

Bursting with flavor and functionality

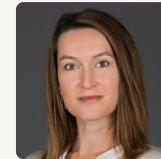
Why flavor emulsification with Cargill's modified starches will deliver tomorrow's winning beverages.

Flavor emulsions are broadly used in the beverage industry for the stable suspension of oil-soluble flavorings such as essential oils (e.g. lemon, juniper, coloring and vitamins). Typical emulsifiers used to create a stable beverage emulsion are gum arabic (acacia gum) (E414) and (n-OSA) modified food starches (E1450). Today's consumer trends and supply chain challenges are

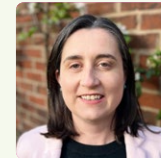
presenting new opportunities for beverage manufacturers using n-OSA starches. In beverages, Cargill offers a range of hydrolyzed n-OSA starches as flavor carriers to help our customers develop great tasting and shelf-stable beverages. We spoke to several of our experts about today's trends and why now is the right time to benefit from the functionality of these flavor emulsions.



Our experts:



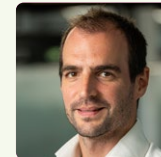
Gayle Pierce
Marketing Manager
Beverages



Fiona Barnett
Business Development
Manager Food Starch



Ines Fuhlrott
R&D Category Leader
Beverages



Wouter Van Beneden
R&D Senior Application
Specialist Beverages





What is happening in the beverage market right now?

Gayle: Soft drinks have become much more than merely thirst quenchers. For example, we are increasingly seeing a shift towards low and no alcohol consumption, particularly among younger generations. To meet the needs of more mindful consumers, the beverage industry needs to come up with new solutions. And this is where we need flavor emulsions to replicate the complex flavors of alcoholic beverages without the alcohol content, ensuring these drinks remain enjoyable and satisfying.

And let's not forget that flavor is the name of the game! According to a 2024 Innova Market Insights consumer survey*, 1 in 3 global consumers are intrigued by new, unique, and different flavors. And with consumers seeking more appealing, refreshing, and novel tasting beverages, the pressure is on the beverage industry to respond with more adventurous flavors as palates become open to bolder flavors. This requires versatile flavor emulsions that can deliver these exciting new tastes.

This is really driving innovation in flavor emulsion technology, pushing manufacturers to develop more advanced, versatile solutions to meet evolving consumer preferences.

That's where Cargill's modified starches can offer a beverage boosting solution!

What about trends on the manufacturing front?

Fiona: There are two things that keep our customers awake at night, increasing costs and supply chain disruption. When making flavor emulsions, beverage manufacturers are using very small amounts of globally traded ingredients, such as emulsifiers. These are especially susceptible to supply disruption in container transportation, making it important that they have a robust supply chain set up.

Geopolitical conflicts contribute to supply chain disruption. The widely reported issues impacting container transport into the Suez Canal and strikes at US ports lead to longer transit times. But a less reported issue has been the security of supply around gum arabic (acacia gum). This ingredient is predominantly grown

* Innova Market Insights, "Consumer Food Trends for Global Flavor Adventure," 2024

in the Sahel region of Africa, and especially Sudan – which is unfortunately still a conflict zone. One of the options for customers today is to use highly specialized emulsifying starches (E1450) instead. E1450 starches have been chemically modified with n-Octenyl Succinic Anhydride (n-OSA). This modification makes the starch molecules amphiphilic, meaning they have both water-attracting (hydrophilic) and oil-attracting (hydrophobic) properties.

This enables manufacturers to create stable emulsions that remain consistent and don't separate over time. This is particularly useful in drinks such as carbonates, juices, and no- and low-alcohol beverages, ensuring a uniform texture.

These specialized starches are also transported in containers around the world. However, they are readily available, which means that supply is not so reliant on a single region, giving a more consistent delivery performance.

Cargill manufactures modified starches for flavor emulsification in both Europe (Haubourdin, France) and the US (Cedar Rapids), and can supply depending on customer requirements. The range is based on locally grown non-GM waxy corn.

Why is flavor emulsification important in beverages?

Ines: Oil is the carrier for flavor in a beverage – think of orange oil, for example. But since oil and water don't mix, you need an emulsifier and mechanical energy to make that happen – and this is where a modified starch for flavor emulsification comes into play. In effect you are microencapsulating the flavor by building a layer around the oil droplets to stabilize and distribute your flavor in the beverage. In this way, the fine droplets swim within the water, and you get that sensory burst when the flavors are released in the mouth. Another technical reason for doing this is that you are protecting the oil from environmental changes such as temperature and oxygen.

It's also important to note that different formulations require different technical performance in emulsification, particularly when comparing a transparent and an opaque beverage.

A typical transparent beverage, think of flavored water or a clear lemonade, will only contain a flavor emulsion, an emulsifier, some preservatives, and water. Since these beverages contain very small oil droplets – the

light is not scattered, and we cannot perceive any opacity. In an opaque beverage, think of an orange carbonate, the oil droplets are a little bigger and then the light is scattered, and consumers perceive it as opaque. Here, the industry adds gums as “weighting agents” to the oil to avoid creaming at the top of the beverage. In each case, you need to ensure that it all works together.



What are Cargill's solutions for flavor emulsification and which functionalities do they deliver?

Ines: Cargill offers C*EmCap™ and EmulTru modified starches for flavor emulsification, which both deliver the functionality of stabilizing oil in water. Beyond bringing flavor to a transparent drink, these ingredients also bring some opacity for a juicier, more authentic appearance.



C*EmCap™ is suitable for most beverage applications, while EmulTru goes a little further in functionality thanks to our unique processing expertise. Since EmulTru is suitable for products requiring cold storage, it can be used in products containing oils that are sensitive to the environment (e.g. oxygen or temperature), or beverages containing active nutritional ingredients.

So, for example, if you were to stabilize a product containing DHA omega 3 oils, or vitamins, and leave them standing at room temperature, they will mature over time – you would need to cold store those beverages to keep them stable. And then EmulTru would be the right choice. But just to be clear, the labeling for both products is the same: “E1450,” “n-OSA starch” or “modified (non-GM) corn starch”

Why are these solutions so important for beverages?

Fiona: Most parts of the food industry use flavors and typically buy them directly from a flavor house. But since beverage manufacturers use such high volumes, they often have the economies of scale to make their own flavor compounds. At the same time there is also a certain amount of intellectual property protection here

– if a beverage manufacturer is making its own flavor compounds, it can be confident in protecting their IP by not sharing it with another party.

What is the potential for n-OSA starches in other applications?

Ines: Since beverages is such a broad category in terms of the flavors that can be used, it's a good area to use modified starches for flavor emulsification. But we should stress that emulsions are suitable for many other applications too, including soups & sauces, and in the dried version even teabags. For instance, if we stay with beverages – when you think about instant coffee creamers – this is also an emulsion. There typically caseinate is used as an emulsifier – but a modified starch for flavor emulsification a good alternative here, where it brings the pure oil into the coffee to get the creamy and turbid experience.

What about synergies with other solutions for beverages?

Fiona: The complexity of the beverage matrix depends on whether the customer is going for full sugar or a sugar-reduced formulation. Either way, we are there to support our customers through our portfolio and expertise. So, the total recipe may require other ingredients such as [pectin](#) and [high intensity sweeteners](#) to make a full beverage formulation.

But I want to stress that the flavor piece is such a small and concentrated amount that is diluted as needed with other components. In other words, since the usage levels are so small, the synergies are not so relevant.

Ines: Indeed. For context, a typical flavor emulsion is 0.1% of a beverage and the required amount of n-Osa starch is much less still – in fact it typically only constitutes +/-0.01% of the beverage!

But it's worth noting though that other typical emulsifiers require about 33% more product to create an emulsion. So here there are cost-saving benefits too, as you need less to achieve the same result. Furthermore, it processes slightly differently too.

Compared to typical emulsifiers, modified starch is functional direct after dispersion in the emulsion. So, there is a time saving element here too when producing the emulsion.

What is happening on the innovation front when it comes to modified starch?

Wouter: Several years ago, Cargill achieved a US patent for the development of a cost effective, solvent-free, quick and reliable process for the production of transparent (clear) citrus beverage flavor emulsions. The solution serves as an alternative to the current time-consuming, solvent-dependent and unreliable “washing” process for citrus oil deterpenation.

Washing is a batch operation that requires 24-72 hours in production, making it a time consuming, space intensive, and overall, an expensive process for clear beverage production. Furthermore, complete consistency across batches can never be guaranteed, due to the several required steps. Another problem with the conventional production of clear citrus flavored beverages is that if you are using ethanol as a solvent



for washing, by definition this flavor is not going to be halal. With this background in mind, our teams looked at the potential of one of our great starch solutions in a new application.

By combining outside knowledge on cloudy emulsions, washing and flavoring with inside know-how on n-Osa starch properties, we succeeded in delivering new growth opportunities with a disruptive system for the current washing technology. The key to success is the power of n-Osa starch as an excellent emulsifier. By applying it, flavor manufacturers can reduce the size of the essential oil particles to below the region of visible light (below 250nm), so there is no interaction with the light and opacity is avoided. You let the starch do the emulsifying work, you homogenize, and you are there. You don't have this decantation process whereby you are never completely sure that batches are identical in composition. Your quality is always set, and you can produce in a single shift.



Cargill, your partner for co-creating growth in Beverages

Leverage our passionate beverages experts with deep ingredient, application, and category knowledge. We're here to support you by developing and testing fully integrated solutions that deliver consumer-pleasing beverages.

The Cargill advantage:

-  Insights-driven innovation
-  Broad solutions portfolio
-  Enhanced expertise
-  Trusted supplier

Meet our experts:



Gayle Pierce
Marketing Manager Beverages

With more than 15 years' experience in various marketing and communications positions, Gayle Pierce joined Cargill in 2016. In her role as Beverages Marketing Manager, Gayle is responsible for crafting and executing category marketing strategies and delivering astute marketing insights.



Fiona Barnett
Business Development Manager
Food Starch

With more than 20 years' experience in starch, Fiona is currently the Business Development Manager for Cargill's starch portfolio. In her role, she spearheads the development and expansion of Cargill's starch offerings across Europe. Before focusing on the starch product line, Fiona held various sales and sales management positions within Cargill's specialty portfolio.



Ines Fuhlrott
R&D Category Leader Beverages

With more than 20 years' experience in the specialty food industry, Ines leads the European R&D Beverage Category team, focused on providing value added solutions in the flavor and beverage industry. Ines has a broad range of experience especially around flavor emulsion and encapsulation across various functions including ingredient research, process development, application development and delivering technical solutions to customers.



Wouter Van Beneden
R&D Senior Application
Specialist Beverages

As R&D Senior Application Specialist Beverages, Wouter thrives on inspiring customers with innovative Cargill solutions. With more than 10 years of experience, he is a passionate food and beverage expert. Holding a Master in Food Science, he is a (co-) inventor of several (pending) patents. Wouter's extensive knowledge spans the beverage spectrum, driven by his love for exploring new trends and innovations.

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