

Grain Science

Lesson 6: Baking Industry



Unit:	Grain Science
Estimated Time:	50 Minutes
Age of Learners:	9th-12th Grade
Equipment, Supplies, References, and Other Resources:	
<ul style="list-style-type: none"> • Case studies • Case study worksheet • Food Industry Trends PowerPoint 	
Instructor Directions & Estimated Time	Content Outline and/or Procedures
Objectives	<ol style="list-style-type: none"> 1. Describe challenges in the baking industry. 2. Identify trends in the baking industry. 3. Identify baking industry domestically and internationally.

Instructor Directions & Estimated Time	Content Outline and/or Procedures
<p>Feed the Sourdough</p> <p>~3 minutes</p> <p><i>Only one student needs to feed the class starter.</i></p>	<ul style="list-style-type: none"> • Start feeding by removing the starter from the container. • In a bowl, mix 1 cup (115 grams) flour and 1/2 cup (115 grams) water with the starter, mixing by hand until smooth. • Clean original container before replacing the starter. Cover and store.
<p>Poll – What did you eat for breakfast?</p> <p>~ 2 minutes</p> <p><i>Have students raise their hands to show what they ate for breakfast – or if they didn't eat breakfast, what they wanted to eat for breakfast. Count how many ate baked food versus proteins or fruits.</i></p>	<p>Think about what you ate for breakfast today. With a show of hands, how many had protein, like eggs and bacon? How many had fruits? Who ate something dairy like yogurt? How many students had a pastry or something based, like toast, cereal, donuts, poptart, muffin, or pancakes?</p> <p><i>It was probably more baked goods!</i></p> <p>Last week we discussed grain and how it is milled. One of the main products of milling is flour and flour can be used for baking. This week we are talking about baking.</p>
<p>Baking Industry Case Studies</p> <p>~ 20 minutes</p> <p><i>There are three Case Studies. Divide the Case Studies among the students.</i></p> <p><i>When students finish, ask the discussion question to review what they learned.</i></p>	<ol style="list-style-type: none"> 1. Read the background and Q&A about the featured technical expert. Use the space below to take notes. 2. Identify the problem in the baking industry that the expert and their company are trying to address and overcome. 3. How has the company solved the problem? (Be specific – have they created products, devices, or equipment?) 4. How does the expert's career play a role in solving the problem? <p>Abby Ceule and Corbion Case Study</p> <ul style="list-style-type: none"> • Problem: consistency — dough strength, tolerance and volume • DATEM (Diacetyl Tartaric Acid Esters of Mono- and Diglycerides) is a compound derived from natural sources and added to food to blend ingredients and soften dough. <p>Jeff Hodges and ADM</p> <ul style="list-style-type: none"> • Problem: fewer calories and reduced sugar, without sacrificing taste <p>Richard Leboucher and Puratos USA</p> <ul style="list-style-type: none"> • Problem: Oil in baked goods — increasing price, desire for lower fat <p>Class Discussion Questions</p> <ol style="list-style-type: none"> 1. How do food manufacturers balance the demands for consistency, taste, and healthiness in their products, considering challenges such as ingredient sourcing, formulation, and consumer preferences? 2. What strategies can food companies employ to address industry-wide challenges such as reducing sugar content, lowering fat levels, and managing ingredient costs while maintaining product quality and meeting consumer expectations for taste and healthiness?

Instructor Directions & Estimated Time	Content Outline and/or Procedures
<p>What do you Look for in Food?</p> <p>~ 2 minutes</p>	<p>On the white board or app like Mentimeter, record what you look for in food.</p> <ul style="list-style-type: none"> • When they are shopping (at a grocery store, gas station) • When they go to a restaurant (fast food, sit down) • At home <p>Based on the responses shared, what common themes or preferences emerge regarding food choices across different settings such as grocery stores, restaurants, and home environments? How do these preferences reflect broader societal attitudes towards food?</p> <p>Now that we've explored what individuals look for in food across various contexts, let's explore broader food trends and their implications.</p>
<p>Trends</p> <p>~ 15 minutes</p> <p><i>Display the PowerPoint and discuss the trends together as a class.</i></p>	<p>Today, we dive into the evolving landscape of consumer preferences and sustainability in the food industry, exploring the factors from convenience and health to environmental stewardship and economic responsibility.</p> <ul style="list-style-type: none"> • Sophisticated consumers want: <ul style="list-style-type: none"> • Convenience • Healthy, “good for me” foods • Locally grown or fresh foods, “real” foods • Minimally or traditionally (fermented foods) processed • Foods they enjoy • Consumers are looking for <ul style="list-style-type: none"> • Shortest ingredient list • Recognizable ingredients • Minimally processed • Nothing artificial • No chemicals • Transparency • Sustainability: <ul style="list-style-type: none"> • More prevalent in consumer's attitudes and lifestyles • Personal – Responsibility for one's own (or one's family's) needs and desires • Social – Responsibility for the well-being of others, including animals • Environmental – Responsibility for the well-being of the planet at both the local and global level. • Economic – Responsibility for the economic well-being of one's town, region, or nation for businesses one supports <p style="text-align: right;"><i>(continued on next page)</i></p>

Instructor Directions & Estimated Time	Content Outline and/or Procedures
<p>Trends, continued</p>	<ul style="list-style-type: none"> • Environmental sustainability: <ul style="list-style-type: none"> • Consumers look for manufacturers to be good stewards of the environment • Conserving natural resources, “green”, carbon foot print, responsible farming • Food waste coming under scrutiny • Consumers looking for companies that try to minimize waste (including packaging) • Economic sustainability <ul style="list-style-type: none"> • Ability to last overtime • Support the local economy • Provide good wages • Social sustainability <ul style="list-style-type: none"> • Employment and hiring practices • Cares about community • Animal welfare • Government policies and regulations <ul style="list-style-type: none"> • Environment • Labor laws? <i>What is the point of this?</i> • Nutrition guidelines • Regulatory mandates • Sugar tax • Labeling <ul style="list-style-type: none"> • GMO labeling, partially hydrogenated oils, added sugars
<p>Food Industry Trends Reflection and Discussion</p> <p>~ 10 minutes</p> <p><i>When students finish, you can have them share their thoughts with a partner and then with the class.</i></p>	<p>Now that we have discussed the Case Studies with Food Industry professionals, and learned about key trends in the food industry, you will reflect on your worksheet.</p> <ul style="list-style-type: none"> • Were any of these trends addressed as problems in the case studies? • Which trends do you follow? Why? • Which trends do you not follow? Why? • Are there trends that you think will go away?

Instructor Directions & Estimated Time	Content Outline and/or Procedures
<p>Enrichment Activity – Partner Research Presentation Jig Saw</p> <p><i>After completing the PowerPoint, distribute the Food Industry Trends Worksheet.</i></p> <p><i>Assign each student a partner and a trend to research.</i></p> <p><i>If there is time, students can present to the class.</i></p>	<p>With a partner, you will research a specific trend.</p> <p>Use the internet to research your assigned topic. Collaborate with your group members to gather relevant information and discuss findings.</p> <p>Prepare a Google Slides presentation based on your findings that includes four slides.</p> <p>The presentation should include the following:</p> <ul style="list-style-type: none"> • Slide 1: Title Page that includes your trend and group member names • Slide 2-3: Key information you found about your topic might include: <ul style="list-style-type: none"> • Relevant examples • Statistics (nationally or globally) • Key players in this trend • News stories • Slide 4: Conclusion or reflection about your trend. This may include: <ul style="list-style-type: none"> • Impact on you and your peers • Impact on agriculture • Impact on the economy • Impact on the environment
<p>Enrichment Activity – Survey</p>	<p>Following the FFA Agriscience Fair guidelines, create a social sciences survey to determine the food preferences of students and/or staff in your school.</p>
<p>Enrichment Activity – Baking Brands Web Search</p> <p><i>Students will use the internet to search for the top global baked good brands.</i></p>	<p>Use the internet to search for the top 10 baked good brands in the world.</p> <p>Record the top 10 brands and then select two of those brands, one domestic (in the United States) and one that is international.</p> <p>The criteria they will search for are:</p> <ul style="list-style-type: none"> • What are the top 10 brands? • Select two brands (one domestic and one international) and answer the following: <ul style="list-style-type: none"> • Where is it located? • Summarize its background/origin story. • What products does that company make? • Describe the types of grains and milling processes that would be used to make these products. • Does the company create foods for convenience, healthy, locally grown, fresh, minimal processing); are they sustainable; do they address government policies, have GMO labeling <p>When students have completed answering their questions, they will do a “gallery walk” by sharing their international company with other students. Classmates will star the country that their baked good company is in on other classmates’ maps.</p>

	State Standards
Language Arts	<ul style="list-style-type: none"> • W.9-10.9. Draw evidence from literary or informational texts to support analysis, reflection and research. • SL.9-10.1c. Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify or challenge ideas and conclusions. • W.9-10.3.e. Provide a conclusion that follows from and reflects on what is experienced, observed or resolved over the course of the narrative.
Math	<ul style="list-style-type: none"> • S.IC.1. (+). Understand statistics as a process for making inferences to be made about population parameters based on a random sample from that population. • N.Q.3. (all). Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. • N.Q.2. (all). Define appropriate quantities for the purpose of descriptive modeling.
Science	<ul style="list-style-type: none"> • HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. • HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. • Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)

Lesson 6: Case Studies

featured technical expert Q&A

Abby Ceule

Corbion



Abby Ceule has worked in the baking and ingredient industry for 19 years, but that wasn't her original plan.

Ms. Ceule's background is in marketing, and she graduated from Kansas State University, Manhattan, Kan., with a bachelor's degree in the subject, as well as from Rockhurst University, Kansas City, Mo., with a master's degree in business administration. She then joined Corbion in the American ingredients division in 2004 as the company developed its marketing department.

"Once I got into the industry, I was really intrigued with the science behind the foods that we eat, and I really appreciated the sense of community that I found in baking," she said. "Since then, I've spent a lot of time with our scientists, bakers and technical service team to expand my knowledge."

Ms. Ceule has since held several roles in the company's marketing department and led its baking industry team. She now serves as Corbion's senior director of ingredient solutions.

As both a marketing and ingredient expert, Ms. Ceule is finding new and creative ways to solve customer problems and help them deliver profitable growth, she said.

This can be a challenge, however, especially now as the industry grapples with supply issues and inflation.

"We're all facing supply challenges on raw materials and equally we're all facing cost pressures due to material and freight cost," Ms. Ceule explained.

For bakers, this means critical ingredients like gluten and DATEM may be costlier and more difficult to come by. To help bakers navigate these challenges, Ms. Ceule shared how these ingredients can be replaced in a formulation while still ensuring product quality.

What role do ingredients like gluten and DATEM serve in baked goods?

Gluten and DATEM can help bakers achieve consistency. They are important ingredients for providing dough strength and tolerance as well as crumb structure. Over the years, these ingredients have helped to improve formulas, and they help dough go through the wear and tear of the industrial baking process.

Why may bakers wish to reduce or replace these ingredients in their products?

With gluten, we're seeing increasingly higher prices over the past 12 to 18 months, and we anticipate this will continue into 2023. DATEM, similarly, has had cost increases in addition to supply chain challenges in the US in 2022. These cost increases and ingredient shortages have forced many bakers to look for alternatives to keep their production lines going.

What are common solutions bakers can use to replace their ingredients?

Enzymes are a great way to reduce or eliminate the need for ingredients like gluten and DATEM and can also help clean up the label. Corbion's extensive line of enzyme-based solutions can reduce or remove the need for gluten and DATEM, as well as other emulsifiers. In particular, our Pristine 3000 solution was developed to remove gluten from bread and bun applications, as well as remove the DATEM in formulas. Other emulsifiers, such as sodium stearyl lactylate (SSL), could also be used to replace DATEM in many formulations.

What are the challenges posed by replacing these ingredients? What key functionality must be replaced?

Gluten and DATEM provide strength, tolerance and volume in baked goods. When replacing these ingredients, it's important that bakers look at the entire formula and properly balance it with the replacement ingredients. This will ensure there's no sacrifice in the overall quality of the finished product. By moving to enzyme-based solutions, such as Pristine 3000, bakers can also insulate themselves from further cost fluctuations and tight supply in both gluten and DATEM.

Are there certain applications in which removing these ingredients is more difficult?

Ingredients with more inclusions/particulates and whole wheat formulations can be tricky and often require stronger solutions. In these situations, it's important to look at the whole formula, balance it and ensure that the replacement solution is a suitable substitute that can be used at a high enough level to replace the full functionality needed for that application.

What mistakes do bakers make when reducing or eliminating these ingredients?

One mistake we see is that bakers don't always balance the entire formula when swapping ingredients. It is very important bakers consider the entire formula, including processing conditions and how the swap they are making will impact other ingredients in the formula. Corbion can offer onsite technical service to ensure a seamless transition from one ingredient to another. Our technical

services team is very skilled not only in industrial bread production, but also in how to apply our enzyme and emulsifier-based solutions.

“WITH GLUTEN, WE’RE SEEING INCREASINGLY HIGHER PRICES OVER THE PAST 12 TO 18 MONTHS, AND WE ANTICIPATE THIS WILL CONTINUE INTO 2023. DATEM, SIMILARLY, HAS HAD COST INCREASES IN ADDITION TO SUPPLY CHAIN CHALLENGES IN THE US IN 2022.”

Abby Ceule, senior director, ingredient solutions, Corbion.



FOCUSED DAILY MARKET Coverage



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Bakery Flour
Bookings of bakery flour were light. Mixed price changes for wheat futures provided no incentive for bakers to leave sidelines. Most bakers already were comfortable with futures coverage through the end of calendar 2016 and into 2017. Some millers encouraged bakers to book supply or at least futures component coverage through end of 2017, pointing to lowest prices in years. Hard winter-spring blends were raised 5c a cwt, spring standard patent was raised 25c, and soft flour was moved up 5c. The prices of semolina and rye flour were left unchanged.

Millfeed
Needy prices were steady to higher with exception of spot Southwest rick, down \$2 a ton, and spot Southwest hucks, down \$10, as ample supplies. Defersals values were steady to higher. Market activity was quiet following a weekend when local sold of accounts were relatively light. Loaders were pick up in demand in Southwestern. Loaders said it was a "slow print" to this region. On other hand, most retailers said there were no recent but cheap feed.

Bakery Flour Prices – per cwt

Hard winter-spring blends, K.C.	\$11.95@12.05, 10 days
Export straight - 48 to .50 ash	\$12.15@12.25, truck
Clear, 1.20 ash	\$11, K.C.
Spring standard patent, Mpls.	\$13.30@13.40
High gluten	200@300c more
Fancy spring clear	\$13.15@13.25
First spring clear	\$13.05@13.15
Papers Buffalo	\$15.55@15.65
Semolina, Minneapolis	\$18.85@18.95
First clear	\$16
Second clear	\$16
Rye, Minneapolis	\$12.50
Crocker, Chicago	\$16.30@16.40
	\$10.75@10.85

Spot Midds, \$ per ton, delivered rail unless noted

Kansas City	\$83@73 (\$102@112, f.o.b. truck)
Minneapolis	\$82@92 (\$78@88, f.o.b. truck)
Chicago West	\$95@105 (\$83@93, f.o.b. truck)
Central states	\$78@85
Buffalo	\$82@92
Chattanooga	\$121@136
N.S. California	\$117@132, f.o.b. truck
South California	\$105@120
Pacific Northwest	\$325
Upper Midwest	\$220@240
Wheat germ	

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featured technical expert Q&A

Jeff Hodges

ADM



With nearly two decades of industry experience, Jeff Hodges is an expert in all things formulating for baking and snack products. He said this passion for baking began at a young age.

“I was captivated by how a simple combination of ingredients could create something delicious,” he said. “This curiosity of how ingredients interact followed me from childhood through college.”

At the University of Kansas, Mr. Hodges dove into the world of mechanical engineering but kept his baking skills sharp, experimenting with different ingredients and intriguing formats.

“Imagine my delight after graduation when I was offered a position that allowed me to combine my education and love of baking and innovation,” he said.

Mr. Hodges graduated with a bachelor’s degree in chemical engineering and took a position at Cereal Ingredients Inc., where he held a variety of roles including product development engi-

neer, senior technologist and program administrator. He then worked at Bimbo QSR as senior new product specialist.

In August 2020, Mr. Hodges joined ADM as the manager of the bakery, snacks and confections applications group in Decatur, Ill. Every day is different in his role at ADM, Mr. Hodges said, bringing new challenges to solve for a variety of baking applications.

“I enjoy being pushed daily to find new solutions, and I’m grateful to work alongside the incredibly talented and skilled scientists at ADM,” he said. “It’s exciting to see how new ingredients can be used in different ways to overcome formulation hurdles while also growing our technical expertise across an ever-expanding range of baked and even some non-baked applications.”

How has the better-for-you movement spurred the use of alternative/low-calorie sweeteners in baked goods?

Consumers are increasingly scrutinizing product labels, as they take a more proactive approach to supporting their overall well-being. To do this, many consumers look to reduce calories and limit added or total sugars. Our research shows that sugar reduction becomes 62% more important for consumers purchasing low-calorie foods and beverages. However, consumers will not sacrifice an enjoyable sensory experience, with 82% rating both taste and sugar reduction as important in their purchasing decisions. Since baked goods often derive much of their total calorie count from added sugars, any reduction of sugar in a formulation has the potential to constitute a significant reduction in calories in finished baked goods. Bakers can address these growing consumer demands for fewer calories and reduced sugar content by using alternative sweeteners that contain low or no calories.

What are common alternative sweeteners for baked goods? What applications are they best suited for?

Stevia is one of the most common and popular alternative sweeteners most often used for baked goods. Our SweetRight Edge stevia has no calories and a glycemic index of zero, and it’s exceptional for reduced-sugar and low-calorie baked goods.

With structural similarity to fructose, allulose is also a fantastic option for bakery items. Plus, our SweetRight allulose tastes and functions like traditional sugar, maintaining the taste profile and mouthfeel consumers love in their baked goods, cereals, confectionery and snacks. Allulose occurs naturally in wheat and dried fruits, contains no sugar alcohols and isn’t listed on prod-

uct nutrition labels as an added sugar — making it appealing to conscientious consumers closely reviewing ingredient lists and nutrition facts.

Moreover, SweetRight Reduced Sugar Glucose Syrup (RSGS) is an excellent alternative, allowing for more formulation flexibility in applications like protein bars and snacks. When used in reduced-sugar formulations, RSGS can replace corn syrup without sacrificing functionality, as it provides binding and viscosity comparable to this traditional sweetener.

When considering alternative solutions, are there other complementary ingredients that can be leveraged?

When leveraging alternative sweeteners in baked good formulations, it’s also important to consider the broader consumer appeal and demands. Lowering sugar and calories is top-of-mind for many consumers, and often goes hand-in-hand when they’re seeking out functional ingredients to incorporate into their diet. In fact, sugar reduction becomes 56% more important for shoppers searching for functional foods and beverages.

ADM/Matsutani LLC’s innovative soluble dietary fiber solution Fibersol meets consumers’ desire for added fiber in functional applications, while also acting as a complementary ingredient to reduce sugar without affecting aroma, flavor or texture. Fibersol builds back integrity through structural and binding qualities that can be lost when sugar is reduced or removed completely. Additionally, product developers can use Fibersol in place of sugar, syrups and honey. Fibersol is a good addition to reduced-sugar cakes, crackers, breads, pastries, frostings and coatings, maintaining a desirable texture in each application.

What are common formulation challenges when using these sweeteners? How can they be resolved?

We often see several formulation challenges when reducing sugar and replacing it with an alternative sweetener — especially in baked goods. Sugar plays a vital role beyond providing sweetness; it's crucial for functionality. All sensory factors must be rebalanced, rebuilt or replaced to ensure consumer acceptance of low-sugar formulations.

Methods for sweetener optimization rely heavily on the type of baked offering and the preferred sweetener system. For bakery formulations that are already not as sweet, like breads, only a slight adjustment to the yeast is needed to achieve sugar reduction. Alternatively, cakes, muffins, cookies, brownies and bars can use a simple one-to-one swap of ingredients to yield desired results, such as SweetRight Edge stevia in place of sugar, or RSGS rather than corn syrup. Additionally, replacing sucrose with our GrainSweet glucose-fructose syrup is a simple exchange, bringing sweetness, functionality and cost optimization to a variety of applications, including bread and bakery.

For nearly all other bakery offerings, bakers need to test the formulation with incremental changes until sugar reduction and sensory goals are met in the finished product. Furthermore, switching from traditional granulated sugar to liquid sugar systems may require minor adjustments involving water content and the preferred sweetness level. However, greater formulation modifications might be necessary when moving from a conventional sweetener to a lower sugar option.

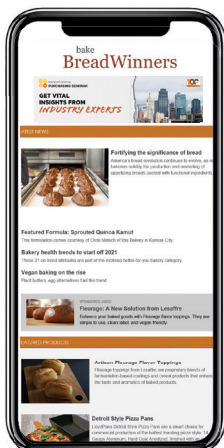
How can bakers ensure they find the best sweetener for their bakery product?

A collaborative supplier is an important piece of the puzzle when bakers are considering the right sweetener for their bakery offerings. We partner with bakers to overcome formulation challenges and reach calorie-reduction goals with optimized sweetening solutions, formulation ingenuity and our comprehensive sugar reduction approach. By identifying the best sweetener or combination of sweeteners, our technical experts help bakery brands create low-calorie and reduced-sugar bakery and snack items.

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featured technical expert Q&A

Richard Leboucher

Puratos USA



Richard Leboucher was born and raised in Paris, but his summers as a child were spent in the French countryside.

“I would spend my days with farmers growing and harvesting wheat, and this is how a passion for the baking industry was born,” he said. “It was always a painful time to go back to city life after the summer.”

At the Institute of Science and Technology in Paris, Mr. Leboucher was exposed to baking even further, and he loved linking the biochemistry science he was learning to real baking applications related to wheat, flour and bread.

“The biochemistry education was already very much oriented toward the baking industry, which made it so interesting,” he said.

Mr. Leboucher graduated with master’s degrees in cereal biochemistry and food technology and processing. He spent the first eight years of his professional career in R&D roles in France before accepting a position with Puratos USA, where he’s worked for the past 20 years.

At Puratos USA, Mr. Leboucher has served as vice president of R&D, R&D director and R&D manager, and is currently the company’s R&D director for bakery in Los Angeles. One of the most recent advancements he helped create is an enzyme-based solution bakers can use to replace oil in their baked goods.

Even after nearly 30 years in baking, Mr. Leboucher said, the industry is still full of new challenges that he loves to take on.

“The industry moves very quickly, which provides a lot of op-

portunities to come up with new solutions and new technologies; it is not a steady industry where nothing happens,” he said.

“It is really amazing to look at the bakery products available in the market and to ask ourselves, ‘How many of these were already in the market five years earlier?’ Besides that, everybody knows in this industry that a good performing solution in one bakery does not necessarily mean that the solution will be optimal in another industrial environment. This is another layer of complexity or, as I like to put it, another layer of excitement and opportunity. It keeps us sharp and forces us to never settle for the status quo. Even with existing solutions, we need to find ways to make them work everywhere.”

While there is plenty of opportunity in the industry, Mr. Leboucher noted that a big challenge facing it is the lack of skilled workers and bakers, something he and Puratos are working to change. The company has opened bakery schools in underprivileged communities across the globe, including most recently in Puratos USA’s headquarters of Pennsauken, NJ.

“What is nice about this initiative is that not only does it help the community by providing an education, but it will also help our industry to find more people interested in bakery and who will start with a solid formation,” he said.

What role does oil serve in baked goods?

Oil is widely used in baked goods and can have a lot of different functionalities. At high levels, its role is essentially to bring softness and texture while contributing to the flavor perception. At lower levels that I am covering here — less than 5% — it is used mainly to facilitate slicing for applications like sliced breads and hamburger buns while contributing to the softness of the crumb and giving the crumb a shorter bite. At these levels, oil also improves and facilitates the processing of the dough on automated lines as the oil serves as a lubricant.

Why may bakers want to remove oil from their formulation? What are some of the benefits?

Oil prices have skyrocketed over the past year and a half, going from approximately \$0.30/lb to more than \$0.80/lb. Although it is still not a very expensive ingredient in the recipe in terms of \$/lb (compared to enzyme systems, for example), the large quantities used can end up adding up to large amounts of money at the end of the year. Supply issues have also been reported; because of that,

removing oil started to appear on the radar screen of bakers. And, with the ever-growing trend of “better for you,” any reduction in oil that does not affect the quality of the bread is a benefit. Who would not choose a bread lower in fat vs. the full-fat version if the quality and the eating experience remain the same?

What are some of the challenges of removing oil from a formulation?

The challenges are in all the attributes that these low levels of oil bring: how to facilitate the slicing of bread without oil, how to keep that shorter bite that the oil brings and how to keep the processing ability of the dough when oil is removed. All of these are challenges that need to be addressed by any potential alternate solution.

What bakery applications are best suited for oil replacement?

All yeast-raised baked goods that contain less than 10% of oil on flour weight are good candidates; considering the volumes of sandwich breads (white, multigrain, whole wheat-bread slices) and

hamburger buns manufactured, these are particularly good applications for this technology considering the cost savings that can be generated.

As an enzyme manufacturer, we developed a product called Frimase S3106. It is a cost-effective enzyme system that can be used to replace low levels of oil (less than 5%) without affecting the dough or the bread. A specific enzyme combination is used in this module to ensure a good slice-ability of the bread or bun while delivering on the texture attribute (short bite) and the slightly extra softness that low oil levels bring.

Are there certain bakery applications where oil replacement is easier or more difficult?

Since we are talking about yeast-raised products, as a rule of thumb, the higher the oil content, the more challenging the replacement is. At or below 5%, the replacement is pretty straightforward and requires little adjustments; next to the oil being removed and the enzyme system being added, the hydration is slightly increased to keep the same dough rheology. When the oil content is above 5%, the replacement is a little bit more challeng-

"WITH THE EVER-GROWING TREND OF 'BETTER FOR YOU,' ANY REDUCTION IN OIL THAT DOES NOT AFFECT THE QUALITY OF THE BREAD IS A BENEFIT."

RICHARD LÉBOUCHER, PURATOS USA

ing and usually requires a few trials to adjust the enzyme activity to the entire formula and to adjust the hydration.

How can bakers determine whether a full or partial oil replacement is best for their product?

Here also it depends mainly on the amount of oil to replace; below 5%, a full replacement is possible in almost all cases; above 5%, the situations have to be approached on a case-by-case basis but good results can be achieved at up to 10%. Beyond that, a certain amount of oil needs to be kept in the formulas.

Considering that this module replaces low levels of fat (less than 5%), a full replacement can be achieved in most cases. Plant trial validations have shown that the dough rheology remains very good while delivering on the attributes that the oil normally brings, even when the full 4% to 5% oil is removed.



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4. How does the expert's career play a role in solving the problem?

Featured Technical Expert Q&A pdfs:

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Lesson 6: Trends Reflection Worksheet

Food and Baking Industry Trends Reflection

Reflect on the Baking Industry Case Studies and Food Industry Trends that were discussed in class and answer the reflection questions below.

1. Were any of these trends addressed as problems in the case studies?

2. Which trends do you follow? Why?

3. Which trends do you not follow? Why?

4. What trends do you think might go away? Why?

Lesson 6: Key Food Trends Group Jigsaw

With a partner, you will research a specific trend.

Use the internet to research your assigned topic. Collaborate with your group members to gather relevant information and discuss findings.

Prepare a Google Slides presentation based on your findings that includes four slides.

The presentation should include the following:

- Slide 1: Title Page that includes your trend and group member names
- Slide 2-3: Key information you found about your topic might include:
 - Relevant examples
 - Statistics (nationally or globally)
 - Key players in this trend
 - News stories
- Slide 4: Conclusion or reflection about your trend. This may include:
 - Impact on you and your peers
 - Impact on agriculture
 - Impact on the economy
 - Impact on the environment

Lesson 6: Baked Goods Brands Web Search

Use the internet to search for the top 10 baked good brands in the world.

Record the top 10 brands and then select two of those brands, one domestic (in the United States) and one that is international.

Top 10 Brands:

- | | |
|----|-----|
| 1. | 6. |
| 2. | 7. |
| 3. | 8. |
| 4. | 9. |
| 5. | 10. |

Domestic Brand:

1. Where is it located?
2. Summarize its background/origin story.
3. What products does that company make?
4. Describe the types of grains and milling processes that would be used to make these products.
5. Does the company create foods for convenience, healthy, locally grown, fresh, minimal processing); are they sustainable; do they address government policies, have GMO labeling

International Brand

1. Where is it located?
2. Summarize its background/origin story.
3. What products does that company make?
4. Describe the types of grains and milling processes that would be used to make these products.
5. Does the company create foods for convenience, healthy, locally grown, fresh, minimal processing); are they sustainable; do they address government policies, have GMO labeling

You will do a “gallery walk” by sharing your international company with other students. Your classmates will star the country that their baked good company is in on your map. (A larger map is on the next page.)





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Grain Science lessons are posted at:

<https://www.grains.k-state.edu/educator-resources/untitled.html>

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