



CYCLOCHEM BIO

ENHANCING
INGREDIENT
FUNCTION THROUGH
CYCLODEXTRIN
INNOVATION

Prof. Dr. Keiji Terao,
President and CEO



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The effectiveness of many functional ingredients depends on more than the ingredients themselves. The intended biological function is also influenced by their molecular structure, stability and ability to reach the right place in the body. Many naturally occurring ingredients with well-documented health benefits are highly sensitive to heat, light and oxidation, or suffer from poor water solubility and low bioavailability, limiting their effectiveness. For researchers and manufacturers, preserving molecular integrity is essential to ensuring ingredients deliver as expected.

CycloChem Bio has developed cyclodextrin-based (CD) inclusion technologies, using α -, β - and γ - CDs to support consistent ingredient performance. The naturally derived cyclic sugar molecules are produced from maize starch, and are characterized by a unique, ring-shaped structure containing nano-sized cavities capable of encapsulating other molecules. These cavities enclose delicate functional ingredients and prevent them from degrading.

The technology significantly improves stability, extends shelf life and enhances formulation flexibility without altering the original biological properties of the encapsulated ingredient. It also improves the water dispersibility and bioavailability of compounds that otherwise exhibit poor absorption. Even while functioning as an inclusion complex, α -CD also serves as a functional dietary fiber, adding nutritional value.

CycloChem Bio has also developed Fresh Oligo Powder Technology, which applies the same scientific principles to convert natural materials into powders that retain their

biological activity and freshness. The combination expands formulation possibilities for manufacturers serving the nutritional, beauty and functional food markets.

"Understanding molecular structure allows us to unlock biological functions that conventional ingredient development often overlooks," says Prof. Dr. Keiji Terao, president and CEO.

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I'M NOT JUST TRYING TO SELL MY COMPANY'S PRODUCTS. AS A SCIENTIST, I WANT TO MAKE EVIDENCE-BASED TRUTHS COMMON SENSE.

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Dr. Terao is an organic chemist whose distinguished career has been dedicated to CD research and functional ingredient chemistry. Drawing on decades of research, scientific publications and human clinical studies, he evaluates every functional ingredient from the perspective of precise molecular structure. That chemistry-first mindset guides CycloChem Bio to identify how molecules behave inside the body and translate that knowledge into commercially viable ingredient solutions.



Engineering Function at the Molecular Level

Central to this approach is its ability to match different CDs with different biological challenges. α -CD stands out as a water-soluble dietary fiber with applications spanning gut health, metabolic wellness and functional nutrition. Many dietary fibers and prebiotics available today consist of mixtures of compounds that do not get completely digested. But α -CD as a single molecule possesses a precisely defined molecular structure that makes it completely indigestible by human digestive enzymes. The entire amount reaches the large intestine intact, where it can be efficiently utilized by specific beneficial gut microorganisms that are useful for beauty and wellness.

"I believe 100 percent delivery and utilization is what truly defines the value of a real prebiotic," says Dr. Terao.

Once it reaches the colon, α -CD selectively supports the growth and activity of beneficial bacteroides, promoting the production of short-chain fatty acids, particularly butyrate. Growing research has highlighted butyrate's role in maintaining gut health, regulating immune function and supporting metabolic wellness. This expanding body of evidence strengthens the case for α -CD as a functional dietary fiber.

CycloChem Bio has also explored α -CD's potential to address lifestyle-related health concerns. Research demonstrated that α -CD can help suppress post-meal blood glucose spikes. It also reduces small dense LDL, the cholesterol particle increasingly associated with the development of arteriosclerosis. By targeting this specific form of LDL instead of lipoprotein cholesterol alone, it supports a more precise approach to cardiovascular health.

CycloChem Bio supplies α -CD for nutritional supplements, functional foods and metabolic wellness formulations designed to support gut health, healthy aging and long-term lifestyle management.

β -CD, known for its exceptional molecular stability, is particularly effective at encapsulating cholesterol and supports specialized inclusion applications where stable molecular complexation is required.

γ -CD serves as an advanced carrier system for highly fat-soluble compounds that usually exhibit poor absorption. It prevents those molecules from combining. This allows bile acids to form micelles that separate fat-soluble substances molecule by molecule more efficiently and significantly improves intestinal absorption.

Extending Nature's Functionality

CycloChem Bio's expertise in CD inclusion extends into the preservation of natural ingredients. Its Fresh Oligo Powder Technology turns functional ingredients found in fresh vegetables and fruits into commercially stable powders using α -CD during the powdering process.

Traditional drying methods expose ingredients to high temperatures, accelerating oxidation. This degrades enzymes and reduces the activity of functional compounds.

Encapsulation using Fresh Oligo Powder Technology shields compounds from heat, light and oxygen, allowing them to retain the stability required for commercial manufacturing and long-term storage. The finished powders preserve the functionality, aroma and freshness of the raw materials.

The technology has shown promising results across a range of natural materials. Delicate enzymes such as actinidin, derived from kiwi fruit, retain nearly full activity after long-term storage. Volatile compounds like isothiocyanates from radish remain significantly more stable than those in conventional formulations. Similar approaches have been applied to ingredients derived from olives, watermelon and other agricultural resources.

The technology also helps develop new ingredient systems where existing formulations show limitations.

For example, in South Korea, α -CD has attracted significant attention as a slimming ingredient, creating a demand for several hundred tons annually. But research indicates that α -CD's benefits are most effective among individuals who are obese with a high BMI seeking to lose weight, but they don't work for those who are just a bit overweight. Building on these findings, CycloChem Bio has developed radish fresh powder, an α -CD inclusion complex that has demonstrated potential weight loss support for those with moderately elevated BMI.

The same platform supports a broader sustainability objective. CycloChem Bio collaborates with agricultural producers to transform non-standard or underutilized crops into premium functional ingredients. Converting surplus agricultural materials into stable, value-added powders suitable for domestic and international markets contributes to resource efficiency and creates new commercial opportunities for regional agriculture.

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Supporting High-Performance Human Chemicals

CycloChem Bio's research goes beyond plant-derived functional ingredients to compounds naturally produced within the human body. Dr. Terao refers to these compounds as 'hitochemicals,' a term derived from the Japanese word for human. These naturally occurring molecules play essential roles in maintaining health. Production of these compounds gradually declines after the age of 20. CycloChem Bio sees significant potential in developing technologies that help restore their availability and effectiveness.

Coenzyme Q10 is one of the three major hitochemicals identified by Dr. Terao because of its essential role in mitochondrial energy production. Acting as a coenzyme, it supports the production of ATP, the energy source required by every cell in the body. It also functions as a powerful antioxidant that helps neutralize reactive oxygen species generated during energy metabolism.

Its relevance for individuals taking statins for treating lipid disorders is important. Although statins effectively reduce cholesterol synthesis, they also inhibit the body's

natural production of CoQ10 because both are produced through the same metabolic pathway. Reduced levels are typically associated with fatigue, poor circulation and diminished cellular function, making supplementation vital.

The second major hitochemical, R- α -lipoic acid, plays an indispensable role in converting glucose into cellular energy by supporting key enzymatic reactions within the mitochondria. R- α -lipoic acid is also recognized for its exceptional antioxidant capacity, helping neutralize reactive oxygen species while regenerating depleted antioxidants such as Coenzyme Q10, vitamins C and E and glutathione. It also plays a role in suppressing glycation, a process where excess sugars damage proteins and accelerate aging.

Since CoQ10 is fat-soluble, its bioavailability is extremely low. However, it can be significantly enhanced by solubilizing in digestive fluids through encapsulation with γ -CD. The bioavailability of R- α -lipoic acid is also low because it is unstable in stomach acid. So, it was found that stabilizing it through γ CD encapsulation improves its bioavailability.

L-carnitine, the third major hitochemical, transports fatty acids into the mitochondria, where they are converted into energy, making it an important component for fat metabolism, muscle function and physical performance. While L-carnitine is readily absorbed by the body, its hygroscopic nature makes it difficult to formulate as a stable commercial ingredient. Encapsulating L-carnitine with α -CD creates a stable powder that preserves its functionality while improving handling and formulation.

Championing Science-Backed Nutrition

Alongside product development, CycloChem Bio is committed to narrowing the gap between emerging scientific evidence and its adoption in healthcare and consumer nutrition. It believes that many clinically relevant findings remain underutilized in everyday practice, limiting opportunities to improve preventive health and lifestyle management. The company remains dedicated to advancing scientific understanding of CD through ongoing collaborations with universities, healthcare researchers and academic organizations.

"I'm not just trying to sell my company's products, says Dr. Terao. As a scientist, I want to make evidence-based truths common sense."

As consumer expectations continue shifting toward evidence-based nutrition, personalized wellness and naturally derived functional ingredients, technologies that preserve ingredient efficacy will play an increasingly important role. CycloChem Bio's expertise in cyclodextrin chemistry positions it to address these evolving demands. [LS](#)