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# Carob in Crisis: Dairy's Hottest Commodity Faces Shortages

LBG is inescapable in dairy—so the current supply crisis is forcing brands to find creative workarounds.

by Kimberly J. Decker

Ingredient technology has gotten so sophisticated in recent years that it's easy to forget: Even "advanced formulation solutions" are often, at their roots, agricultural commodities.

But those roots are impossible to ignore in the face of the current crisis in carob bean gum—also known as locust bean gum or LBG. An indispensable ingredient in everything from oatmilk to ice cream to pie fillings, LBG is made from seeds—and those seeds happen to be in severely short supply now and for the foreseeable future.

That shortage is driving prices to untenable highs, and in response, formulators are scrambling to find substitutes—particularly in the dairy sector, where LBG is near ubiquitous.

"The dairy industry relies on this popular texturizer and stabilizer because it's such a versatile and functional ingredient with

a great clean label reputation," says Anne Sinha, director, strategic segment, CP Kelco.

But what if neither Mother Nature nor market forces can bring LBG supply, demand—or price—back into alignment soon? If no such resolution comes to pass, Sinha bets that "2021 may be the year that industry finally begins to look seriously at ingredient alternatives."

### Straitened Supplies

Nesha Zalesny, technical consultant, IMR International, has been watching the LBG market as closely as anyone. As per her latest observations, spot prices for the ingredient are at historic highs—that is—when any material can be found.

"Specifically," Zalesny continues, "the price for the seeds from which LBG is made are nearly eight times higher than their historic average."

Those seeds come from the carob tree (*Ceratonia siliqua*), which grows wild under semi-arid conditions in countries like Portugal, Spain, Greece, Turkey, and Morocco. Like any other crop, it's subject to nature's whims, and as the 2021 harvest ramps up, early reports are that the Spanish crop is coming in below expectations, with the Portuguese and Moroccan harvests just squeaking by at average.

"The current supply situation is extremely tight," Zalesny concedes. It's so tight, in fact, that some manufacturers aren't meeting customers' contracted volumes. And while as recently as several years ago industry could tap into "rollover stock" for use—Zalesny notes that the seeds can be held for several years before milling—"this is no longer the case," she says. "There's no rollover stock. Everything harvested goes to current-year production, and that's sold out for the past few years."

### Alternatives Are Imperative

Though some efforts to start carob plantations have emerged, they've met limited success. Land is expensive, Zalesny says, and with trees requiring nearly a decade to mature and begin producing, getting a plantation off the ground is "a risky and long-term investment that not many corporations are in the position to make," she says.

Furthermore, though carob trees may be hardy, they're not invulnerable to weather or a changing climate. "And they have their own growth cycles," Zalesny adds. "Trees may have an extremely productive year followed by a year or so of recovery with smaller harvests."

Neil Morrison, head of global sales technical service, CP Kelco, notes that when prices for top-quality crude LBG began spiking in 2018, "we were of the belief that inflation would calm down within the 12-month cycle. But what we've found is that crude LBG market pricing isn't always predictable for several reasons. This includes speculation in spite of volume and traders who use their inventory of seeds as a fiber source for a secondary value stream. I think now industry is realizing that inflation won't go away and that alternatives are imperative."

### Demand in Dairy

The dairy sector understands this imperative acutely.

Morrison points to Innova Market Insights data indicating that the leading LBG applications by CAGR from 2016 to 2020 were ice cream, frozen yogurt, spoonable yogurts, and cheeses.

"There's also been a lot of growth in plant-based dairy alternatives, such as non-dairy frozen confections and bever-



➤ Locust bean gum comes from the seeds of the carob tree (*Ceratonia siliqua*), which grows wild in countries like Portugal, Spain, Greece, Turkey, and Morocco.



➤ LBG has excellent freeze/thaw capabilities and inhibits ice-crystal formation in frozen dairy.



ages," he adds.

LBG keeps turning up in these applications for obvious reasons.

Quite simply, observes Morrison, it "answers several consumer trends, including the desire for clean labels and short, recognizable ingredient lists. It's also an approved dietary fiber, can be certified kosher and halal, and is vegan. Consumers view it in a very positive light."

Formulators prize the hydrocolloid's versatility as a stabilizer, texturant, and thickener, he continues, adding that LBG "has excellent freeze/thaw capabilities and inhibits ice crystal formation in frozen dairy."

Zalesny emphasizes that last point. "That's what lets consumers pull their ice cream

straight out of the freezer, scoop it into a bowl—or directly into their mouths—put it back in the freezer, and not get a sandy bowl of ice cream the next time they take it out again."

And Linda Dunning, systems business development manager, IFF, notes that LBG's gelling, emulsifying, and water-binding properties "optimize mouthfeel, provide a smooth texture, and prevent syneresis in cream cheese, Neufchâtel, and similar products."

In the end, Zalesny says, "There are all kinds of theories as to why LBG's so popular. But one of the main reasons is tradition. LBG is in nearly every ice cream stabilizer commercially available and has been for

decades. Dairies are accustomed to using it in nearly everything. It has a very clean flavor and smooth mouthfeel and it's synergistic with other hydrocolloids like xanthan gum, gellan gum, carrageenan, and agar. Blending it with these creates novel textures, which makes it valuable in a variety of systems."

#### Chemistry Lessons


As Morrison puts it, "LBG's strength lies in its functionality." And its functionality lies in its chemistry.

Namely, LBG is a galactomannan, a polysaccharide comprising a beta-1-4-linked mannose backbone with alpha-1-6 galactose substitutions every fourth mannose—"what scientists call a 1:4 ratio of galactose to mannose," Zalesny explains.

Because "nature is rarely precise in its placement of galactose," she continues, LBG has large sections of unsubstituted mannose that she describes as being "nearly crystalline, with chunks—or blocks—of mannose with galactose attached. It's this grouping, or blockiness, of galactose that makes LBG unique."

The large unsubstituted blocks play a role in the gum's solubility and might also be the reason that LBG prevents ice crystal formation in ice cream.

"LBG is also nonionic," Zalesny continues, "so it doesn't interact with proteins, which makes it particularly suitable for dairy systems. And it's not soluble in cold water or milk, so dairies can add it to cold milk and start processing without having to pump very viscous material through homogenizers and heat exchangers. It doesn't develop viscosity until it's heated above 85°C and cooled."

  
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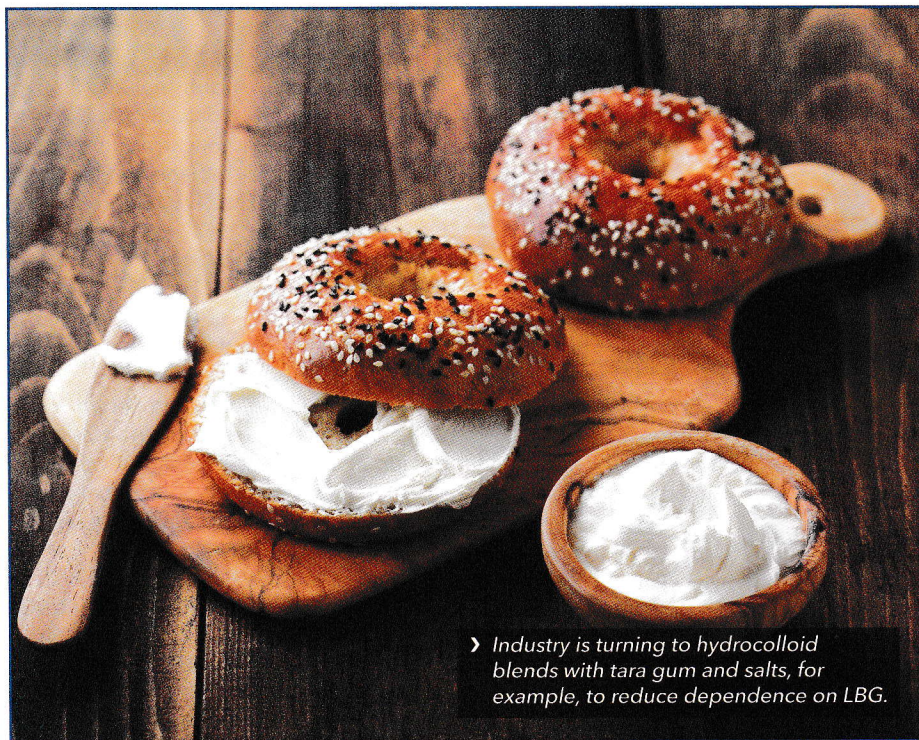


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› Industry is turning to hydrocolloid blends with tara gum and salts, for example, to reduce dependence on LBG.

### Feeling the Pinch

Those beneficial features are hard to forgo. But smaller dairies are already eyeing replacements, Zalesny notes, with some brands “changing their labels and pulling out LBG entirely.”

Others are waiting out the situation, perhaps banking that the ingredient’s relatively low use levels—roughly 0.25% or less for ice creams and 0.1% or less for beverages—will render its rising cost absorbable for now, Zalesny says.

Thus, larger multinational brands are evaluating their portfolios and reformulating product lines regionally, she observes. “It makes little to no sense to ship a very expensive ingredient into a region that cannot bear the expense,” she notes. “And regional preferences vary, so a substitution that succeeds in one region may not go over as well on a different continent.”

“Still,” Zalesny wagers, “I expect reformulations to accelerate if prices remain as high as they are.” Not that introducing novel stabilizers into an ingredient mix doesn’t carry burdens of its own. “There are a lot of regulatory hurdles to clear,” Zalesny cautions, “most countries have standards of identity for dairy products, and it takes time to reregister labels with the EU. Label printing and packaging can also be very expensive.”

And don’t forget consumers: Even subtle taste and texture shifts brought on by reformulation can trip their detection sensors; and close label-readers might wonder what that new gum in their favorite yogurt is, she adds.

### Next-Best Bets

So if and when brands reformulate, they’ll have their work cut out for them.

“As with most hydrocolloids,” Zalesny admits, “there’s not really a drop-in solution.” That said, other galactomannans come about as close to one as possible.

Take tara gum, which Zalesny praises as “particularly well-suited” to replacing LBG, in part thanks to its 1:3 galactose-to-mannose ratio. That said, it’s more soluble in cold water than LBG and appears in reformulations at about 75% to 85% of LBG’s original use level. And while it commands about half the price of LBG, the tara crop is smaller than LBG’s, she notes, “so availability may be difficult.”

With a 1:2 galactose-to-mannose ratio and cold water solubility, guar is an even further departure from LBG; but treatment with a galactosidase that cleaves galactose from the mannose backbone yields partially hydrolyzed guar, which more closely approaches LBG’s functionally and thus is finding use as a replacement in the US, Zalesny says.

“In Europe, the enzymatically treated guar needs to have a new E number assigned.” However, there are partially hydrolyzed guar products available that have been treated chemically.

“Cassia tora gum may be another option in Europe,” she continues. Thanks to its 1:5 galactose-to-mannose ratio, it’s less soluble than LBG but “has proven effective in retorted systems.”

Other substitutes, however, warrant case-by-case evaluation. “Citrus fiber

can prevent sanding-out in ice cream systems, for example, but doesn’t build the viscosity or creaminess of LBG,” Zalesny says.

“Konjac gum is a glucomannan that may also be an option. And other hydrocolloids can substitute, but may not be nearly as label friendly.” Case in point: Carboxymethylcellulose (CMC) is a texturizing whiz in plant-based milks, “but CMC isn’t as label friendly as LBG.”

### Less Is More

Rather than replacing LBG entirely, Dunning notes, some dairy brands are trying to do more with less, and companies like IFF produce ingredient blends “with newer and existing hydrocolloids” to help stretch each’s functionalities.

She names Grindsted Cream Cheese 6997 as one such reduced-LBG option containing salt, guar gum, xanthan gum, and locust bean gum—hydrocolloids “specifically selected and formulated to mimic the functional characteristics of LBG alone,” she says.

IFF also produces LBG-reduced and -free blends for frozen dairy, including Grindsted SSD 7051 IC, an LBG-free, clean-label, non-GMO solution for ice cream.

“Additionally,” Dunning says, “we offer functional blends containing tara gum, alginates, and other hydrocolloids and functional salts, depending on the finished product.”

Morrison agrees that “it’s important to understand the formulation goals and desired taste and texture when building blends either to minimize dependence on LBG or simply help with texture, stabilization, gelling, water-binding, and syneresis control.”

So for stabilization and texture in low-pH beverages, he suggests working with a blend of gellan gum and pectin, adding that CP Kelco’s Genu Pectin “is a workhorse in dairy that’s sustainably sourced and easily recognizable to consumers.”

KelcoGel Gellan Gum functions well in both dairy and plant-based beverages, he continues.

He lauds its “long-lasting suspension” and LBG-like “mouthfeel support,” adding that both gellan gum and pectin help recover the body that’s lost in sugar-reduced formulations.

And along with its clean label fiber contribution, the company’s Nutrava Citrus Fiber builds stability, body, and texture in beverages, cream cheese, plant-based cream cheese alternatives, and yogurt, Morrison says.



### Maintaining Flexibility

So formulators have options and will likely see more emerge as the crisis continues.

After all, notes Dunning, the current LBG crisis only adds to the supply chain traumas, workplace closures, and transportation bottlenecks of COVID-19.

But both events, she believes, forced the market to "grow more flexible and more likely to proactively evaluate any given application, so as to build in that supply flexibility."

In the meantime, "Demand has to decrease for the market to right itself," Zalesny believes. Yes, supply-side solutions are in the pipeline, and start-ups are even trying their hands at plantations again. "But these efforts," she fears, "are a drop in the bucket."

### Supply-Side Solutions

Don't tell that to Udi Alroy, co-founder and CEO of Israel-based CarobWay. The startup began three years ago with the mission of locally growing carob trees not just for their seeds—and subsequent gum—but to maximize the whole plant's potential.

"Since we anticipated the coming shortage, we made some adjustments and a thorough analysis of market inefficiencies

to look into the whole fruit, crop, and full supply chain," Alroy explains.

"We see ourselves as providing a long-term sustainable solution for a stable supply of seeds to the LBG industry. It'll enable industry to focus on future growth and application work, reducing the risk of shortage on the supply side."

Lasting relationships are the bedrock of the business model, Alroy continues. "Growers should get a safe, stable income as they invest in the future of food."

And given climate change, wildfires, and diminishing water suppliers, farmers are on the frontlines of responsibility in the supply chain. We're going to change that by creating a complete value chain that's beneficial to all partners involved, from grove to table."

All of which should be music to Zalesny's ears. "Of course, my hope is that the workarounds work for individual companies and that we can get the crisis under control," she says.

"At the same time, a lot of people earn a living in the LBG industry, either harvesting, kibbling, or producing the finished gum. They need to be able to continue thriving. If the industry could find some supply-demand equilibrium, it'd be a miracle." ■

► Citrus fiber can prevent sanding-out in ice cream systems, but doesn't build the viscosity or creaminess of LBG.



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