

THE ROLE OF BINDING PROTEINS IN GUT HEALTH

A breakthrough approach providing the missing link – ensuring a diverse gut and a strong gut barrier

The leading causes of gut health issues



POOR DIET



BAD BACTERIA



STRESS



ANTIBIOTICS

Common signs and symptoms of a disrupted gut

Diarrhea

Pain

Irregularity

Flatulence

Bloating

Energy fatigue

Brain fog

Acne

Addressing gut health challenges

Gut health is essential for overall well-being, yet lifestyle habits, environmental factors such as diet, and medicines contribute to an increasing prevalence of gut dysbiosis and a compromised gut lining. These disruptions can have significant health implications, ranging from acute digestive discomfort to long-lasting challenges and broader systemic effects¹. In fact, the U.S. microbiome has lost over 30% of its bacterial diversity – mainly due to antibiotics and poor diet.^{2, 3}

For too long, a critical insight has been overlooked: susceptibility to gut issues is not solely determined by exposure to viruses or harmful bacteria, but by the body's underlying resilience – particularly the strength and stability of the gut microbiome. In other words, external stressors weaken this microbial foundation, and the resulting loss of resilience leaves the gut more vulnerable to disruption.

Traditionally, dietary fibers, fermented foods, probiotics, and prebiotics have been promoted to support gut health. However, new innovations have expanded the range of functional food ingredients available to help maintain a balanced gut. One of the most promising advancements in this field is Binding Proteins. These proteins act as gut-stabilizing ingredients, leveraging natural mechanisms to support gut health and immunity unlocking the option to maintain a healthy gut proactively⁴.

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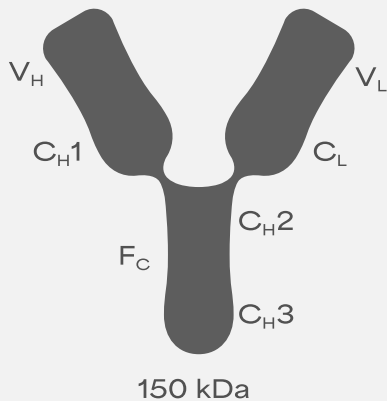
The science behind Binding Proteins

Binding Proteins are a novel class of functional protein ingredients inspired by nature and the protection from immunoglobulins found in colostrum and raw milk. Binding Proteins, derived from camelid immunoglobulin G (IgG) binding domains, are specifically designed by nature itself to selectively bind and neutralize microbial metabolites that can compromise your gut health. Binding Proteins stop the metabolites from disrupting gut homeostasis, by gently and specifically binding them and allowing a safe passage through your gastrointestinal tract ⁵.



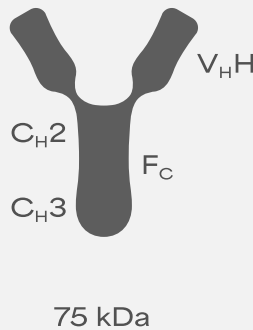
Immunoglobulins

Found in the body and in IgG enriched foods like milk, colostrum, serum, and eggs



Camelid Immunoglobulins

Found in camel milk, known for their simple structure and high functionality



Binding Protein

A small stable protein, mimicking natural IgG, optimized for nutrition



Graphical representation of the protein structure of different immunoglobulins found in nature, and in food, including their size and complexity. The small, simple structure of Binding Proteins make them highly applicable for oral supplementation and application in food products. ⁴

Key properties of Binding Proteins

TARGETED BINDING

- Each Binding Protein specifically binds to selected microbial toxins, undesired metabolites, or microbes facilitating their safe and gentle passage through the gastrointestinal tract

FAST ACTING

- Binding Proteins have a fast onset of action with effects observable shortly after ingestion

RESILIENT STRUCTURE

- Binding Proteins are small (12–30 kDa) and naturally robust against enzymatic degradation, extreme pH, and heat, ensuring stability during food processing, in storage, and in use

VERSATILE APPLICATIONS

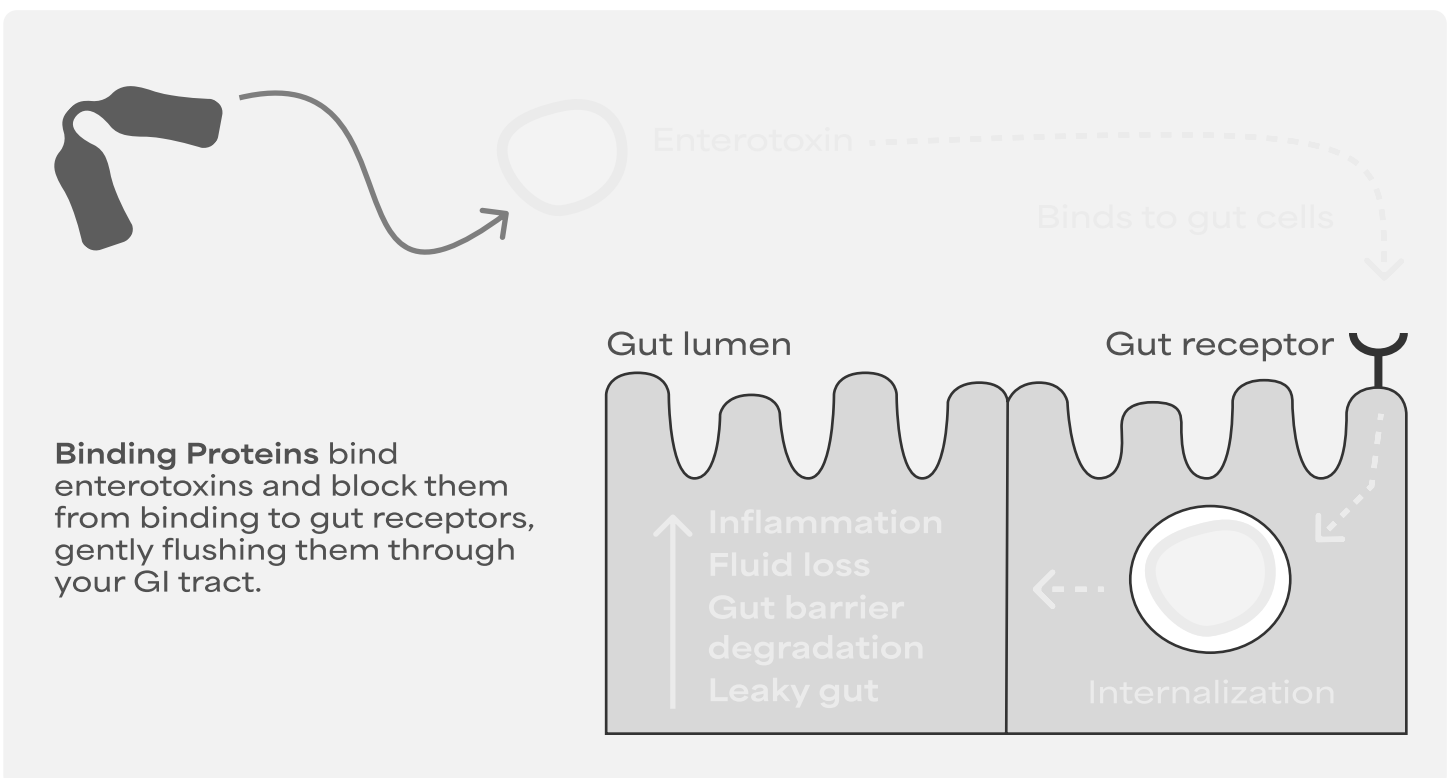
- Binding Proteins can be incorporated into various food and supplement formats without altering taste, texture, or nutritional profiles

GENTLE AND NON-ABSORPTIVE

- Binding Proteins do not cross the gut epithelial barrier or activate the immune system, meaning low risk of allergic reactions via dietary exposure

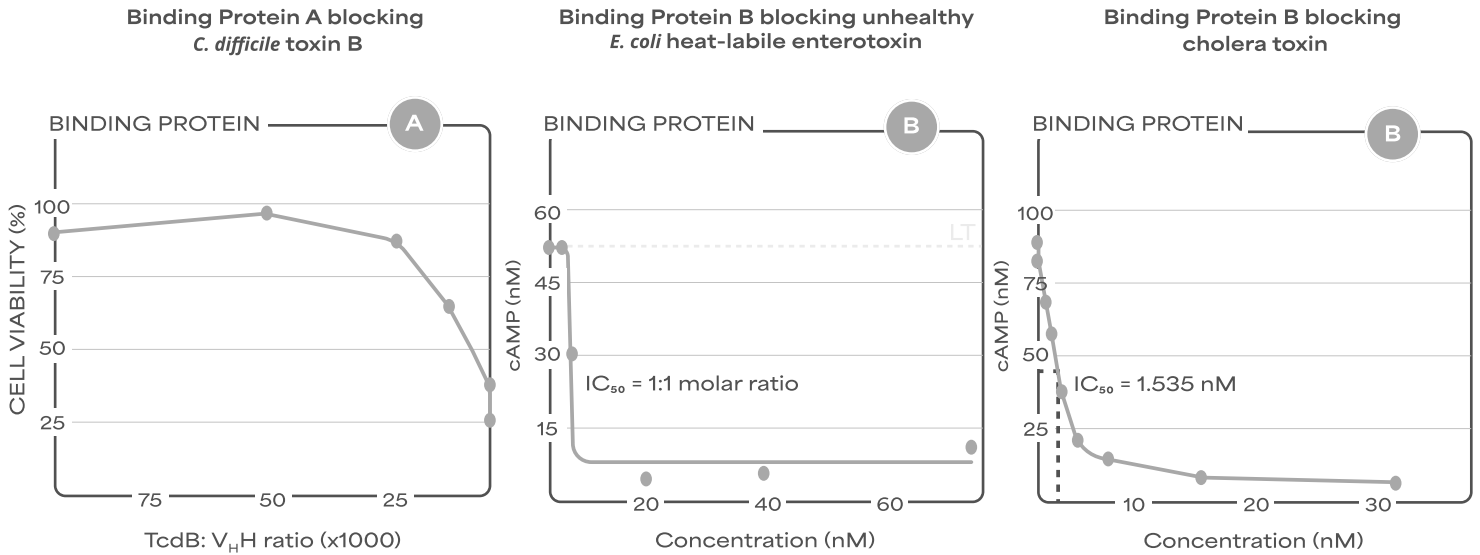
SAFETY

- Binding Proteins are well tolerated, with no evidence of any adverse findings in safety studies and an established NOAEL level of 450 mg/kg body weight/day⁶



Targeted binding action

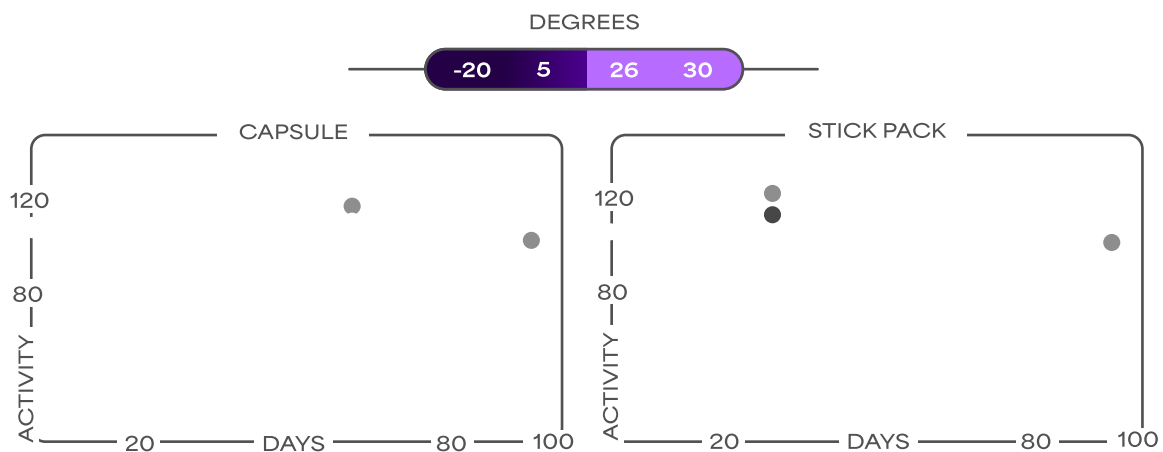
Binding Proteins are documented to block enterotoxins completely in a dose dependent manner in gut cell models:



Intestinal cell assay measuring either the viability of the cells or the release of cAMP in response to enterotoxin binding gut cells. The Binding Proteins block enterotoxins in a dose dependent manner. By blocking the enterotoxins, the intestinal cells are kept intact, and the gut barrier is protected from disruption. ^{5, 28}

Stability of Binding Proteins in different matrices

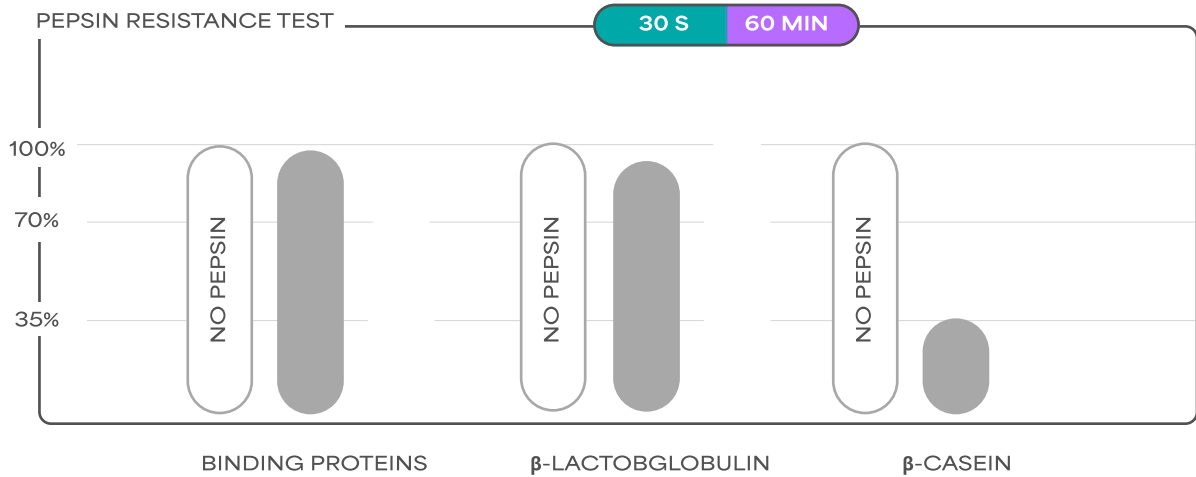
Stability measured in a capsule and stick packs:



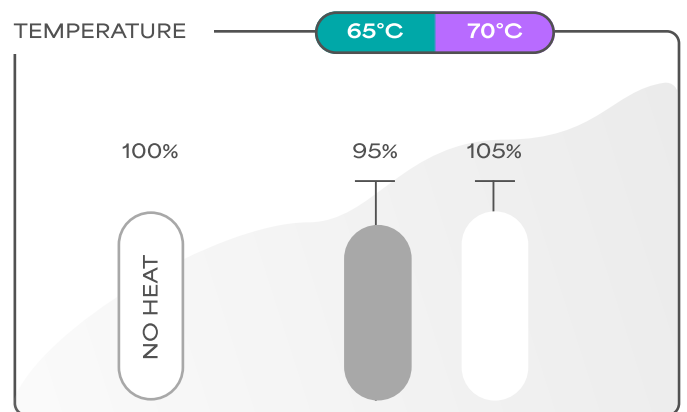
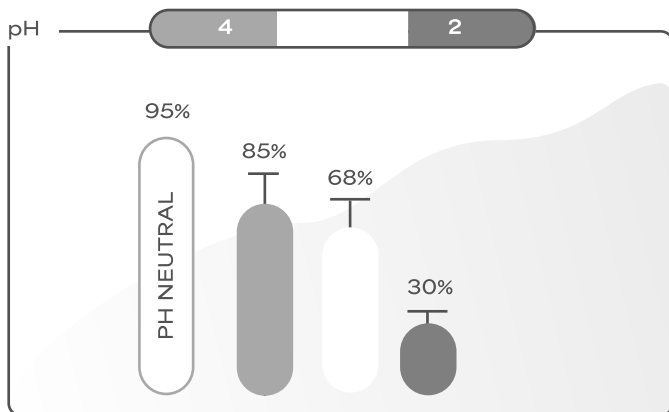
Stability of Binding Proteins measured by residual activity (%) in capsules (left) and stick packs (right) under various temperatures over time. The data demonstrate that Binding Proteins remain stable under different storage conditions (internal data).

Robust against extreme pH, enzymatic degradation, and heat

Binding Proteins tested in a pepsin resistance model and a pH and temperature assay:



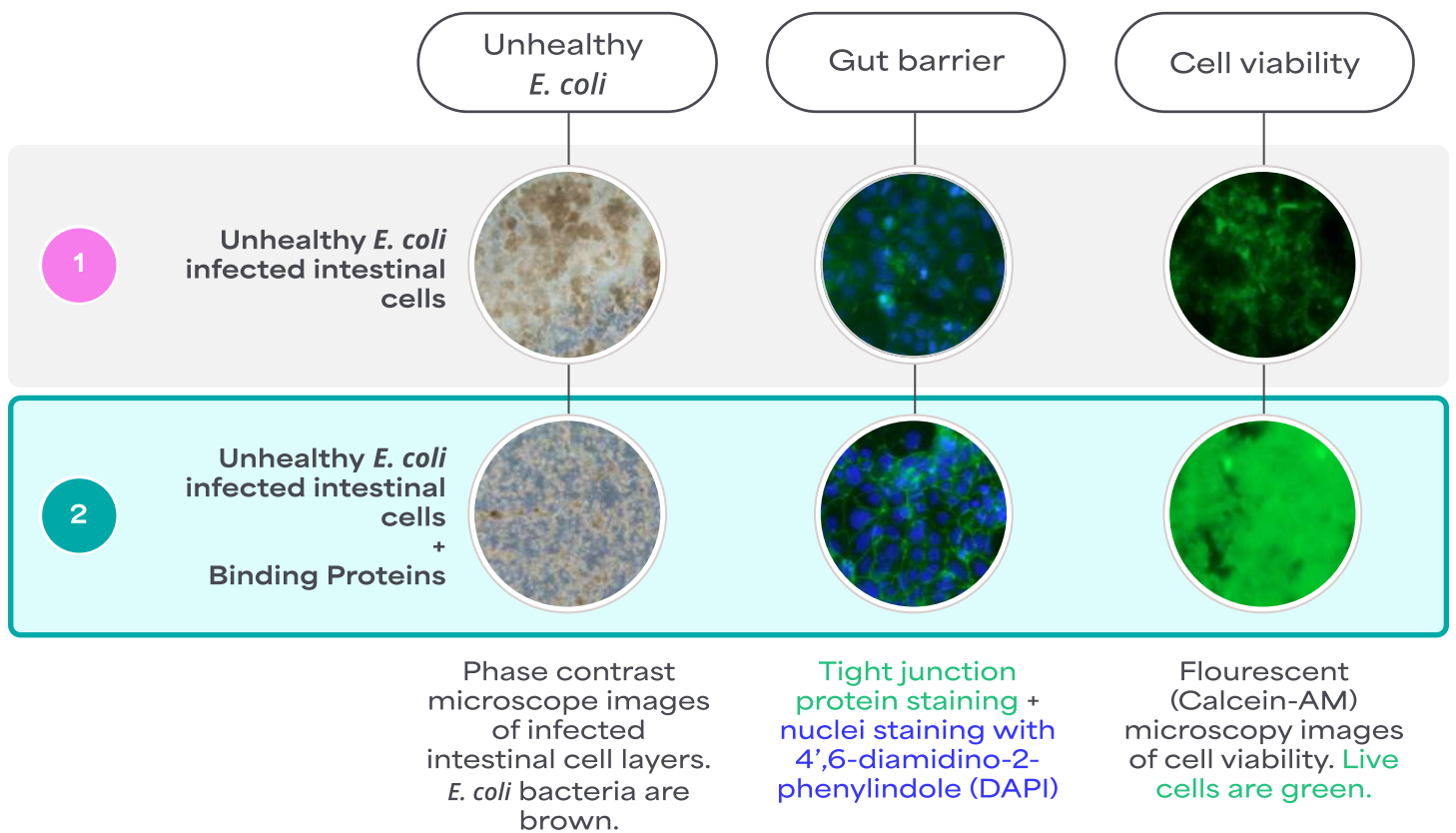
Pepsin resistance test with inoculation of either no pepsin, pepsin for 30 seconds, or 60 min. β-Lactoglobulin and β-casein are used as controls. Distinct digestion patterns among the Binding Proteins, β-Lactoglobulin and β-casein over time with the Binding Proteins being robust against enzyme degradation. (Internal data)



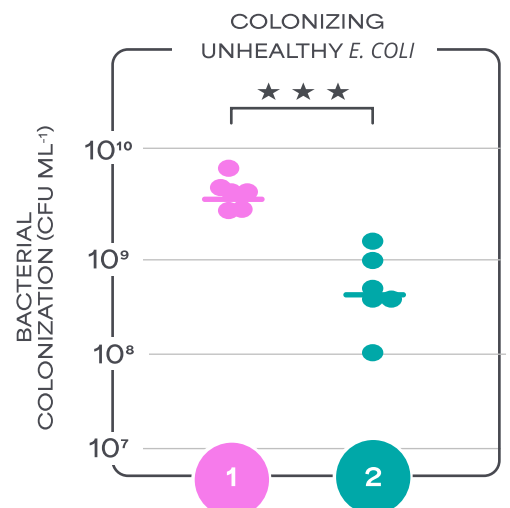
pH and temperature assays evaluating binding activity at varying pH levels (left) and temperatures (right). Binding Proteins exhibit high stability, as indicated by strong binding activity at low pH and elevated temperatures⁷.

The gut barrier and its role in health

A well-functioning gut lining acts as the body's first line of defense, preventing harmful substances from entering the bloodstream while allowing essential nutrients to be absorbed. Disruptions to the gut barrier have been associated with various health challenges, including inflammatory responses and digestive distress⁸. Emerging research suggests that reinforcing gut barrier integrity through targeted nutritional interventions can provide a proactive approach in supporting long-term gut health⁹.



Flow-cell systems emulating gut cell lining and flow using CACO-2 cell layers for differentiated epithelial-like structures. Unhealthy *E. coli* can colonize and infect, as in real life (left, top panel 1), the bacteria are abrogated by toxin-binding proteins, which protect tight-junction proteins, gut barrier, and cell viability (left, bottom panel 2). By only blocking toxins, colonization of unhealthy *E. coli* is drastically limited, maintaining gut balance and integrity (right). Petersson et al (2025) Gut Microbes.

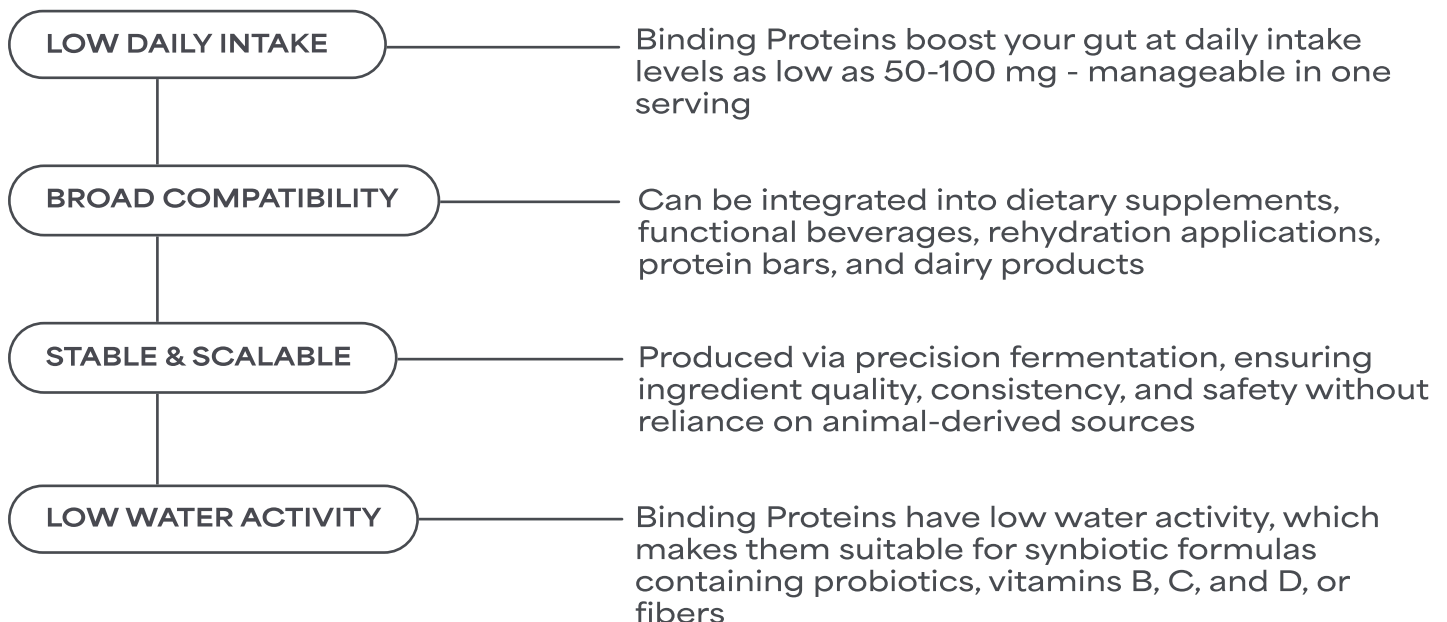


Binding Proteins: A novel approach to gut stability

Binding Proteins offer a differentiated approach to gut health by mimicking the natural protective functions of immunoglobulins found in milk and colostrum - they are a specific and convenient daily passive immunity boost. While conventional probiotics or prebiotics focus on promoting microbial gut diversity ¹⁰, Binding Proteins directly interact with and neutralize microbial risk factors, blocking their harmful effect on your gut, such as inflammation and degradation of the gut barrier (ie. tight-junction proteins), helping to maintain gut homeostasis in a gentle and effective manner ⁵.

Category	Daily Intake (Active)	Stability	Shelf-life	Precision Fermented	Animal Free Production	Target Specific Mode of Action	No Kill Effect	Gut Barrier	Supports Gut Microbiota Diversity
Binding Proteins	50-100 mg	++++	++++	+	+	++++	Yes	++++	++++
IgY	15-50 mg	+	+	-	-	++	Yes	++	+
pIgG	1000 mg	+	+	-	-	++	Yes	++	+
Purified colostrum	<1000 mg	++	+	-	-	+	Yes	++	+++
Colostrum	1000 mg	++	+	-	-	+	Yes	+	+++
Bacteriophages	7.5 mg	++	++	-	+	++	No	-	+
<i>Saccharomyces Boulardii</i>	250-500 mg	+	++	+	+	+	Yes	++	++
HMOs (2'FL)	1000-4000 mg	+++	+++	+	+	+	Yes	+	+++
Postbiotics	500 mg	+++	+++	+	+	+	Yes	+	+++

Advantages for formulators and brands



Manufacturing - scaling a groundbreaking solution with precision fermentation

Binding Proteins are manufactured using established food industry best practices, including established (GRAS) microbial expression methods, adherence to Good Manufacturing Practices (GMP), and Hazard Analysis and Critical Control Points (HACCP) protocols.

Key specifications of Binding Protein

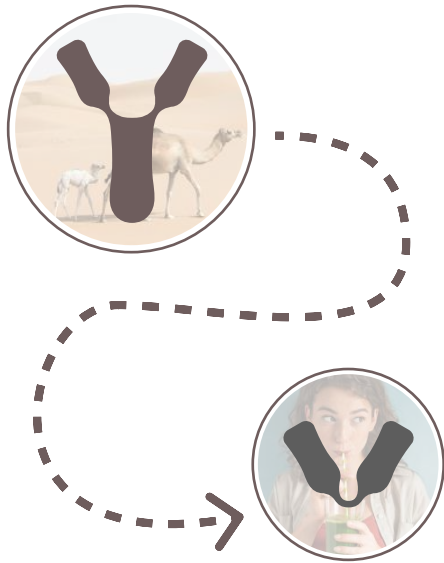
- 1 Produced in Europe and manufactured via precision fermentation in controlled conditions
- 2 Available as a standardized, off-white powder with high solubility
- 3 Compliant with ISO 9001 quality standards
- 4 Formulated to ensure long-term stability across various food matrices and in applications such as capsules, sachets, and powder

The history and discovery of Binding Proteins

Immunoglobulins (a family of globular proteins with protective bioactivities) are among the most important components of all types of milks and colostrum, including those from humans, cows, goats, sheep, and camels¹¹⁻¹⁴. Particular attention has been given to the potential health benefits from the ingestion of camel milk. Camel milk proteins have been credited to support glucose control, healthy cholesterol, and body's immune response¹⁴⁻¹⁹. Camels have acquired significant adaptations enabling them to thrive in particular harsh climates and therefore possess a key role in societies in arid and semi-arid regions where their milk has been a part of human nutrition since ancient time^{20,21}.

Uniquely, it was discovered in 1993 that immunoglobulins from camelids (camels, alpacas, llamas etc.) have a simple structure, and a binding domain comprising a single polypeptide chain, making it a small stable protein with a targeted binding activity. This discovery has since been leveraged to develop ground-breaking new products, where the power of immunoglobulins can be concentrated, scaled, and embedded in everyday food as functional Binding Proteins.

Key milestones in the discovery of Binding Proteins



5000 YEARS AGO

Camel milk has been part of human ingestion in arid areas of the world for thousands of years²⁰

1990-1995

Scientific studies revealed that camel milk supports the body's natural immune response to bacteria and viruses²³⁻²⁴. In 1993, researchers discovered that immunoglobulins from camelids (camels, alpacas, llamas, etc.) are different than other immunoglobulins. They are small and simple structures, with a targeted binding activity²⁵

2023-2025

Upscaling with production of the first IgG derived Binding Proteins by precision fermentation.

First toxicology study demonstrating the safety of a novel IgG Binding Protein for its intended uses in foods and beverages for the general population⁶

2020-2023

New discovery of how Binding Proteins can support the gut microbiome in both human and animals against harmful microorganisms and their metabolites^{4-6, 22, 27-28}

2005-2015

Studies found that camelid immunoglobulins (IgGs) have unique stability properties, including heat resistance and stability across a wide pH range²⁶

A next-generation ingredient for gut health

As consumer demand for scientifically validated gut health solutions continues to grow, Binding Proteins represent a pioneering approach to maintain gut stability. With their targeted mode of action, non-immunogenic nature, stability during processing, and versatility in application, Binding Proteins offer an innovative solution for brands developing next-generation gut health products.

For more information, visit our educational platform www.bindingproteins.com and explore the latest research on Binding Proteins and their role in your daily life.

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