technologies for Baked Goods,” Lin Carson, Ph.D., Founder and CEO of BAKERpedia

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Dairy for Clean Label

CLEAN LABEL IS EVOLVING, and dairy ingredients are well-positioned to deliver clean labeled products. A cleaner label can be achieved by leveraging the unique composition and inherent functionality of “off-the-shelf” dairy ingredients or by tailoring dairy ingredients to achieve targeted solutions.

“Food ingredients play many roles, including providing taste, nutrition and functionality to the finished product. When you start to change ingredients, it is easy to disturb the overall harmony of a food,” said Rohit Kapoor, Ph.D., Vice President of Product Research at National Dairy Council, in his presentation, “Dairy for Clean Label: Innovations in Dairy Based Ingredients for Clean Label Solutions,” prepared for the 2020 Clean Label Conference.

Milk contains 3.4% protein, 4.8% lactose, 3.9% fat, 0.8% ash and 87.5% water. The processing of dairy ingredients is very clean and simple. Typical processes include pasteurization, separation, fermentation, evaporation and drying. Membrane filtration is similar to using a coffee filter but with more sophisticated, specific pore sizes to separate protein from lactose and create concentrated, whey and milk protein ingredients.

In milk, the casein-to-whey protein ratio is 80:20, and protein-concentrated ingredients can be classified as either casein-rich or whey protein-rich. Lactose-rich ingredients are created as a by-product, as are ingredients that are rich in important dairy minerals.

“Off-the-shelf” dairy ingredients can deliver important functional properties, including gelation and emulsification. The intrinsic properties of casein-rich vs. whey protein-rich ingredients are different. Casein-rich ingredients will exhibit better heat stability and less solubility at lower pH, while whey protein-rich ingredients show superior solubility at lower pH. (See chart “Protein Ingredient Functional Property Comparisons.”)

Dairy ingredients are an ideal choice for clean label, because they deliver excellent functionality, cleaner flavor and higher protein quality than many other ingredients. They allow food manufacturers to use fewer starches, hydrocolloids and flavor maskers. They also don’t require protein blending for protein claims, as do many vegetable protein ingredients.

Researchers at the University of Wisconsin-Madison compared various dairy vs. plant protein

This chart shows results of research at Wisconsin Center for Dairy Research (CDR) comparing functionality of various proteins.

ingredients. They ran a battery of functionality tests and concluded that overall, dairy proteins were generally more functional and versatile than plant proteins.

Dairy ingredients, with their fairly neutral, clean flavor, also deliver a superior sensory profile in final products.

In a model UHT beverage study, milk protein yielded a more homogeneous product, while pea, soy and rice proteins caused some coagulation; rice protein caused considerable discoloration. In a protein water model beverage study, whey proteins delivered superior clarity and stability as compared to soy or pea protein.

Dairy proteins deliver superior nutritional quality. The PDCAAS of milk protein and whey protein is 1.0, whereas soy protein is 0.98; pea protein is 0.89; and rice protein is 0.42.* Using plant proteins often requires blending of several proteins to achieve desired protein quality, thus increasing the length of the ingredient legend.

Fat-rich dairy ingredients provide unique mouthfeel, as well as superior flavor release and sensory experience. Use of high-fat dairy ingredients in coffee creamers is a growing clean label trend.

Dairy ingredient manufacturers can perform slight processing adjustments to achieve ingredients with very specific, tailored heat-stability or emulsification properties. For example, chelating out some of the calcium yields milk protein ingredients (e.g., MPCs) with significantly greater solubility and heat stability in RTD beverages. These tailored MPCs can replace phosphates in RTD beverage applications.

Protein Ingredient Functional Property Comparisons

Functional Property	Results
Water-holding capacity	Milk ~ Soy ~ Pea > Whey ~ Potato ~ Rice
Viscosity	Milk ~ Pea > Whey ~ Soy ~ Potato ~ Rice
Heat stability (acidic conditions, pH 3)	Whey > Plant > Milk
Heat stability (neutral conditions, pH 7)	Milk ~ Whey > Plant
Emulsion activity	Milk ~ Whey ~ Pea ~ Soy > Potato > Rice
Emulsion stability	Milk > Whey ~ Pea ~ Soy > Potato > Rice
Foamability	Whey > Soy ~ Potato > Milk > Pea
Foam stability	Whey > Milk > Soy and > Pea > Rice
Gel strength	Whey > Potato ~ Pea ~ Soy

SOURCES:
1. USDEC. 2018. A NEW ERA FOR PROTEIN: WHY U.S. DAIRY DELIVERS IN THE CROWDED PROTEIN MARKETPLACE. WWW.THINKUSADAIRY.ORG
2. KAPOOR ET. AL. 2017. CHARACTERIZATION OF COMMERCIAL FOOD PROTEIN INGREDIENTS. INTERNATIONAL WHEY CONFERENCE. CHICAGO IL



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In other examples from emerging research, a tailored ingredient that combines whey protein isolate and pectin has shown to enhance emulsification in salad dressings and replace less label-friendly ingredients, such as mono-

glycerides and polysorbate 80. And, skim milk powder can be produced by treating milk with high-pressure jet to increase its foaming properties. This ingredient will be useful in ice cream and lattes, where foaming is desired



and can be declared as simply “skim milk” on the product label.

Other processing adjustments produce micellar casein that can result in a coffee creamer with superior whitening and emulsification properties and can be used to replace sodium caseinate in this application. Emerging research has also shown that lactose-rich ingredients can be modified by catalytic treatment or enzymatic conversion to create a sweetening syrup that can be used as an alternative to artificial sweeteners.

Additional beneficial ingredients, such as cultured milk or cultured whey ingredients, function as label-friendly, unique bio-preservatives that can replace potassium sorbate or sorbic acid.

Dairy ingredients have a clean image and are well positioned to deliver diverse functional properties and versatility, leveraging their unique composition and inherent functionality.

* Information from Phillips SM, *Front. Nutr.*, 2017; 4: 13 (<https://doi.org/10.3389/fnut.2017.00013>)

“Dairy for Clean Label,” Rohit Kapoor, Ph.D., Vice President, Product Research, National Dairy Council, rohit.kapoor@dairy.org



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Who's Who: 2020 Technology Snapshot Companies

SINCE THE FIRST CLEAN LABEL CONFERENCE in 2013, Global Food Forums—along with the help of a Technology Snapshot Advisory Panel—has selected 18-21 Technology Snapshot presentations from a field of dozens of submissions. Each ingredient is ranked on seven attributes, such as “Newness,” “Uniqueness in the Marketplace” to “Functional/Technical Benefits.” The results from the judges on all attributes are then averaged; the highest scoring submissions are invited to participate. Most presentations were video recorded in 2020. See website links below.

The 2020 Advisory Board members included Stevan Angalet, Ph.D., Angalet Group International; Webb Gerard, MSc, Director of Technology, Culinex, LLC; Kerry Hughes, MSc, Pure Encapsulations & Ethnopharm; David Lafond, Ph.D., MBA, Lafond Food Technology LLC; Raj Narasimmon, Ph.D., Narasimmon Consulting; and Alex Woo, Ph.D., CEO & Founder, W2O Food Innovation. For more information on the selection process, see www.globalfoodforums.com/technology-snapshots

Botaniline - O'Brien's Best Potato. This one ingredient substitution allows manufacturers to eliminate fillers, binders, allergens and chemical additives, resulting in a reduction in calories, saturated fats and up to a 90% reduction in sodium in their finished processed protein products. <https://vimeo.com/405519502/>

CP Kelco - NUTRAVA Citrus Fiber. As the clean label megatrend strengthens, for F&B manufacturers, NUTRAVA™ Citrus Fiber serves as a unique solution, providing both nutritional benefits and distinctive rheological properties in various applications, while meeting clean label needs. <https://vimeo.com/401390383>

DDW - Naturbrown® Organic Apple. A breakthrough brown ingredient manufactured from organic apple juice concentrate, Naturbrown® can be used as a simple label alternative to caramel color in most applications. <https://ddwcolor.com/>

DuPont - ENOVERA. As DuPont's newest game-changing enzyme innovation for the U.S. industrial baking industry, ENOVERA offers exceptional strength, volume and performance in a robust, easy-to-use solution for manufacturers looking at label-friendly formulation alternatives. www.food.dupont.com/

EDGE Ingredients - FiberGel 200. FiberGel 200 is a novel, gelling whole-food fiber. It enables formulators to improve texture and replace gelling hydrocolloids with a clean label alternative. <https://edgeingredients.com/>

Fiberstar - Citri-Fi® Natural Citrus Fiber. Replace methyl cellulose in meat alternatives! Use Citri-Fi natural citrus fiber, which forms gels with other natural hydrocolloids, to create clean label, vegan meats with improved nutritional profiles. www.fiberstar.net/

HPI - Ortiva® Rice Milk. Got Rice? Ortiva® Rice Milk is a clean label formulation alternative to dairy, soy and almond milk. <https://vimeo.com/409202127>

The Ingredient House - Nouravant™. This maple fiber is an all-natural breakthrough new to the world of ingredients! Functioning as an egg replacement and emulsifier, it is a clean label product that can be added to a variety of applications. <https://vimeo.com/406305199>

INGREDION - Evanesse™. As a clean label emulsifying agent derived from chickpeas, Evanesse™ CB 6194, an ingredient known as aquafaba, provides emulsification for a wide range of oil levels in high-moisture applications such as mayonnaise and sauces. Labelled simply as “Chickpea Broth,” it allows for vegan positioning. <https://vimeo.com/406569732>

Innovopro - CP-Pro 70®. This chickpea protein concentrate is a highly nutritional protein that is easily incorporated into various food and beverage products due to its neutral taste and color; its emulsifying and other functional properties; and its ability to replace artificial additives. <https://vimeo.com/405002528>

Jungbunzlauer - Sodium Gluconate. As an affordable and effective flavor ingredient with modifying properties, Sodium Gluconate is used to suppress the bitterness in a variety of products, including high-intensity sweeteners like stevia, polyphenols, natural colors, caffeine and minerals. www.jungbunzlauer.com/

Mane-Kancor - OxiKan CL. There is an increasing demand for natural antioxidants globally, but their impact on color and flavor has limited their use. Kancor's innovative product OxiKan CL is a fully decolorized, deodorized and de-flavored natural antioxidant. <https://vimeo.com/405974080>

Nascent - SoPure Stevia. Reb E is a new stevia leaf extract that has fewer off-notes compared to Reb A. New stevia-based natural flavors may provide more mouthfeel and flavor-blocking capabilities, as well as enhance sweetness (FEMA GRAS Status). <https://vimeo.com/405978708>

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Who's Who: 2020 Technology Snapshot Companies

Naturex by Givaudan - Xtrablend RN. This new, natural synergistic blend offers successful oxidation management for food emulsions, including mayonnaise or salad dressings. It delivers a powerful combination of both chelating and free-radical scavenging activities, with no impact on taste, and is a perfect direct replacement for EDTA. <https://vimeo.com/405955378>

Paragon Pure – CaptaClean®. This brown rice flour-based technology is used for spray-dried flavor, color and nutraceutical powders. It provides excellent encapsulation performance within the format of a clean label, gently processed traditional food. We capture delicious, naturally. <https://vimeo.com/405949275>

Prova - Cold Brew Coffee Extract. Made from Cold Brew Arabica Coffee concentrated with proprietary technology to a minimum of 44' TDS, PROVA's Cold Brew Coffee Extract may be stored at an ambient temperature for up to 12 months. <https://vimeo.com/406305566>

Sensient Flavors - Entice. Entice is a taste technology that provides moistness, juiciness, mouthfeel and taste to offset the dryness and off-notes that come from the use of various protein sources used in making meat alternatives. www.sensientflavorsandfragrances.com/

Socius Ingredients - SenseFi® Oat Fiber. As a new multifunctional ingredient offered to the clean label food industry, it enables formulation of food products, plant-based and traditional dairy products without compromising mouthfeel, texture or taste. <https://vimeo.com/407331095>

Socius Ingredients - GLYLOID® Tamarind Seed Gum. Used in Japan for 50+ years, it has now been recommended by the NOSB to be added to the organic exempt list (7 CFR 205.606) in the U.S. <https://vimeo.com/406573503>

Sweet Green Fields - STEVIAROMA. As a ready-to-use, stevia-based natural flavor modulator for high-intensity sweeteners, STEVIAROMA improves the sugar-like taste profile by harmonizing sweetness and flavor from low-to-high level sugar reduction without changing the label. <https://vimeo.com/406565255>

Synergy Flavors - Pure® Hops Essences. Hop Essences are the latest clean label ingredient from Synergy Pure® that adds the characteristic flavor and aroma of hop varieties to any beverage and doesn't need to be labeled for use in beer. www.synergytaste.com/

2020 Clean Label Conference Magazine Advertiser Profiles



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in the food industry and are designed to provide exceptional initial knockdown and long-lasting defoaming during food processing. We offer both liquid and powder defoamers with options suitable for organic, non-GMO and identity-preserved processing. MAGRABAR products are allergen-free, kosher and halal and are produced in a Global Food Safety Initiative (GFSI)-certified facility, operating under food GMPs and a HACCP-based food safety system. www.magrabar.com



Inspired by Nature since 1895, **Nexira** is the world leader in acacia and a premier supplier of natural ingredients and botanical extracts for the food,

nutrition and dietary supplement industries. Our portfolio of products includes highly functional solutions to overcome your technological challenges and nutritional ingredients to enrich your formulations (e.g., native vitamins, all-natural prebiotics). Keep your ingredient list short and simple with our label-friendly ingredients. From superfoods and botanical extracts to branded ingredients, Nexira's solutions meet consumers' increasing demand for clean label & sustainable ingredients. www.nexira.com



Sensus produces the innovative ingredients, chicory inulin and chicory oligofructose. Besides being effective fat and sugar replacers, these prebiotic fibers contribute to a healthy microbiome,

affecting our health and general wellbeing. These dietary fibers are extracted from a natural source, the chicory roots, and are verified natural according to the ISO 19657:2017 guidelines. Thanks to their beneficial properties, chicory inulin and chicory oligofructose are extremely suitable for use in healthy dietary products. www.inspiredbyinulin.com/



SSI is a manufacturer of naturally treated grain products that are designed to replace chemically modified ingredients in various applications. You can remove modified food starches from soup; replace

chlorinated cake flour with a natural alternative; and use ingredients such as wheat flour in applications where food safety is of concern. www.siemersi.com



With **WTI** on your side you'll have an innovation partner, dedicated to applying industry insights strategically and creatively. You'll have much

safer clean label products with longer shelflife. WTI produces dry and liquid clean label, all-natural, organic, low-sodium and traditional antimicrobials for a variety of food product applications that improve food by inhibiting pathogens; extending shelflife; enhancing yield; and improving quality. www.wtiinc.com/

Delivering Fresh Ideas.

...Passionate about food safety



Simple. Clean. Safe.

Functional Food Ingredients

With WTI on your side, you'll get a fresh perspective on how to improve safety and food quality while meeting your clean label requirements. Our out-of-the-box thinking will help you navigate every option and utilize more naturally derived ingredients.

Our scientific knowledge and passionate approach to food safety brings more unique ideas to the table.





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