



Innovation Report

The next generation of bakery shortenings

A look at the new products and processes
designed to meet the changing needs of your customers.

Exploring tomorrow's bakery shortenings. Today.

Over the past decade, palm oil (including its fractions), interesterified fats, fully hydrogenated oils, and high oleic oils have all largely replaced PHOs as shortening components of choice for bakery manufacturers. Palm oil, for example, has many functional and supply chain benefits, which is why it has largely become an industry staple. As we continue to learn more about nutrition, functionality and bakery manufacturing needs, there is opportunity for new innovation to respond to trends in the bakery space.

This report takes a closer look at some of the ways the baking industry is addressing current opportunities with bakery shortenings: the new products, emerging processes and innovative approaches underway to tackle functional and palm sustainability issues—while still delivering on the health benefits and taste today's consumers demand.

WHY IS IT CALLED SHORTENING, ANYWAY?

Before shortening, baked goods were made largely from animal fats, namely lard and tallow. Vegetable oil-based shortenings came along in the late nineteenth century and were made initially from cottonseed oil. The modern-day shortening was made possible via the invention and use of the hydrogenation process. Shortening prevents the cohesion of wheat gluten strands during mixing. This action physically shortens the strands of gluten resulting in less elastic and sticky doughs.¹

Cracking the code on bakery fats.

Baking fats are designed to deliver high functionality. Unlike foundational liquid oils used in cooking or frying applications, the shortenings used in baking applications require solids and melting profiles that deliver the desired structure and texture that characterize today's quality baked goods. For example, shortenings enable mixing and machinability of doughs during production—and in finished goods provide the desired eating texture.



Choosing the right shortening is both a science and an art that requires experimentation.

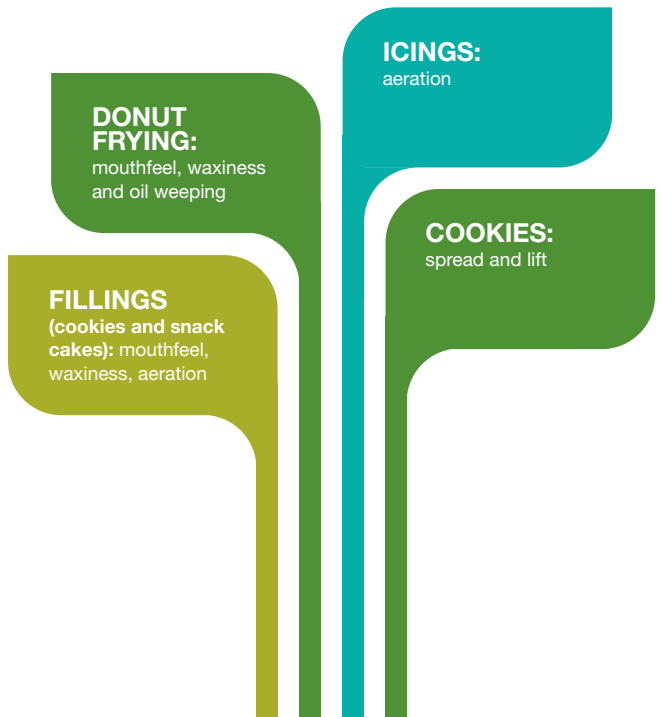
There are several factors that make a fat functional in a bakery application—which can make choosing the right shortening for the right product a bit challenging. The functional properties of the fat affect the properties of the end product—influencing characteristics like shelf life, mouthfeel, appearance, and ultimately consumer acceptance.

A few of the key functional attributes to consider are:

- **MELT POINT:** the temperature at which solid fat melts and becomes liquid
- **PLASTIC RANGE:** the temperature at which the shortening will stay workable
- **LABELING:** certain terms may be more acceptable to consumers than others
- **NUTRITION:** the fatty acid profile, especially the level of saturated and unsaturated fat

Health and taste preferences are driving new product formulation.

As consumers' attitudes about health and taste evolve, ingredient manufacturers are adapting to create the next generation of structuring fats. With more than half of consumers closely monitoring fats and oils in foods,² it's critical to provide products that function while meeting desired nutritional needs, such as less saturated fat. Functionally, shortenings should accommodate a wide range of baking applications and corresponding characteristics:



Palm oil: A reliable option

Pros

- High level of solids for structuring
- Oxidatively stable
- Versatile

Cons

- Brittleness, especially when stored at cold temperatures
- Sustainability concerns
- Sourced offshore with a long supply chain
- Saturated fat level may affect nutritional profile of finished application

Palm oil is still a dominant player.

Palm oil remains a dominant base oil due to its versatility for baking products, spreads and frying.

Solid at room temperature, palm oil's high melting point accounts for its technical utility with baking manufacturers.

Refined palm oil has high oxidative stability and gives products desirably long shelf life. Stable at high temperatures, it helps to give fried products a crispy and crunchy texture. It's a highly versatile product that can be used in many applications without compromising the finished products' characteristics.

Industry continues to evolve and look for new solutions in the bakery space. For example, improvement of the palm supply chain and its nutritional profile. Sustainability is one area where consumers are becoming more aware—but we see that they also hold onto nutritional concerns with saturated fats.





As manufacturers and product developers continue to explore new ways to create oil products with more favorable ingredient profiles, three processes—hydrogenation, interesterification and fractionation—are playing key roles.

Interesterification, a tool for enhancing functionality

Interesterification is a process being used by ingredient manufacturers in which the oil or oil blend's fatty acids are rearranged and the positions of fatty acids on the glycerol backbone are changed to alter its melting properties, and optimize the functionality.

There are two types of interesterification processes: Chemical interesterification, which produces complete randomization of fatty acids, and enzymatic interesterification, which allows more control of the positions on the glycerol backbone that are rearranged.

While interesterified oils give food manufacturers the promise of a high-performing—and in some cases, a lower saturated fat—product, the biggest challenge may be earning trust from skeptical consumers who may be quick to reject the unfamiliar term “interesterified.”

Hydrogenation as a tool for enhanced shelf stable and functionality.

Hydrogenation is a process in which a liquid oil turns into a solid fat. The hydrogenation process uses a catalyst (often nickel) to make unsaturated fatty acids saturated. Premature termination of the hydrogenation process was used in the industry for many years to make partially hydrogenated fats (containing artificial trans fats, which raises LDL, or “bad,” cholesterol). Fully hydrogenated fats are theoretically trans fat-free. These fully hydrogenated fats have high stability and provide structuring in applications.

The fatty acid profile is essentially a unique fingerprint for each fat. From the fatty acid provided we can calculate the IV value. The lower the IV, the more saturated the fat. So a lower IV oil (very high in saturated fat) is harder at room temperature. The U.S. Food and Drug Administration (FDA) defines fully hydrogenated fats as having an IV value of less than 4.

THE SKINNY ON FULLY HYDROGENATED OILS

Pros

Efficient and proven technology for designing functional fats
Converts a liquid oil into a structured fat that can be used in bakery applications

Cons

Very brittle
Associated with the manufacture of artificial trans fats
Consumer perception of processed ingredients

Deconstructing interesterified oils

Pros

Better consumer perception than hydrogenation

Cons

Still largely untrusted because of the highly technical nature of the word



Examining consumer perceptions of bakery fats and oils.

While sustainability is a growing concern for consumers, the nutritional component of palm oil seems to be a bigger concern than the sustainable factor.

33% of consumers say they are likely to check for palm-free claims on products. Of those, 51% say it's because they are trying to avoid saturated fats.³ (Fig. 1)

Reasons for checking for a palm-free claim

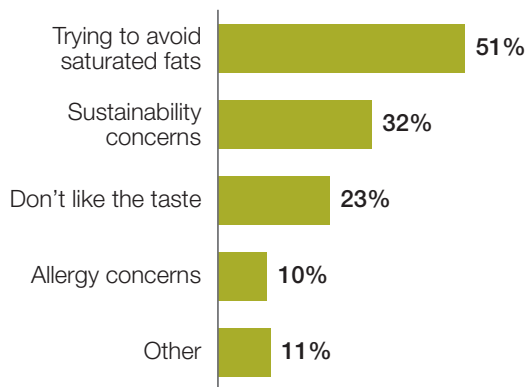
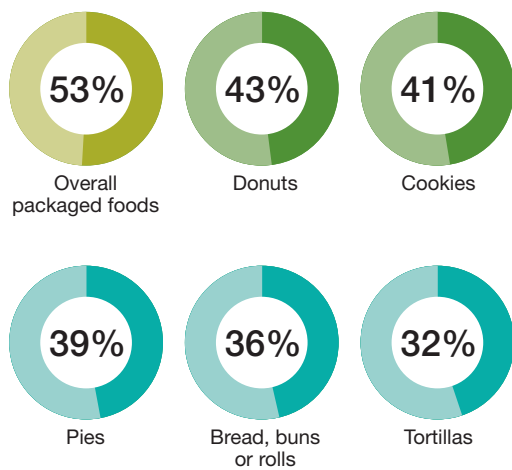


Fig. 1

When it comes to fats commonly used in bakery products, none are likely to drive a purchase by consumers.⁴ (Fig. 2)

“To what extent do you pay attention to the type of oil or amount of fat in each of the following food categories before you choose to purchase a particular packaged food?”



[% of people who pay extremely close attention/close attention]

Fig. 2

Consumers don't seem to distinguish between the terms partially hydrogenated oil and hydrogenated—and seem to associate the term “hydrogenation” with trans fats. Nearly the same percent of consumers say they would be less likely to purchase a product containing partially hydrogenated oil or hydrogenated oil. But because interesterified oils are not connected to a significant health implication, like trans fats or high saturated fats, it is less negative to consumers than hydrogenated oils or lard. (Fig. 3)

FATS & OILS	2020 GEN. POP.
Sunflower Oil	17%
Coconut Oil	16%
Canola Oil	3%
Safflower Oil	0%
Vegetable Oil	-1%
Butter	-2%
Soybean Oil	-11%
Palm Oil	-26%
Intesterified Oil	-39%
Partially Hydrogenated Oil	-48%
Hydrogenated Oil	-51%
Lard	-69%

Fig. 3

Cargill's proprietary consumer survey, called FATitudes™, tracks consumer perceptions, behaviors and attitudes of fats and oils in packaged foods.

Fractionation separates liquid and solid parts of fats

Fats and oils are a heterogenous mixture of triglycerides. These triacylglycerols display high and low melting temperature profiles. The fractionation process utilizes this physical property and separates liquid and solid components of fats from their native form. This results in multiple products with varying physico-chemical and functional properties. For example, whole palm oil can be fractionated into two major components:
(1) palm olein—liquid portion, which is used as a frying oil and
(2) palm stearin—solid, used mostly a structuring fat.

Pros

Production of multiple products from single starting base stocks

Cons

Main base stocks used are offshore fats



Other players? Low saturated fat starches and liquid-solid blends.

Interest in saturated fat claims among consumers is at its highest point in 8 years, with 53% of consumers being more likely to purchase NO saturated fat items.⁵ As a result, many ingredient manufacturers are also exploring the addition of starches to lower the saturated fat levels in shortenings. The starch acts as a structuring agent and essentially replaces the saturates in a solid fat. Liquid-solid blends are another approach to lowering saturated fat levels. Each solution offers the functional needs for baking applications—while improving the nutritional profile of the shortening product.



STARCHES & LIQUID-SOLID BLEND ROUND OUT THE OFFERINGS

Pros

Improved nutritionals

Cons

May present challenges from a clean label perspective

What's on the horizon?

A few predictions.

Innovations in packaged foods are anchored in consumer demands for products that meet their nutritional needs and align with their values. Cargill tracks these trends through its proprietary TrendTracker™. Four global macro trends have been identified that will influence how and what consumers buy: **Conscious Consumption, Healthy for Me, Experience It and Simplify My Life.**

Healthy for Me and Conscious Consumption likely will impact oils and shortening innovations most. Here are some ideas of what may evolve:



For more information about Cargill's TrendTracker contact your Cargill representative.

Healthy for Me is about how consumers seek health benefits in their food as well as avoid those they consider bad for their health. Plant-based protein, clean label and immunity fit into this trend. For the bakery segment, impacts may include an increasing interest in baked items boosted with plant protein, for enhanced immunity or for improved gut-health. However there is also room for plain indulgence as a feel-good treat.

HOW OIL AND SHORTENING INNOVATIONS MAY RESPOND TO THIS TREND:

- Ingredient systems to create solutions for plant-based protein inclusions into bakery products
- Blends and ingredient systems to reduce saturated fat levels or increase the nutritional value by adding fiber or antioxidants
- New crop hybrids that bring new nutritional value to oils, such as higher omega-3 or lower saturated fat content

In **Conscious Consumption**, consumers seek out brands that align with their values and may be willing to pay more for a product that has a compelling story. This may impact how consumers view ingredients in the packaged products that they purchase. Sustainable supply chains and a commitment to the betterment of the environment become expectations.

HOW OIL AND SHORTENING INNOVATIONS MAY RESPOND TO THIS TREND:

- Enhancements in supply chain for palm and soil health programs provide avenues for storytelling about how your ingredients contribute to an improved environment
- New oil blends that increase options for non-palm shortenings

Outside of responding to consumer trends, there is the perpetual need to formulate to meet operational and functional needs, such as for higher stability or increased plasticity. The industry continues to work on functional improvements through the use of different oil blends and technologies, which may include digital transformations like 3-D printing or new crop hybrids that provide new functional attributes.

Count on Cargill to deliver the oil solutions ideally suited to bakery.

A dynamic portfolio of dependable oils to meet all your baking challenges.

From our all-purpose, dependable Regal™ and Advantage® shortenings to next-generation oil and shortening solutions like PalmAgility®, count on Cargill's innovation, product breadth and expertise to help you identify the fats and oils that best meet the individual needs of your operation—easily and cost-effectively.

An expanded food pilot facility to accelerate products to market.

Our \$6.4 million facility expansion allows us to better partner with our bakery customers to develop innovative new products and quickly bring them to market.



Trusted teams to move your business forward.

Available globally, our dedicated tech service and applications teams work side-by-side with you in our customer labs—problem-solving and efficiently scaling up or down to meet your individual needs.

Contact us today for the product breadth, proven capabilities and industry expertise to bring greater growth and improved performance to your operation. Or learn more at www.cargill.com.

1 Bakerpedia.com

2-6 Cargill FATittudes™ consumer perception study, May 2020