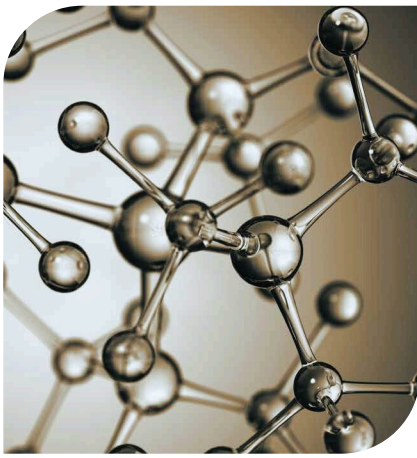


AKAY  
BIOACTIVES



# FenuMat® Technology

Unlocking Effective Nutrient Delivery  
Through Nature



# Revolutionizing Nutrient Delivery

In a world where the pursuit of optimal health and wellness is paramount, the realm of nutraceuticals faces a persistent challenge: how to ensure the effective delivery of bioactive nutrients to the body. Despite advancements in supplement technology, the trifecta of low solubility, limited bioavailability, and rapid metabolism continues to hinder the full potential of many health-promoting compounds. In this environment of obstacles, one innovation shines brightly: FenuMat®. Developed by the pioneering minds at Akay Bioactives, FenuMat represents a paradigm shift in bioactive nutrient delivery, seamlessly blending science, nature, green technology, and efficacy into one powerful solution.

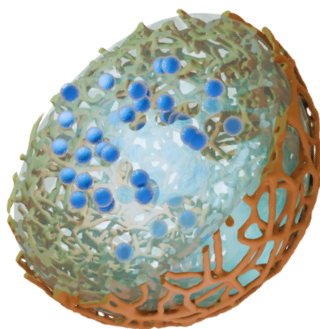
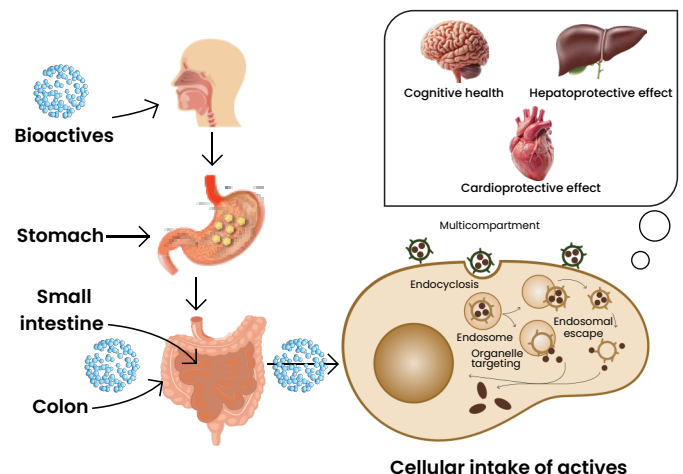
## 80%

Eighty percent of consumers believe a supplement should be easily absorbed by the body, making bioavailability a key consideration in product development (*Nutrition Business Journal, Condition Specific Report 2023*).

## The Bioavailability Challenge

Bioavailability refers to the portion of a compound that is absorbed and reaches circulation after oral administration, typically measured by the area under the plasma concentration-time curve (AUC). Bioactive molecules, including drugs and nutrients, often face absorption challenges, particularly hydrophobic and water-insoluble substances. These compounds may remain insoluble in gastrointestinal fluids, limiting their dissolution and absorption. Additionally, some undergo rapid enzymatic metabolism, forming less active or inactive water-soluble conjugated metabolites that are quickly excreted through renal pathways.

For instance, curcumin, a bioactive compound from turmeric, usually suffers from poor absorption (<1%) and rapid glucuronidation (an elimination and detoxification mechanism), resulting in less effective metabolites and limited health benefits. However, when formulated with Akay Bioactives' FenuMat technology, curcumin's bioavailability is significantly enhanced, improving 'free' curcuminoid bioavailability by 45.5x compared to unformulated curcumin (Kumar et al, 2016). FenuMat technology optimizes dispersion, provides sustained release, and overcomes bioavailability challenges, ensuring improved therapeutic performance.



## Introducing FenuMat®

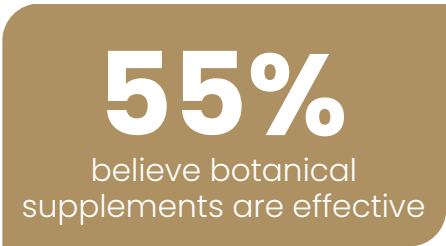
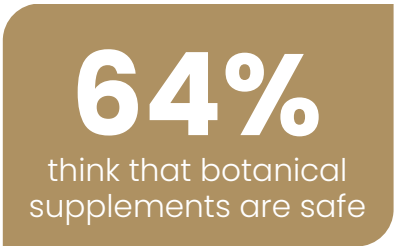
As the natural market evolves, addressing solubility, bioavailability, and stability concerns have become crucial. At Akay Bioactives, we leverage our extensive experience in nutrient delivery to ensure maximum assimilation, absorption, and bioactivity of our bioactive ingredients. This expertise led to the development of FenuMat, a self-emulsifying reversible hydrogel technology that provides a clean, plant-based solution for superior bioavailability of bioactive nutrients. FenuMat also offers taste and odor-masking benefits, enhancing the overall consumer experience.

Discover the advantages of FenuMat—a best-in-class, plant-based, green and clean nutrient delivery technology—and explore how it can elevate your products to the next level.

# Back to Nature

## Consumers Seek Clean Labels and Natural Botanicals

The global surge in botanical supplements reflects a growing appreciation for their health benefits. This market is projected to grow from \$29.2 billion USD in 2023 to \$61.8 billion USD by 2032, with a CAGR of 8.7% (Global Market Insights). Traditional practices like Ayurveda, Traditional Chinese Medicine, and Herbal Medicine have long utilized botanical and herbal ingredients, fostering belief in their advantages. According to the Innova Health & Nutrition Surveys (2023), 64% of consumers perceive natural ingredients as safe and 55% as effective, driving their popularity. However, consumers increasingly prioritize bioavailability, as higher absorption leads to greater therapeutic outcomes, yet not all technologies deliver the same results.



## The Search for Efficient Nutraceutical Delivery Technology

Delivery system technologies, which first emerged in the 1950s to improve drug absorption, offer significant advantages for the controlled, sustained release of active ingredients, maximizing therapeutic efficacy (Ezike et al, 2023). They address issues like particle size, permeability, solubility, site targeting, stability, and toxicity. Nutraceuticals face similar challenges, including low solubility, poor oral bioavailability, limited tissue distribution, inadequate cellular uptake, short half-life, and rapid metabolism. Despite advancements, finding delivery technologies that enhance bioavailability, ensure transparency, and meet regulatory standards has been a significant challenge.

## FenuMat® Technology Unveiled

### The Innovative Solution

Nearly 15 years ago, Akay Bioactives scientists tackled nutrient delivery challenges, creating FenuMat, a green, clean-label, plant-based technology using self-emulsifying reversible hydrogel science. This patented innovation improves the solubility, bioavailability, and stability of bioactive nutrients by safeguarding active ingredients and aiding their transport across cell membranes (Krishnakumar et al, 2012). The result is higher absorption rates and increased bioavailability, ensuring effective nutrient delivery in their ‘free’ unconjugated form. Additionally, this whole-food approach meets consumer demand for transparency and adheres to stringent regulatory standards worldwide.

### History of FenuMat®:

2010

Formulation conception

2012

Bioavailability with FenuMat

2013

FenuMat name trademarked

2014

Granted two USA patents for FenuMat Technology

2015–24

Human safety, high bioavailability, and clinical benefits

2021

Granted World Patent for delivering hydrophilic and hydrophobic bioactive substances



# FenuMat® Technology

## Designed with Intention

FenuMat is designed to significantly enhance the solubility and bioavailability of bioactives using advanced hydrogel science and a whole-food approach using soluble dietary prebiotic fiber (galactomannan) from fenugreek seeds. Fenugreek galactomannans' unique structure is ideal for loading oils and hydrophobic molecules, optimized through a water-based process without organic solvents or synthetic excipients. With over 40 peer-reviewed scientific papers, FenuMat's efficacy is well-documented across various bioactives, including vitamins, minerals, botanicals, and condition-specific formulations. This innovative technology meets the demand for plant-based, sustainable, and effective nutrient delivery solutions, harnessing nature's potential with scientific precision.

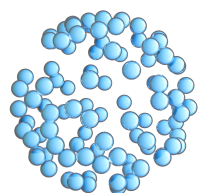
## Experience the Difference:

- ✦ Patented Hydrogel-Scaffold Technology
- ✦ Plant-based, utilizing soluble dietary prebiotic fiber (galactomannan/mucilage) from fenugreek seeds
- ✦ Clinically substantiated (40+ RCTs)
- ✦ Processed using water-based technology
- ✦ High bioactive loading capacity for oils & hydrophobic molecules
- ✦ Clean label, powder formulation
- ✦ Enhances bioactive bioavailability
- ✦ Minimizes taste and odor
- ✦ Responsibly sourced with full scale traceability
- ✦ Suitable for different delivery formats (powders, tablets, capsules, sachets, gummies)

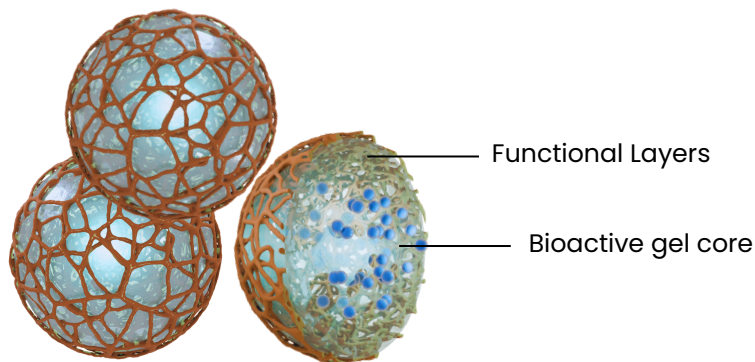
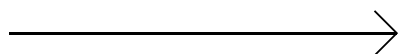
## How FenuMat® Works: Nature's Blueprint for Enhanced Bioavailability

Through advanced ultrasound-mediated gel-phase dispersion, FenuMat transforms poorly absorbed nutrients into viscous colloidal dispersions. This process leverages fenugreek's soluble dietary fiber's extensive gel-forming properties, providing protection from degrading enzymes in the upper gastrointestinal tract and facilitating fermentation by action of  $\beta$ -mannanase in the colon. The matrix shields bioactives in the gastrointestinal tract, allowing their gradual, sustained release in the colon for absorption, significantly enhancing bioavailability and maximizing therapeutic benefits thus, overcoming common absorption challenges.

### Bioactives



FenuMat

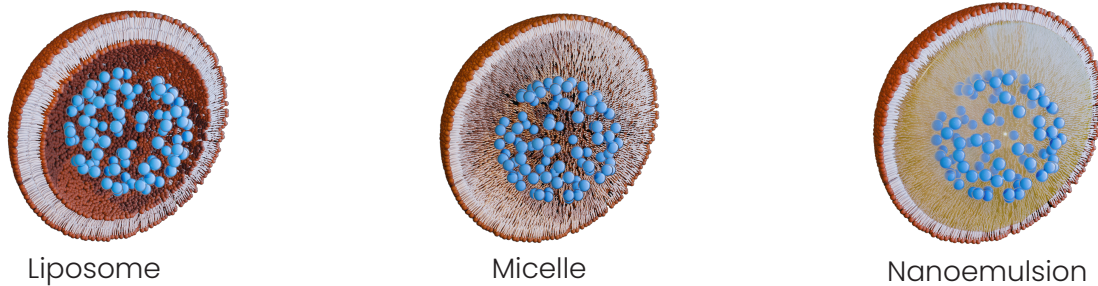


Utilizing fenugreek galactomannan (mucilage), a soluble dietary prebiotic fiber, FenuMat encapsulates essential bioactives within a protective hydrogel matrix, enhancing nutrient solubility, stability, and controlled release for improved absorption and bioavailability.

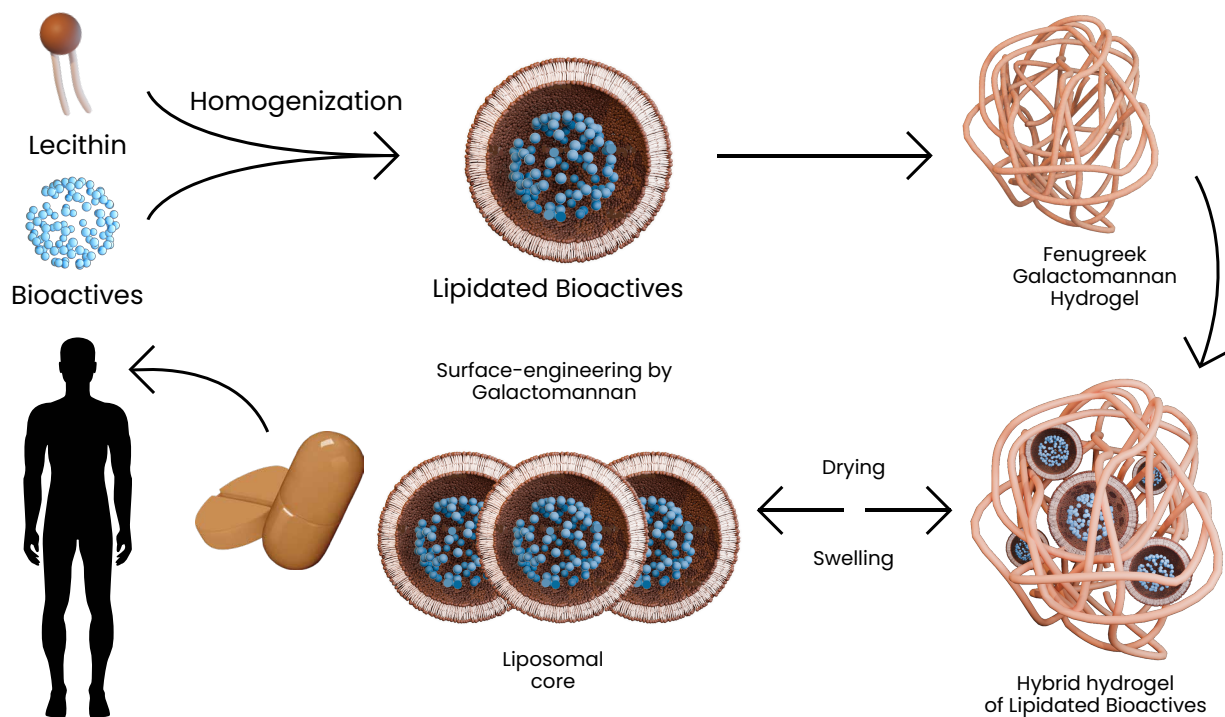


## Second generation Hybrid-FenuMat® Technology

The benefits of FenuMat technology can be further extended to other novel delivery systems like liposomes, micelles, and nanoemulsions. Liposomes and micelles are spherical lipid structures that encapsulate bioactive molecules. Liposomes have double layers, while micelles have single layers. They are widely used in pharmaceuticals, especially for intravenous administration, to address poor bioavailability.



However, when delivered orally, liposome and micelle-based technologies face challenges such as being in a liquid state and having low bioactive loading capacity. Additionally, these systems often have high thermodynamic energy, meaning the molecules have weak bonds and are highly reactive. This reactivity can cause instability, leading to rapid agglomeration or aggregation of particles. Such instability compromises the delivery system's structural integrity, reducing its ability to encapsulate and protect bioactive molecules, resulting in leakage in the stomach, separation during storage, and a short shelf life. Conventional emulsions and nanoemulsions also tend to break down over time due to various destabilization mechanisms.



FenuMat can be integrated with these technologies to overcome challenges, ensuring they remain protected, stable, and effective. The Hybrid-FenuMat approach involves “surface modification” of liposomes and micelles, enhancing their solubility, stability, and bioavailability. FenuMat acts as a “Hydrogel Trap,” preventing agglomeration and providing a free-flowing, instantly water-soluble powder, even for fat-soluble ingredients, ensuring absorption and enhanced bioavailability. It's easy to blend, encapsulate, and formulate with - offering minimized taste and odor. Additionally, this technology prevents product settling and layer separation during storage, resulting in a longer shelf life.

## FenuMat® in Action: Versatility and Flexibility

FenuMat technology enhances a wide range of molecules, vitamins, oils, and condition-specific combinations, delivering synergistic effects at low doses without sacrificing efficacy. For instance, a typical joint health supplement might require 1,500 mg of curcumin and boswellia. However, with FenuMat's hydrogel technology, this dosage can be reduced to just 250 mg while achieving superior bioavailability and effectiveness (Abhilash et al, 2021). This innovation eliminates the need for high dosages, multiple servings, or extra products.



Curcumin + Boswellia



Curcumin + Ashwagandha



Vitamin C + Quercetin

Its versatility extends to different delivery forms such as capsules, tablets, powders, and more. This water-soluble technology also enhances the consumer experience by minimizing taste and odor, ensuring convenient and effective nutrient delivery across a spectrum of products. No matter the combination or formulation type, FenuMat can bring it to life.



Gummies



Chews



Functional Foods



Capsules



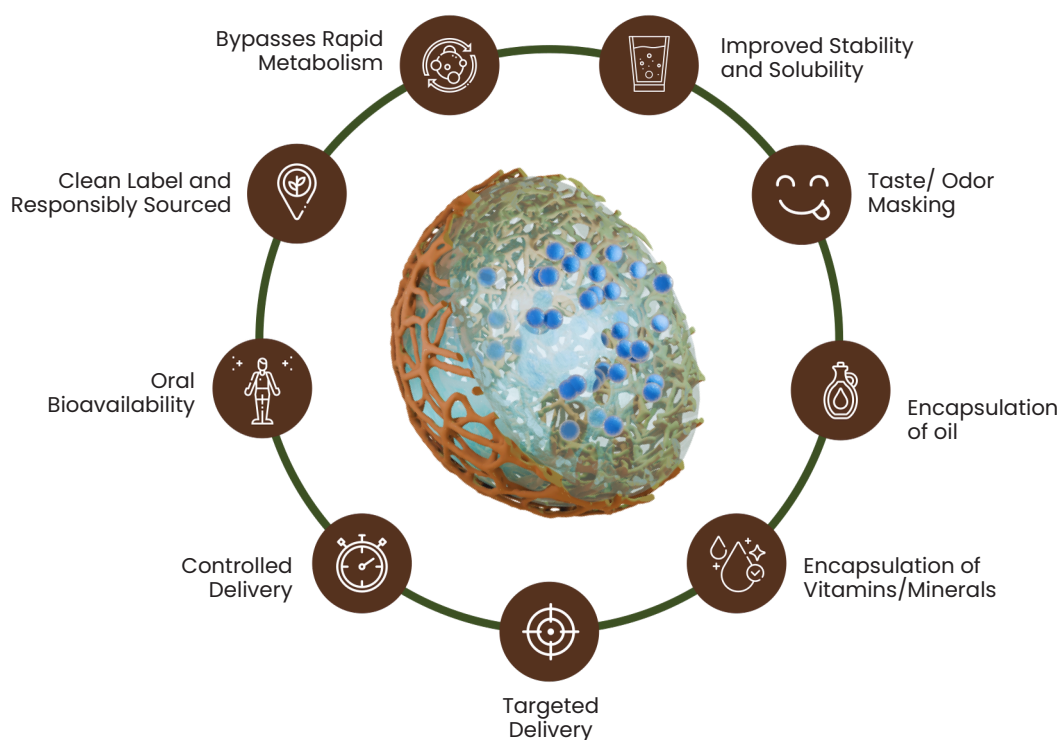
Tablets



Powder

## The FenuMat® Advantage

Discover a revolutionary new era in bioactive delivery with FenuMat, and experience the advantages of enhanced aqueous solubility, stability, and compatibility, enabling sustained-release bioactive kinetics under normal physiological pH conditions. The result? Elevated nutrient bioavailability upon simple oral administration, rendering bioavailability challenges a thing of the past. Welcome to a future where FenuMat transforms the way we unlock nature and absorb its healthful benefits.



# Our Range of FenuMat® Products

## Explore Our Offerings

Akay Bioactives offers a carefully curated selection of bioactives blended with FenuMat technology, supported by clinical data for bioavailability and human health outcomes. This selection offers a rapid pathway to market with innovative, low-dosage, highly effective products. Whether you're looking to enhance an existing formulation or develop something new, Akay Bioactives is your natural partner for success. Explore the potential of FenuMat and take your products to the next level.



### CurQfen®

Redefines curcumin excellence, responsibly sourced from *Curcuma longa* rhizomes. Enhanced with FenuMat®, it offers a 45.5x improved bioavailability of 'free' curcuminoids, supported by 25+ clinical studies, leading in curcumin innovation.



### Asafin®

Revolutionizes gut health with its patented asafoetida oleoresin gum complex from *Ferula asafoetida*. Formulated with FenuMat®, Asafin® ensures a taste-minimized experience and sustained bioactive release to the intestines.



### Capsifen®

Supports healthy weight management with its patented red chili pepper complex from *Capsicum annuum*. Enhanced with FenuMat®, it ensures a pungency-free experience and a consistent slow release for improved 19x bioavailability.



### FenuMat® Vitamin C

Delivers potent antioxidant support for comprehensive immune health. Enhanced with FenuMat®, it provides a 7x increase in "free" ascorbic acid bioavailability.



### FenuMat® Berberine

Provides efficacious GLP-1 modulation for effective healthy weight management and cellular energy balance. Formulated with FenuMat®, it delivers a 6x improvement in 'free' berberine bioavailability.



### FenuMat® Boswellia

Offers effective inflammation management and joint support. Formulated with FenuMat®, it delivers a 6.9x improvement in 'free' boswellic acids' bioavailability.



### FenuMat® PEA

Enhances joint mobility, and physical comfort by supporting a healthy inflammatory response. Formulated with FenuMat®, it provides a 5.4x increase in 'total' palmitoylethanolamide (PEA) bioavailability.



### FenuMat® Quercetin

Delivers robust free radical scavenging for metabolic management. Enhanced with FenuMat®, it provides a 60x increase in 'total' quercetin bioavailability.



### FenuMat® Resveratrol

Offers potent free radical scavenging for comprehensive metabolic health. Formulated with FenuMat®, it provides a 10x increase in 'free' *trans*-resveratrol bioavailability.





To connect with a specialist or learn more about our ingredients,  
visit [akaybioactives.com](https://akaybioactives.com).

*\*These statements have not been evaluated by the Food and Drug Administration. These products are not intended to diagnose, treat, cure, or prevent any disease.*