

2016 PROTEIN TRENDS & TECHNOLOGIES SEMINAR

SUMMARY: FORMULATING WITH PROTEINS

Leucine Saturation

% Leucine	Unstrained (gms/100g)	Strained (gms/100g)
8.0%	-26g	-17.7g
7.5%	-28g	-19g
8.6%	-24g	-16g
8.1%	-26g	-17g
9.8%	-21g - 21oz	-14g - 14oz - 2cups
12.0%	-17.5g	-12g

*From data matrix of protein 20 to 30g per 100g (unstrained) for 1 liter of liquid. Add 1.1 to 3.0g for "leucine" (protein) for each 100g of each food prod.



Note: This digital magazine, initially posted at <https://GlobalFoodForums.com>, is now at <https://foodtrendsnotech.com/global-food-forums-magazines/>

NEW!
2017 R&D Report:
Protein Ingredients
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2016 Protein Trends & Technologies Summary

The environment at the 2016 Protein Trends & Technologies Seminar was optimistic. Consumers continue to see proteins as possessing a variety of health benefits. And, as a key component in diets, their future looks bright. As Chris Schmidt, then Senior Consumer Health Analyst at Euromonitor International, said during his Pre-conference: Business Strategies presentation, “Proteins are the only macronutrient category that has not experienced some type of negative campaign in the media...there are no ‘low-protein diets.’”

Now in its fourth year, Global Food Forums, Inc.’s Protein Trends & Technologies Seminar has come into its own as a reliably successful event. Firmly entrenched as North America’s largest conference dedicated to the protein ingredient market and technologies, the event broke previous attendance records. Held May 3-4, 2016, in Oak Brook, Ill., USA, the 253 registrants once again had the option of attending the May 3rd Pre-conference and/or May 4th Technology Program: Formulating with Proteins. A brief summary of the excellent presentations from this year’s program is provided here.

All presentations or/and adapted versions are available at <http://GlobalFoodForums.com/2016-Protein-Seminar/Store>.

We’d love to see you at our 2017 Protein Trends & Technologies Seminar, May 23-24, 2017, at the Westin Hotel, Itasca, Ill., USA. www.GlobalFoodForums.com/2017-protein-seminar



■ Numerous opportunities for networking, booth exhibits and the interactive Protein Sampling Station all added value to the 2016 Protein Trends & Technologies Seminar’s Formulating with Proteins program.

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Chip English, Partner, Davis Wright Tremaine LLP

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The Global Food Forums Story



When we launched Global Food Forums, Inc. in 2012, our vision was to develop a family of in-person, niche product development conferences for the food, beverage and nutritional products industry.

Each event would be tied to a significant, long-term consumer and industry trend in which applied food science would need to play a vital role. The events' technical programs would be designed to provide R&D and other food scientists with practical and impartial formulation advice, along with key consumer trend insights, emerging ingredient technologies, regulatory updates and other factors directly impacting product formulations.

With our focus on food technologists as our "core customers," all decisions are driven by how our actions will impact this community's experience at our events. We also believe that in a world dominated by digital communications, the key to true human innovation and collaboration happens when people meet face-to-face.

Four short years later, our start-up now includes three annual conferences. Besides the Protein Trends & Technologies Seminar, we have the successful Clean Label Conference and new Sweetener Systems Trends & Technologies Conference. To



date, these events have attracted over 1,700 attendees, from VP/Directors of R&D to bench-level food scientists. Additionally, we are launching the *Global Food Forums® 2017 R&D Report: Protein Ingredients*, based on survey results from product formulators on their opinion of current and future use of protein ingredients. (www.globalfoodforums.com/PIR)

We also publish post-conference Summaries for all our events' programs that are distributed in print and online. GlobalFoodForums.com is also home to some 150 complimentary PowerPoint presentations from our events. The website is experiencing exponential growth in page views, currently at over 1,000 per day.

We hope that you'll attend one of our future product development events. We'll work hard to make it one of your best conference experiences ever!

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

GFF: A Winning Team!

The Global Food Forums Team is composed of people who are dedicated to the food and conference industries. We have 100+ years' experience in the worlds of food science, publishing, writing/editing, conference management, market research and graphic design. For an inside look on individual team members, visit: www.globalfoodforums.com/about-us/gff-team/

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Consumer Market Opportunities in Protein

Consumer trends in protein have become a bit polarized. On the one hand, there are drivers pointing to alternative plant proteins as having huge growth potential—what with more interest in vegan and vegetarian diets, greater affordability, and heightened awareness of clean label and sustainability factors in meat production.

“At the same time, there’s also this big, beefy burger trend,” countered David Sprinkle, MBA, Research Director, Packaged Facts, who pointed to brisket and pulled-pork sandwiches, meat jerky, chocolate-covered bacon and pet food sectors that are “taking meat to its most extreme and primal”—and are doing quite well.

There is increased demand for dietary proteins, in general, he reported in his 2016 Protein Trends & Technologies Seminar presentation titled “Consumer Market Opportunities in Protein.” Data compiled by Packaged Facts from Fall 2015 Simmons NCS, Experian Marketing Services, found the share of U.S. adults specifically purchasing high-protein foods in relation to watching their diet has increased steadily, from 11.9% in 2012 to 14.9% in 2015.

If there was an even longer trend line, “I think it would show more growth, as protein has entered the spotlight for weight management and weight control. It’s one of the drivers creating opportunities in this market,” he said.

When Packaged Facts analyzed the demographic information on who was most likely to purchase protein products, a few indicators rose to the top: those with college degrees; who live in condos or co-ops; have household incomes over \$100K; or are under age 35. Millennials are statistically more likely to seek protein and are more often cutting back on meat consumption to seek out vegetarian alternatives. “Millennials are setting the tone and trends in the marketplace,” Sprinkle said. “They’re very conscious of their protein options and choices—and the implication of those choices.”

Americans’ attitudes toward meat proteins are complicated, Sprinkle said, referring to their data. “In terms of America’s love affair with meat, you can see it starting to crack at the edges, but it’s certainly not going away. Meat hasn’t been pushed off center plate; it’s just being critiqued and reconsidered, to a degree.”

Emblematic of the continued demand for traditional, even retro proteins are the top gainers as seen in menu penetration, when it comes to sandwich proteins. Datassential MenuTrends shows egg (often in the form of egg white) is among the highest gainers in this arena, along with pork and sausage, each with more than 5% growth in sandwich menu penetration over the past decade. Plant proteins, meanwhile, haven’t yet gained robust presence on menus, with less than 10% including menu items with lentils, edamame, chickpeas, flax, chia or pumpkin seeds.

Many categories are generating new products making high-protein claims—frozen yogurt, ice cream, smoothies, dairy/soy drinks, cereals and soups among them—as individual companies increasingly morph to take advantage of the heightened demand for protein of all types. Sprinkle pointed to Muscle Milk moving from sports products to the dairy beverage aisle, and Quest spreading from protein powder into indulgent bars.

Even straightforward products take news twists and turns to hook the protein-seeking consumer, such as Hummus Plus’s addition of chicken to become more center plate than on-the-go snack, and peanut butters expanding into more dessert-like flavors. “Everyone is ending up competing with each other for the protein dollar,” he said.

Gender has long been one of the cards to play in differentiating protein products, but even those boundaries blur with

U.S. consumers are reading labels more carefully and are concerned about GMOs, antibiotics and safety/contamination. That said, meat isn’t going away.

Consumer Attitudes: The Meat and The Meatless		
Attitude	Strongly Disagree (%)	Strongly Agree (%)
Am concerned about animals being given growth hormones	6.9	33.2
Am concerned about animals being given antibiotics for production reasons	6.4	31.9
I prefer to meet my protein needs from meat, fish, and poultry	3.8	31.2
Food safety/contamination is a major concern for me with fresh meat/poultry	6.4	28.0
Am concerned about animals being fed GM ingredients	9.8	25.1
Read the labels of meat and poultry products carefully	9.8	23.0
Over the last few years I've been eating less red meat than previously	13.7	20.4
Consuming more vegetarian sources of protein is much better for environment	8.5	17.7
Am eating more meatless/vegetarian meals these days	29.6	13.5
Over the last few years I've been eating less poultry than previously	23.9	10.4
At home I often eat meat alternatives made of vegetarian ingredients	46.9	9.1
When eating out I often eat meat alternatives	45.2	8.1
I avoid meat	49.2	6.0

SOURCE: PACKAGED FACTS, MEAT & POULTRY: U.S. MARKET TRENDS & OPPORTUNITIES (DECEMBER 2015), 2016 PROTEIN TRENDS & TECHNOLOGIES SEMINAR

Enabling the next generation of protein



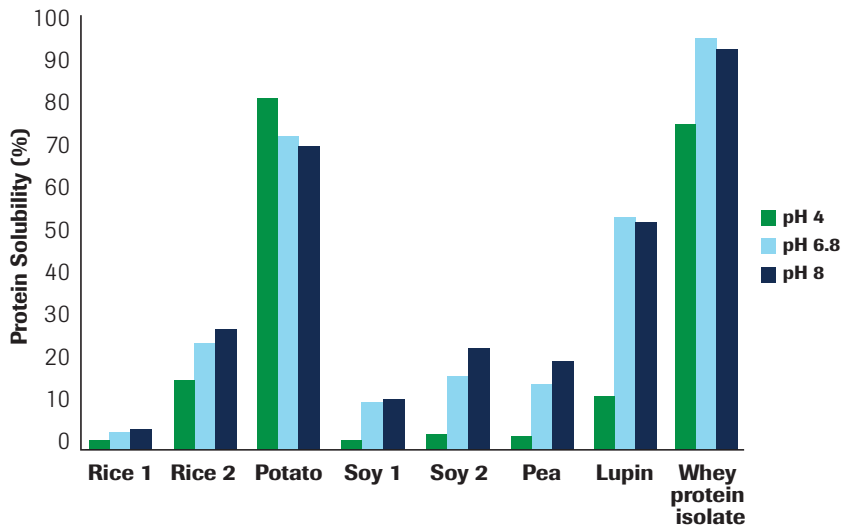
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Plant Solubility

Plant Proteins: Solubility Matters [solubility at various pH]



SOURCE: NIZO FOOD RESEARCH
2016 PROTEIN TRENDS & TECHNOLOGIES SEMINAR

📌 **A few years back, NIZO analyzed the solubility of a number of commercially available proteins at pHs 4, 6.8 and 8 and found they were low. It determined that efforts to improve protein solubility would be a worthwhile goal.**

the rising tide of protein demand across demographic groups. Powerful Yogurt, with its masculine coloring, bull logo and macho marketing, has moved into indulgent flavors and even pink-colored yogurt cups for breast cancer awareness. While this could create dissonance and brand identity issues, Sprinkle pointed to statistics showing men and women have almost identical responses when it comes to what's most important in their food choices. The greatest difference between the two sexes comes in the 50+ age group, while Millennials cut that already small difference in half.

"So what does make sense in the future, as it relates to differentiation among protein products?" Sprinkle asked.

He pointed to opportunities such as clean label, locally made/sourced, and international or exotic flavors. Meat substitutes are starting to make waves, as well, Sprinkle added, especially in overseas markets. "As with dairy alternatives, such as almond, coconut and other plant milks, that have established themselves in their own right and are not simply substitutes, so it will be with meat substitutes."

For more information on Packaged Facts' report, "Food Formulation and Ingredient Trends: Plant Proteins" (February 2016), see www.packagedfacts.com/Food-Formulation-Ingredient-9820141/

"Consumer Market Opportunities in Protein," David Sprinkle, MBA, Research Director, Packaged Facts, dsprinkle@marketresearch.com

Unlocking the Potential of Alternative Proteins for Use in New Applications

In order to meet world demand for protein, food manufacturers need flexibility in choosing protein ingredients, including those from plant proteins. Factors to consider when selecting a plant protein include nutritional quality, functional attributes and sensory properties.

While some protein sources are "well-established" and have been consumed for generations, new ones are also emerging, noted Laurice Pouvreau, Ph.D., Senior Scientist, NIZO food research, in her 2016 Protein Trends & Technologies Seminar titled "Unlocking the Potential of Alternative Proteins for Use in New Applications."

What is established and what is relatively new to consumers and food manufacturers varies by world regions. For example, Europeans are more familiar than those in the U.S. and Canada with potato and lupin proteins, while the reverse is true with protein from rice and rapeseed (canola).

Through advances in ingredient technology, new sources of protein ingredients will come from efforts to extract proteins from a broad range of pulses, such as chickpeas, fava beans (broad beans), beans and lentils, and from by-products of oilseeds. One example is the high-in-protein sunflower cake that is left over when oil is extracted from sunflower seed.

Pouvreau added that there has been much research on the extraction of protein from green leaves, duckweed/Asian watermeal (from the genus *Wolffia*) and microalgae. [NOTE: Some of these are already commercially available and were presented at this event's Protein Sampling Station.]

However, "Plant proteins can be deficient in essential amino acids; so it is necessary to mix proteins in appropriate ratios to deliver the target amino acid profile. Protein blends allow novel source proteins to compete with animal proteins in nutritional quality," said Pouvreau. Understanding protein blends also allows for texture customization and cost optimization. Research at NIZO has created blends of sodium caseinate with soy or pea protein that yield stable emulsions.

Protein digestibility is also important. There are two primary methods for measuring protein quality: PDCAAS and DIAAS. Both require digestibility testing in animals, which can be expensive. The industry is researching analytical methods that avoid these challenges. For example, NIZO has been working



gluten-free
 vegan allergen free
 all natural non-GMO

Rice Bran Food Ingredients

clean label products



RiceBran Technologies' Rice Bran Food Ingredients deliver a significant nutritional profile to finished products.

PADDY RICE



BROWN RICE



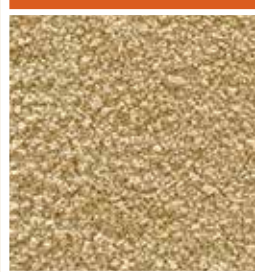
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RICE BRAN



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on a new technology, SIMPHYD (SIMulation of PHYsiological Digestion) that mimics *in vitro* digestion in the mouth, stomach and duodenum.

Solubility is a key property of protein ingredients and impacts a wide range of food and beverage applications. Plant proteins exhibit great variation in solubility, and that solubility is affected by pH. (See chart “Plant Protein Solubility.”)

NIZO has worked on protein processing, such as a mild fractionation process, in order to optimize functional properties. Factors impacting solubility include crop composition, downstream processing and storage conditions, among others. Solubility, in turn, impacts functionalities—such as color, digestibility, emulsification, heat stability, flavor, viscosity and gelling properties.

One important functional property is foaming. Traditional commercial pea protein foams are grainy with an undesirable mouthfeel, but work at NIZO produced pea proteins that maintained 95% solubility and which formed fine, stable foams.

There has been much interest in RuBisCO, which, as the main protein in green plants, is the most abundant protein in the world. A traditional plant protein extraction yields a product that is dark green and highly insoluble. NIZO has developed a mild extraction method, combined with a decoloration method, that yields a plant protein with 70-90% protein, off-white color and high functionality.

Pouvreau noted that it is better to optimize an ingredient’s flavor during its processing than to try to mask or modify flavor in the final product. Plant proteins often have flavors that are described as beany, cardboard, bitter or astringent. Volatile organic compounds, generated by the oxidation of unsaturated fatty acids, also generate off-flavors. Here, too, NIZO has worked on modifying the extraction process to create a pea protein low in oxidation flavors and has used fermentation by co-starter cultures to reduce beany off-flavor.

Astringency, which is defined as a dry, puckering mouthfeel, is a result of the interaction of proteins or polyphenols with saliva and is directly related to the molecular properties of the protein, rather than the extraction method. One area of research aiming to minimize astringent mouthfeel involves controlling the interaction of proteins and saliva components.

These exciting new technologies will allow plant proteins to supplement and compete with animal proteins to serve a hungry planet, concluded Pouvreau.

“Unlocking the Potential of Alternative Proteins for Use in New Applications,” Dr. Laurice Pouvreau, Senior Scientist, NIZO food research BV, +31 318 659 425, Laurice.Pouvreau@nizo.com

Making a Claim: Factors Impacting Protein Quality and a New Way for Measuring

“Protein Digestibility Corrected Amino Acid Score (PDCAAS) is broadly used for determining protein quality; however, it has limitations,” began David W. Plank, Sr. Technical Manager, Medallion Labs, in his 2016 Protein Trends & Technologies Seminar presentation titled “Making a Claim: Factors Impacting Protein Quality and a New Way for Measuring.”

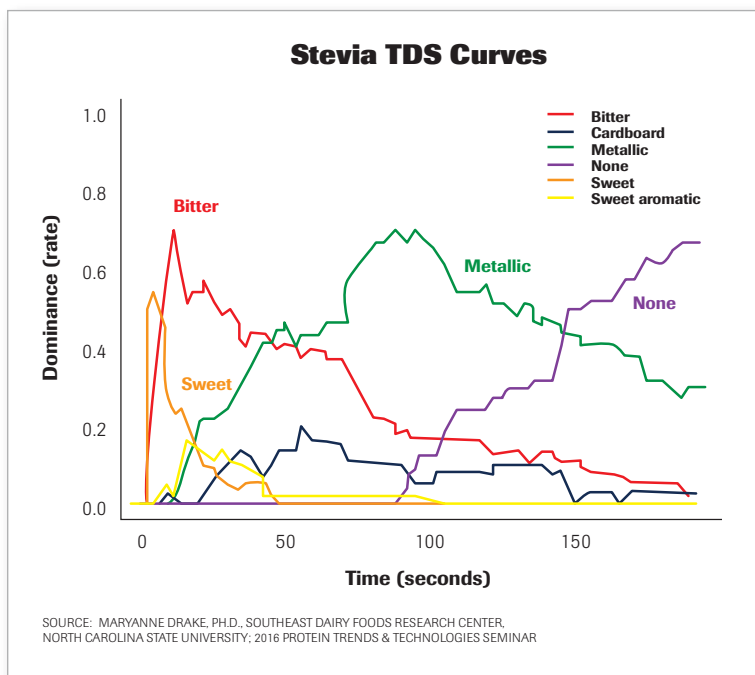
PDCAAS limitations, including required animal testing, high cost, lengthy turn-around time and large sample size requirement, have caused some to look for alternatives to this test. Medallion Labs has developed a test method called ASAP Quality Score that is comparable to PDCAAS, and it is animal-safe, less expensive and takes less time, said Plank.

If a protein claim is made, the FDA requires a food to contain at least 10% of the daily value per serving. Total grams of protein listed on package is crude protein (total nitrogen times a protein factor). But, in order to calculate the 10% DV threshold required to make a Nutrient Content Claim or Structure Function Claim; to list the protein source; or to call out the number of grams of protein on the label, the PDCAAS is required. If the PDCAAS result shows 10% DV for protein per serving of food, then the product is good to make a protein claim. Animal protein sources score high in quality, with a PDCAAS of 1. In comparison, plant sources score less than 1, due to one or more limiting amino acid(s).

Ideal Protein	
Essential Amino Acids for Human Nutrition	FAO Recommended Values (2011) mg/g protein
Histidine	20
Isoleucine	32
Leucine	66
Lysine	57
Methionine + Cysteine	27
Phenylalanine + Tyrosine	52
Threonine	31
Tryptophan	8.5
Valine	43

SOURCE: COMPILED BY DAVID W. PLANK, SR. TECHNICAL MANAGER, MEDALLION LABS; 2016 PROTEIN TRENDS & TECHNOLOGIES SEMINAR

🍌 The ideal protein contains all amino acids essential for human nutrition. Protein from animal sources score higher in this protein quality than plant proteins, because plant proteins are limiting in at least one amino acid. By combining proteins from different sources that contain the limiting amino acid, a complete protein can be made.



🔍 **The amount of protein has no impact on sweet taste perception in neutral pH, ready-to-mix protein beverages. However, changing from a liquid to a solid at the same protein load did increase the level of sweetener needed. Understanding the factors that influence protein flavor will allow the formulator to optimize flavor in the finished product.**

To determine PDCAAS, rats are fed the sample protein in parallel with a control diet. The drawback is that the rats need to be sacrificed, which is problematic for brands that do not wish to use animal testing. However, the law requires use of this method if making protein claims.

“Not only is the pressure considerable not to use animal testing,” explained Plank, “but PDCAAS also costs approximately \$5,000 per sample; takes three months for results; and can lead to an overuse of protein. Developers often over-fortify with protein in order to assure the claim is met, costing industry millions each year.”

In response, Medallion Labs has developed an animal-safe protein quality score analysis to completely emulate the PDCAAS score. Instead of using rats, the method imitates human digestion, giving good correlation to PDCAAS. Many foods have been tested with both methods and show comparable scores.

“Companies with animal-testing bans can use these results confidently,” Plank offered. Turn-around time is reduced to about 15 business days, and a much smaller sample size is required. Cost is also much lower than with traditional animal testing. The next step is to conduct an international collaborative study for AOAC Validation and for official acceptance as an alternative for animal testing, which is estimated to be a two-year process.

Meanwhile, the WHO has recommended a move to the Digestible Indispensable Amino Acid Score (DIAAS) method, which primarily uses pigs and has some advantages. “But the cost

is \$15-20K per sample with four to six months turn-around, and no commercial labs offer this test; private arrangements must be made with universities.” Plank said.

In summary, alternative protein sources and their quality assessment is needed. PDCAAS has drawbacks, including animal testing. ASAP Quality Score offers animal-free, good correlation to PDCAAS, is much less expensive and provides results in 15 days.

“Making a Claim: Factors Impacting Protein Quality and a New Way for Measuring,” David W. Plank, Sr. Technical Manager, Medallion Labs, info@medlabs.com, 800-245-5615

Formulating with Proteins: Processing and Flavor Challenges

Protein is in high demand by consumers, and the flavor of protein ingredients is vital to product success. A recent joint survey of 440 consumers at NCSU revealed the attributes consumers seek include the label claim, protein type, protein amount, sweetener and metabolic benefits. Different clusters of consumers are searching for different attributes.

In consumers who regularly consume protein beverages, whey protein is the most desired protein, followed by milk protein, said MaryAnne Drake, Ph.D., Professor of Food Science at North Carolina State University, in her 2016 Protein Trends & Technologies Seminar presentation titled “Formulating with Proteins: Processing and Flavor Challenges.” These consumers seek products with 20 or 25g of protein. They are searching for naturally sweetened products, as well as products that offer satiety and great taste.

All protein sources do not taste the same. “Principal component biplot analysis by a trained panel reveals that [even] the same ingredient from different suppliers does not taste the same,” said Drake. This is true for all types of protein ingredients.

As protein content increases, protein flavors increase in intensity. This is true for both dairy and soy proteins, and these protein ingredient flavors carry through into the finished product. Proteins with the mildest flavor profile are preferred by consumers. Labeling that says a product contains higher levels of protein improves acceptability, but label claims are not as important as actual flavor.

Challenges differ, depending on the protein ingredient and application. Lipid oxidation and sulfur degradation products are the primary sources of off-flavors in whey and milk protein. Lipid oxidation is also a primary source of off-flavor in plant proteins.

Different lipid oxidation values translate to different flavor perception, as well as to different functional properties—including heat stability and foam stability. Longer storage increases lipid oxidation for both whey and milk proteins, said Drake.

Maillard reactions also play a role in beverages and increase at higher storage temperature and with higher lactose content.

In whey obtained from cheese, the cheese-making process, the whey manufacturing process and the final product processing all impact shelf stability and flavor of the whey. When the manufacturer is aware of potential issues, they can control and minimize flavor impact.

Spray-drying influences flavor of high-protein dairy products. In the spray-drying of whey ingredients, both a lower pH and higher solids result in lower flavor intensities. Instantized protein ingredients have a shorter shelflife, because lecithin is readily oxidized. Storage time and temperature also impact functional properties, especially for milk protein ingredients.

Food and beverage manufacturers are under pressure from consumers to produce products with natural sweeteners as part of the demand for clean label products. The primary natural, non-nutritive sweeteners in use today are monk fruit and stevia. Increasing protein levels yielded little impact on sweet taste.

Drake and her group use various methods to evaluate sweet taste. Magnitude Estimation Scaling (MES) is used to determine iso-sweet concentrations of each sweetener to sucrose. The Time Intensity (TI) method is an assessment of the intensity of a single attribute, such as bitter or metallic, over time. In the method Temporal Dominance of Sensations (TDS), panelists evaluate multiple attributes at once and select the dominant attribute. TDS shows the sequence of dominant sensations rather than intensities. In the final method, Temporal Check-All-That-Apply (TCATA), panelists may select and deselect various attributes over a period of time. This allows one to track how a product's sensory characteristics evolve.

*“Formulating with Proteins: Processing and Flavor Challenges,”
MaryAnne Drake, Ph.D., Professor of Food Science at North Carolina State University, mdrake@ncsu.edu*

Protein Supplementation and Athletic Performance

Much of our knowledge of sports nutrition is based on empirical evidence from athletes. One of the biggest controversies is how much protein an athlete needs. Active individuals need more protein than those who are sedentary, but is there a ceiling? At the 2016 Protein Trends & Technologies Seminar, Jay Hoffman,



■ **Many formulations pack as much protein into sports beverages as possible, which can cause sensory issues. Selecting and blending proteins based in part on their amino acid profile can provide insights into how much is really needed.**

Ph.D., of the Institute of Exercise Physiology and Wellness and the University of Central Florida, discussed this issue in his presentation titled “Protein Supplementation and Athletic Performance.”

Protein sources vary widely in their amino acid profile. There are four common methods to evaluate protein quality. Biological Value (BV), Net Protein Utilization (NPU), Protein Efficiency Ratio (PER) and Protein Digestibility Corrected Amino Acids Score (PDCAAS.) Brown rice, soy protein and wheat are lower quality proteins, which create a challenge for vegetarians.

Another important aspect of protein quality is absorption rate. Whey protein isolate has the highest absorption rate, which means it is absorbed in the blood more quickly than other proteins. This is important for recovery from exercise and maximizing adaption to exercise, explained Hoffman.

The RDA for protein represents the amount necessary to maintain nitrogen balance and muscle mass under sedentary conditions. “If protein degradation is greater than protein accretion, then an individual is in negative nitrogen balance, or a catabolic state. Resting is very catabolic. The opposite is true for individuals who exercise and consume adequate protein to stimulate muscle protein synthesis. These individuals are in positive nitrogen balance, or an anabolic state. The combination of feeding protein and exercising is a potent stimulus for protein synthesis,” Hoffman said.

Protein needs for sedentary individuals are estimated to be 0.8 grams per kilogram of body weight per day (g/kg/

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*Synergy protein research has been in collaboration with its parent company, Carbery, a leading manufacturer of whey protein.


SYNERGY™
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Leucine Saturation

Source	% Leucine	Untrained (grams needed)	Trained (grams needed)
Beef	8.0%	~26g	~17.5g
Chicken	7.5%	~28g	~19g
Egg	8.6%	~24g	~16g
Milk	9.8%	~21g (~21oz)	~14g (~14oz <2 cups)
Whey	12.0%	~17.5g	~12g
Soy milk	6.77%	~31g (~31oz)	~21g (~21oz ~2.6 cups)

SOURCE: JAY HOFFMAN, PH.D., UNIVERSITY OF CENTRAL FLORIDA, ADAPTED FROM NORTON 2009; CUTHBERTSON ET AL., 2005; MOORE ET AL., 2009
2016 PROTEIN TRENDS & TECHNOLOGIES SEMINAR

■ **“Leucine saturation” is the theoretical, minimal single oral dose of leucine required to maximally stimulate muscle protein synthesis (MPS). From the sources of protein listed here, some 20-30g are needed to maximize MPS for untrained athletes. Present understanding appears to support the use of milk or animal-based proteins to maximize muscle protein synthesis and changes in lean body mass.**

day). For runners, protein needs jump to 1.2-1.4g/kg/day. For strength and power athletes, needs increase to 1.8-2.0g/kg/day or higher.

Hoffman’s group conducted research using competitive athletes to learn how greater protein intake affected performance. The athletes were divided into three protein intake groups and performed a 12-week resistance training program. The below recommended intake (BL) group consumed 1.0-1.4g/kg/day; the recommended intake (RL) group consumed 1.6-1.8g/kg/day; and the above recommended intake (AL) group consumed greater than 2.0g/kg/day. Individuals in the BL group had a decrease in lean body mass. The AL group had statistically significant increases in bench-press strength. Another study showed significant decreases in fat mass in a high protein group vs. a normal protein group.

Generally, dietitians and sports medicine organizations take a conservative approach to supplementation. The consensus among these organizations is that protein needs can usually be met through food intake. However, the most convenient and efficient method for providing immediate protein after exercise may be with a protein supplement. Recent studies have shown that providing protein supplementation can decrease muscle damage, attenuate force decrements and enhance recovery.

A recent meta-analysis from 22 randomized, controlled studies that include 680 participants compared results of protein intake on fat-free mass. Results revealed protein supplementation, in combination with resistance training, can significantly augment gains in lean body mass.

A study by Volek compared soy and whey over time. The protein amounts were the same, but the leucine content of the whey group was higher. After nine months, the whey group had a 45%

greater increase in lean body mass than the soy group.

A number of studies have shown that there is a leucine threshold, a theoretical minimum dose of leucine required to stimulate an increase in muscle protein synthesis, of 1.5-2.0g/day. Whey protein has the highest content of leucine and is the most effective leucine trigger.

“Protein Supplementation and Athletic Performance,” Jay R. Hoffman, Ph.D., Director, Institute of Exercise Physiology and Wellness, Sport and Exercise Science and Burnett School of Biomedical Science, University of Central Florida, Jay.Hoffman@ucf.edu

Formulating Protein Beverages: Real World Challenges & Tactical Solutions

Creating successful protein beverages was the topic of the presentation, “Formulating Protein Beverages: Real World Challenges & Tactical Solutions,” given by Justin Cline, Senior Beverage Scientist at Imbibe. Cline first reviewed protein chemistry and functionality basics.

Protein molecules are either hydrophobic, hydrophilic or electrically charged. When a protein molecule carries a charge, the molecules repel each other in solution. But, by adding acids or bases and bringing the proteins to a net 0 charge (isoelectric point), the molecules are attracted to each other; clump together into a solid mass; precipitate; and fall out of solution.

In beverages, the pH of the isoelectric point should be avoided, as precipitation is not desirable. “Protein properties can be harnessed to build viscosity or create emulsions, or these properties can be detrimental when causing clouding or grittiness in a beverage,” Cline explained.

He advised to determine early the desired protein level and source. The trend is toward packing as much protein into a beverage as possible, but too much can cause issues. “When suspending protein, gums are helpful; for a charge issue, adjusting pH can work. As carbohydrates increase, so does viscosity, and reducing sugars may cause browning. Homogenization can mechanically alter protein structure. These are all issues for consideration,” advised Cline.

Vitamins, minerals, salts, whole grains and other solids all have potential to negatively interact with proteins, especially at higher



levels. During processing, order of addition and pH monitoring are key. Emulsions and physical stress on the protein can alter its functionality, and hydration of the protein is very important. Protein is very sensitive to heat, which causes denaturation; and upon cooling, gelling and thickening.

Cline offered several case studies for consideration. “In an average nutritional shake with 3-4% protein, neutral pH (6.6-7) and that uses casein, the protein’s isoelectric point is avoided,” Cline shared.

He recommended grouping ingredients according to their properties during processing. Protein and hydrocolloids should be left on their own to hydrate properly. Vitamins and minerals should be separated from other solids to avoid interactions. In addition, fractionating the water during production is important. Most of the water should be kept for hydration of the protein, for at least 20 minutes. The rest of the water is best retained for hydrating other ingredients, like hydrocolloids.

Each ingredient needs to hydrate separately and completely, so they do not compete for water. This ensures good ingredient functionality, proper stabilization and no grittiness. Cline recommended keeping 5-10% of the water to adjust total solids at the end of processing.

In higher solids beverages, the same rules apply, but interactions with protein are more likely. Commonly used whey proteins are prone to denaturation and thicken at higher temperatures/longer times. “Adjust pH lastly, after everything is added and total solids are adjusted,” Cline instructed. “The whole batch should then be allowed to come to equilibrium and then the pH checked again.

It is important to allow an acid or base to completely mingle with the protein.”

“In high-acid clear beverages with whey protein isolate,” advised Cline, “make sure the protein is completely hydrated, the pH is below 3.5 and few other ingredients, just sweeteners and flavors, are used.”

Beverage stability over time is heavily dependent on protein denaturation. The product may look great when first made, but over time, the denatured protein can build a very unpleasant web or haze that looks like mold.

To summarize a few points, Cline stressed understanding a processing plant’s capabilities. Know that heat processing and protein denaturation release cooked and sulfur notes that mellow over time, as protein reaches equilibrium in a few weeks. Therefore, he recommends refraining from formula changes until the product has properly aged. Also, ask suppliers for information on ingredients, and share as many product and processing details with them as possible—since that aids their understanding in how to help. Cline also urges that shelflife studies be completed before commercialization, as proteins change over time.

“Formulating Protein Beverages: Real World Challenges & Tactical Solutions,” Justin Cline, Senior Beverage Scientist, Imbibe, 847-324-4411, jcline@imbibeinc.com

From Gluten-free to Whole Grain: Formulating On-trend Products

The year of 2016 has been designated the International Year of Pulses, stated Heather Maskus, Project Manager at the Canadian International Grains Institute (Cigi), in her opening remarks. Her presentation, “From Gluten-free to Whole Grain: Formulating On-trend Products,” focused upon using combinations of pulses and whole grains to formulate foods—such as cereals, snacks, pastas, noodles, pan bread and crackers—with higher levels of protein.

Maskus noted that pulses are defined as the dry, edible seeds of legume plants and include lentils, peas, chickpeas and beans [*but excludes soybeans; soybeans are not a pulse, because their seed is not dry*]. Pulses have applications in whole, ground, dehulled, flaked and fractionated forms; the latter is usually produced through air fractionation and wet extraction.

“Pulse flours are nutrient-dense ingredients,” Maskus stated. “They are a high source of dietary fiber (14-25% dry weight) and are a protein source at about 20-30% dry weight.”



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Formulations for Gluten-free Pan Bread using Pulse Flours

	Formulation Amount (Bakers' %)		
	Control	30% Pulse Flour	50% Pulse Flour
Flour blend	100.0	100.0	100.0
• White rice flour	• 68.2	• 47.7	• 34.1
• Potato starch	• 22.7	• 15.9	• 11.4
• Tapioca starch	• 9.1	• 6.4	• 4.5
• Pulse flour	• 0.0	• 30.0	• 50.0
Sugar	5.9	5.9	5.9
Whole egg powder	3.6	3.6	3.6
Yeast	2.2	2.2	2.2
Egg white powder	2.0	2.0	2.0
Xanthan gum	1.6	1.6	1.6
Water (30° C)	90.9	90.9	90.9
Canola oil	13.6	13.6	13.6
Cider vinegar	1.1	1.1	1.1

SOURCE: HEATHER MASKUS, MSc, CANADIAN INTERNATIONAL GRAINS INSTITUTE (CIGI) 2016 PROTEIN TRENDS & TECHNOLOGIES SEMINAR

Maskus provided formulas using fava beans as the source of pulse flour that they have worked with to produce non-gluten pan bread with higher levels of protein.

Pulses are high in lysine but low in methionine and cysteine, while cereal grains are typically the opposite. “Combining pulse and cereal grains is, therefore, of interest to create more complete protein profiles in products.”

Maskus described research that focused on the development of extruded breakfast cereal that use pulses. Pea fiber (6.5%) added to a blend of corn meal (31.5%), and whole pea and semolina flour (56.5%), enhanced extrusion due to its starch characteristics. “The goal for protein levels in pulse-based products is 5g of protein per 30g serving,” she stated. “However, this blend would not be able to make a protein claim, because the protein digestibility of peas at 87.9 is not high enough.” Maskus indicated that Cigi is continuing this work, using oats and buckwheat as complementary amino acid sources to improve end-product protein quality.

Maskus presented data showing the effects of various milling methods to produce whole yellow pea flour and resulting quality parameters of extruded snacks. She noted that similar formulation principles exist for snacks and cereals. Maskus stated that “extrusion of whole yellow pea flours is more controlled than for the split yellow pea flours. The additional fiber in whole yellow pea flour acts as a nucleation agent and controls air cell size within the final product.”

Pasta was one of the first products investigated for fortification with pulses, due to characteristically low fiber and nutrient contents. Pulse flour milling was undertaken to produce low-, medium and high- (21, 24 and 26.4%) protein content flour and blended with durum semolina (30:70). The advantages of including pulses in pasta include enhanced protein content, quality and nutrient density.

As pulse protein increased, it was necessary to change processing parameters. The challenges, Maskus noted, include sticky dough crumb due to the soluble proteins present in pulses which affect extrusion. Drying cycles should be modified to low temperature-long time to minimize color changes. Maskus stated that a “2% reduction in water addition for yellow pea semolina and the use of a fine semolina pulse ingredient will help to improve the appearance and cooked pasta firmness.” Cooked firmness of the pasta was increased with increasing pulse addition.

Maskus also discussed their work with pulses in flour blends for the development of gluten-free breads. (See chart “Formulation for Gluten-free Pan Bread with Pulse Flours” for products with 30 and 50% fava bean flour that resulted in breads of 5 and 6g protein, respectively.) The breads were also eligible to carry dietary fiber nutrient content claims with 4 and 5g of fiber.

Maskus noted that the gluten-free breads formulated with fava bean flour showed similar loaf characteristics and resulted in breads with a firmer texture and smaller cell diameters compared to the control bread.

“Pulse-based products offer several advantages, including gluten-free potential, as well as a product with higher protein and fiber,” concluded Maskus. “Pulses offer a sustainable protein that is non-GMO with low allergenicity. They can meet many of the requirements for a clean label and have increasing global recognition.”

Maskus went on to note that “challenges include texture, color and flavor, and also meeting protein claims. However, the blending of grain ingredients and processing modifications can solve many of these.”

Heather Maskus, MSc, Project Manager, Canadian International Grains Institute, hmaskus@cigi.ca

Update on GMO Labeling: Where do We Stand; Where are We Headed?

[Please note: This presentation was given before the President signed legislation that will require labeling of genetically modified ingredients for the first time. The legislation, passed by Congress on July 29, 2016, will require most food packages to carry a text label, a symbol or an electronic code readable by smartphone that indicates whether the food contains GMOs. The Agriculture Department has two years to write the rules, which will pre-empt the Vermont law that kicked in earlier this month.]

Today's consumers want to know all about their food. But what limits are there on the powers of a government body to tell food manufacturers what they must tell their consumers? The GMO debate cuts to the heart of that question.

Vermont passed a GMO labeling law that goes into effect July 1, 2016. Connecticut and Maine also passed GMO labeling laws, but their laws would only go into effect if other states in the region passed similar regulations. Of course, it is difficult for a food manufacturer to comply with label regulations for one state only.

"In 2013, mandatory labeling laws, similar to the Vermont law, were introduced in both the U.S. House and Senate, but neither passed. In 2016, legislation establishing a national voluntary labeling framework preempting individual state laws was introduced and passed in Senate committee, but was subsequently blocked by the full Senate," explained Chip English, a partner at the law firm Davis Wright Tremaine LLP, in his 2016 Protein Trends & Technologies Seminar presentation titled "Update on GMO Labeling: Where do We Stand; Where are We Headed?"

FDA regulations preempt states from doing anything that interferes with the Nutrition Facts panel. In November 2015, the FDA did publish voluntary and non-binding guidance on GMO labeling. The FDA does not like the phrase, "genetically modified organisms," and instead prefers the term "produced with genetic engineering." The FDA also said that foods produced with genetic engineering are safe, and that there are no differences in food produced with or without genetic engineering.

The Vermont law requires that if a food is produced with genetic engineering, that information must be disclosed. The Vermont law refers specifically to genetically modified organisms, rather than addressing the processing issue. The Vermont law requires that the message must be screened and in bold letters on the ingredient panel. The law also allows the FDA message that there is no significant difference in foods produced with or without genetic engineering. Vermont law exempts finished foods from GMO labeling, if the animal from which the food was obtained

had been given GMO animal feed. This means Vermont cheese does not have to have a GMO label, even though GMO feed was used for the cow.

The First Amendment right to free speech applies to states and localities. There was an excellent recent *Arizona Law Review* article on compelled speech under the First Amendment, according to English, discussing whether or not it is lawful. Currently, it is impossible to reconcile decisions by various courts with respect to compelled speech under the First Amendment.

The Grocery Manufacturers of America and the International Dairy Foods Association both sued Vermont to prevent the law from going into effect July 1. The local Federal district court did not rule in their favor, and the groups appealed. The appeal was heard on Oct 16, 2015, but, as of May 2016, nothing has been heard from the court of appeals. Currently, food businesses are spending hundreds of millions of dollars figuring out how to comply with the Vermont law.

So what are companies currently doing? Campbell Soup has said that it will implement voluntary labeling of GMO ingredients. While simultaneously calling for federal standards for labeling products with GMOs, Mars, General Mills, Kellogg and Danone recently announced that they also will comply with the Vermont law for national labeling.

Where does it stop, and how do conscientious food companies comply? Currently, gluten free labeling is voluntary. Will health-conscious consumers demand the labeling of gluten next? English believes that the Vermont law will become the *de facto* law of the country, unless the second circuit rules in a timely manner. And, ultimately this issue may need to be decided by the Supreme Court. In the meantime, marketing and packaging groups are left with difficult decisions.

"Update on GMO Labeling: Where do We Stand, Where are We Headed?" Chip English, Partner, firm Davis Wright Tremaine LLP, 202-973-4272, chipenglish@dwt.com

Global Food Forums, Inc. again wishes to thank the speakers, attendees, sponsors and tabletop exhibitors for making the 2016 Protein Trends & Technologies Seminar a very successful event. We invite you to attend the 2017 Protein Trends & Technologies Seminar, which is in its planning stages. It will be held at the Westin Hotel, Itasca, Illinois, USA—a venue close to Chicago O'Hare International and Midway airports. Please see <http://www.globalfoodforums.com/2017-protein-seminar/> for updates. Hope to see you there!

Additional Resources



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Since its first Protein Trends & Technologies Seminar and Clean Label Conference held in 2013, Global Food Forums, Inc. has offered unique, practical information for use in the development of food, beverage and nutritional products. The majority of presentations focus on applied food science and technology. Links to pdfs of these presentations and conference summaries can be accessed at www.globalfoodforums.com/store or by scanning the QR code to the left.



With Our Compliments

Global Food Forums, Inc. wishes to thank the speakers, attendees, sponsors and tabletop exhibitors for making the 2016 Protein Trends & Technologies Seminar a very successful event.

To download complimentary copies of presentations from the Seminar, including both Formulating with Proteins and Business Strategies, go to <http://www.globalfoodforums.com/2016-protein-seminar/store/> or scan the QR code, left.



Protein Sampling Station Products—Online!

One of the most popular aspects of the Seminar: Many new products promoting their protein content have been introduced in Global

Food Forums' Protein Sampling Station during the Protein Trends & Technologies Seminars. To see and read about these products online, go to <http://www.globalfoodforums.com/new-protein-foods-beverages-nutritional-products-2016/> or scan the QR code.

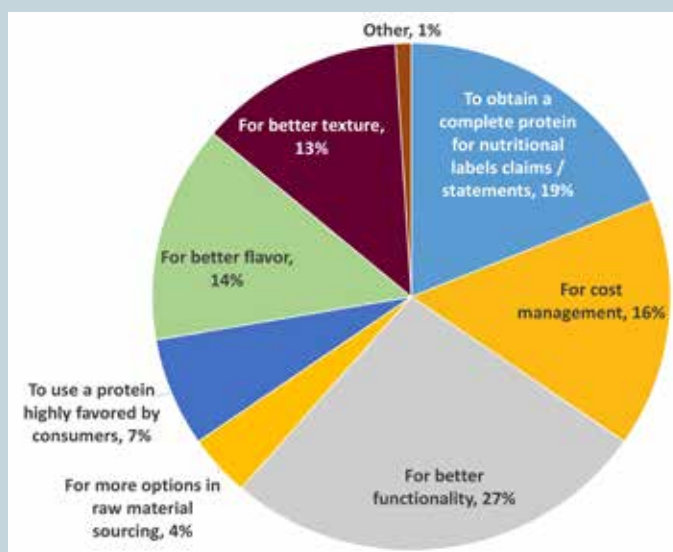


New! R&D Report on Protein Ingredients

The new *Global Food Forums® 2017 R&D Report: Protein Ingredients*, conducted by NSM Research, Inc., provides strategic analysis and actionable

data on the difficult-to-obtain key drivers of protein ingredient selection. Using Global Food Forums' contact database, 200 food, beverage and nutritional product formulators were asked for their opinions on current and future protein ingredient uses and needs.

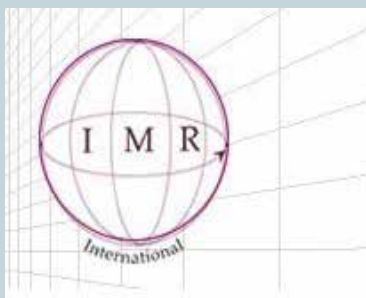
For example, when respondents currently formulating health bars, infant formulas or dietary supplements were asked why they



blended proteins, all mentioned nutritional reasons, but none said “for better flavor.” Just some of the other subjects delved into include:

- Which health trends will influence protein ingredient selection?
- Which protein categories will experience the greatest growth?
- What protein characteristics and functions are considered most important?
- How important are traceability, organic, non-GMO and local sourcing among other characteristics and certifications?
- How does R&D rank the value of various supplier services?

For more information, go to www.globalfoodforums.com/PIR or contact Peter Havens, Peter@globalfoodforums.com, 630-621-0230, or scan the QR code.



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food thickeners, stabilizers and gelling agents.

The IMR Hydrocolloid Conference 2017 will be held April 30-May 2, at the prestigious Westgate Hotel in the heart of downtown San Diego, Calif., USA. With the theme “Hydrocolloids - Safe, Sustainable & Suitable,” it will be a gathering of who's who in the global hydrocolloids industry that includes suppliers, users, regulatory authorities, investors and consultants.

For more information on IMR International and the company's Spring 2017 conference, contact Dennis Seisun, 1-858-217 5024, DSeisun@hydrocolloid.com, <http://www.hydrocolloid.com/>

PROTEIN TRENDS & TECHNOLOGIES SEMINAR

Global Food Forums, Inc. is pleased to announce its 5th annual **Protein Trends & Technologies Seminar** to be held May 23-24, 2017, at the Westin Hotel, Itasca, Illinois, USA. The Pre-Conference Program: Business Strategies will, once again, focus on fundamental and ever-changing

factors impacting the global protein ingredient market. The information is crucial for anyone guiding their protein ingredient business or for those where the protein ingredient marketplace has significant impact on their business. The Technology Program: Formulating with Proteins will be focused on providing R&D and application food scientists with practical, non-commercial advice on how to work with protein ingredients in a range of foods, beverages and nutritionals. Solutions will be suggested for protein formulation and labeling challenges and sensory (texture & taste) issues. Please plan on joining us for both days!

www.globalfoodforums.com/2017-protein-seminar

Global Food Forums, Inc. wishes to thank the following sponsors of this Formulating with Proteins Summary:



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2017 R&D Report: *Protein Ingredients*

Product Formulators' Opinions on Current and Future Protein Ingredient Use and Needs



The new *Global Food Forums® 2017 R&D Report: Protein Ingredients* provides strategic analysis and actionable data on the difficult-to-obtain key drivers of protein ingredient selection.

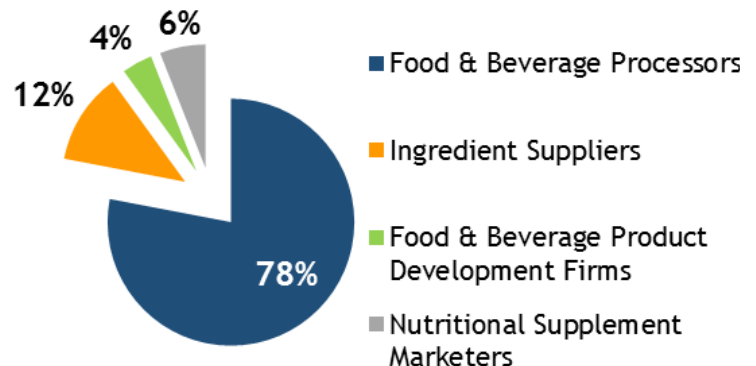
Conducted by NSM Research, Inc., this unique R&D Report will help guide corporate strategy and industry communications. Through increased understanding of customers' current and future needs as related to proteins, increased sales will result.

Examples of Topics:

- Which health trends will increase the most in importance?
- Which foods will be increasingly promoted for their protein content?
- What protein characteristics and functions are considered most important?
- How important will traceability, non-GMO, local sourcing, Paleo and other certifications be to business?
- How does R&D rank the value of various supplier services?
- What are R&D's leading reasons for blending multiple proteins in a product?

Survey Respondents:

200 Product Formulators from Four Industry Segments



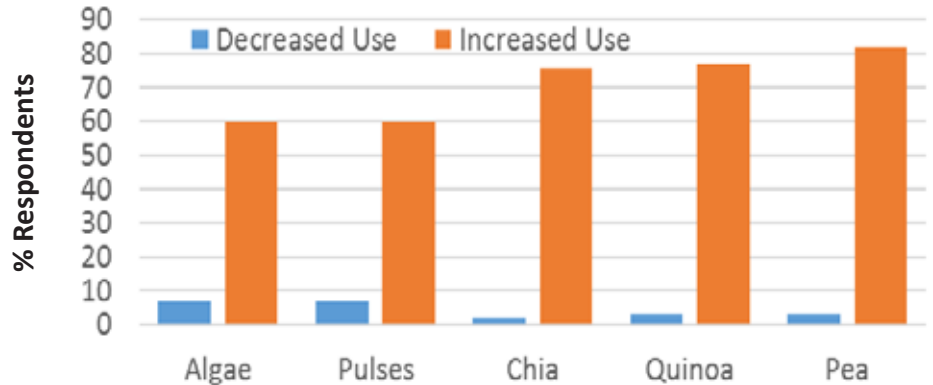
Source: *Global Food Forums® 2017 R&D Report: Protein Ingredients*

Deep Dive: Protein Types

Insights and opinions on proteins such as whey, egg, pea and soy by R&D and application food scientists who primarily work with those proteins will be delved into. For example, among formulators who primarily use whey proteins, "Taste" was ranked as the most important characteristic, while "Clean Label implications" and "Consumer popularity" the least important of the nine listed.



Protein Types Predicted to Increase/Decrease in Use (5 of over 25 listed)



Source: *Global Food Forums® 2017 R&D Report: Protein Ingredients*

Deep Dive: Applications

Survey results providing insights and opinions on current and future protein use by R&D at food processing companies and application food scientists will be segmented by work area such as Beverages and Grain-based Products.

For updates on content and expected launch data,
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2017 Protein Trends & Technologies Seminar
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Attendees will receive a registration receipt and confirmation email. Visit www.GlobalFoodForums.com/2017-Protein-Seminar to update your registration information and/or to register. Registrations include Tuesday, May 23rd (5:30-7:00 p.m.) evening networking reception, general sessions, meals, Protein Sampling Station, networking events and attendee bag and binder.

I plan on attending Tuesday Night Reception

Official Hotel-Westin Hotel, 400 Park Blvd., Itasca, IL, 60143. A limited number of discounted rooms have been reserved at \$139.00, plus tax, per night for May 23-24, 2017. Call 1-630-773-4000 and mention the 2017 Protein Trends & Technologies Seminar or go to <https://www.starwoodmeeting.com/Book/2017ProteinTrendsandTechSummit>. The cut-off date for reservations is May 1, 2017. **Cancellation & Substitution Policy.** Cancellations must be received in writing. Visit www.GlobalFoodForums.com/2017-Protein-Seminar for refund details. Alternative parties may be substituted at any time without penalty.

Total Solution for Protein Purification & Production on Large Scale



Orochem Technologies Inc., a U.S. based Biotech Company has successfully commercialized purification and production of plant proteins such as Rubisco from spinach and alpha-alpha, recombinant heme from yeast, and proteins from peas. Orochem's R&D center in Naperville, Illinois provides vertically integrated Chromatography and Simulated Moving Bed processes from discovery to manufacturing. Orochem's team of chemists and chemical engineers assist customers to develop and implement economical and scalable processes with very short cycle time.

New 2017 R&D Report: Protein Ingredients

New market research conducted by NSM Research, Inc. surveys R&D and food application formulators on their attitudes, formulation issues and future trends, as related to their use of protein ingredients. This 60+ page *Global Food Forums® R&D Report: Protein Ingredients* will become available fall of 2016. Updates and more information on the report are available at: <http://goo.gl/WEJ4KQ> or contact Jenny Stricker at Jenny@GlobalFoodForums.com or +1.800.799.9671 ext. 1.

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