AEB ENZYMES:

INNOVATION, SUSTAINABILITY AND QUALITY FOR THE FOOD INDUSTRY

CHOOSE
ENDOZYM®,
THE COMPLETE
RANGE
OF AEB
ENZYMES

AEB®

AEB: BY YOUR SIDE FOR SUSTAINABLE, OPTIMIZED, AND HIGH-QUALITY FOOD PRODUCTION

For over 60 years, AEB Group has been synonymous with **scientific expertise, technological innovation, and passion for quality** in the world of biotechnologies applied to the food and beverage sector. With a vision oriented toward research and development, we support producers worldwide every day in implementing **efficient, safe, and sustainable processes.**

Our offering integrates advanced biotechnological solutions, specialized equipment, and constant technical support, contributing to improving every phase of the production chain: from fermentation to stabilization, from plant cleaning to packaging.

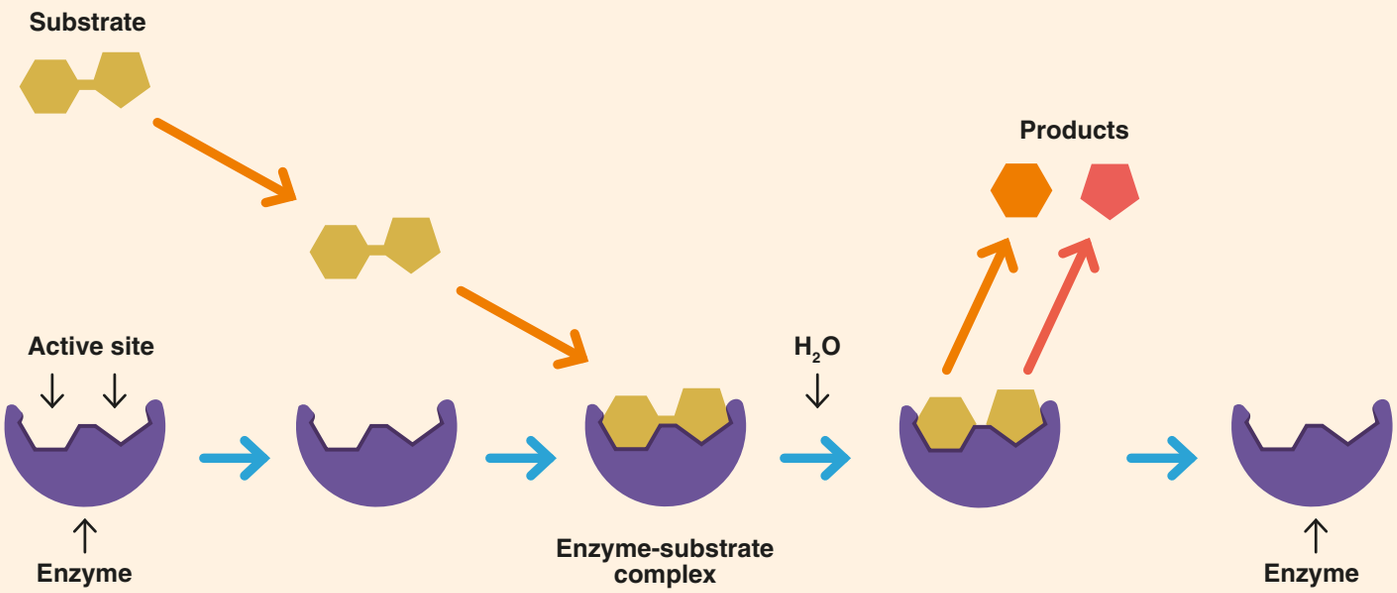
We operate in over one hundred countries with an extensive network of subsidiaries and production facilities, developing customized products adapted to the specific needs of different markets. The quality of our solutions is guaranteed by rigorous internal protocols and **international certifications**, which ensure high standards of safety, traceability, and reliability.

We are convinced that innovation means evolving with responsibility. For this reason, our multidisciplinary team works every day to create technologies that enhance raw materials, protect the environment, and respond to the challenges of the modern food industry.

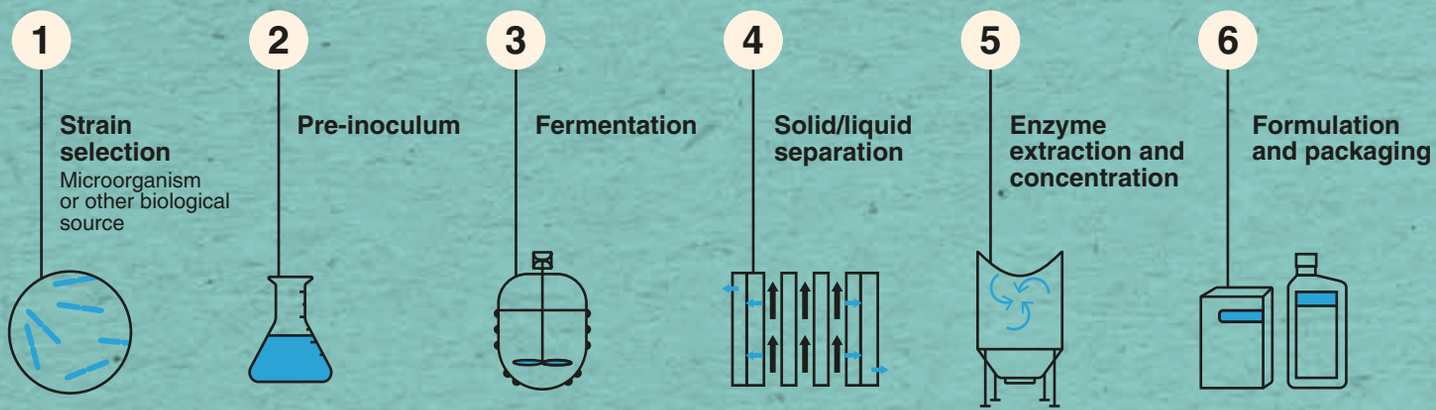
AEB®

WHAT ARE ENZYMES

Enzymes are **natural proteins** that act as **biocatalysts**, meaning they accelerate specific chemical reactions without being consumed in the process. Thanks to their high **action specificity**, they allow selective transformation of certain food components, improving their structure, digestibility, preservation, or sensory characteristics.



PRODUCTION PROCESS



Present in nature in every living organism, enzymes used in the food industry are obtained through controlled biotechnological processes, which guarantee **purity, safety, and consistent quality standards**. Their application makes production processes more efficient, sustainable, and compliant with international regulatory requirements.

Enzymes represent a key resource for safer, more sustainable, and innovative production.

WHY USE ENZYMES IN THE FOOD INDUSTRY?

BIOTECHNOLOGICAL INNOVATION IN SERVICE OF FOOD EXCELLENCE

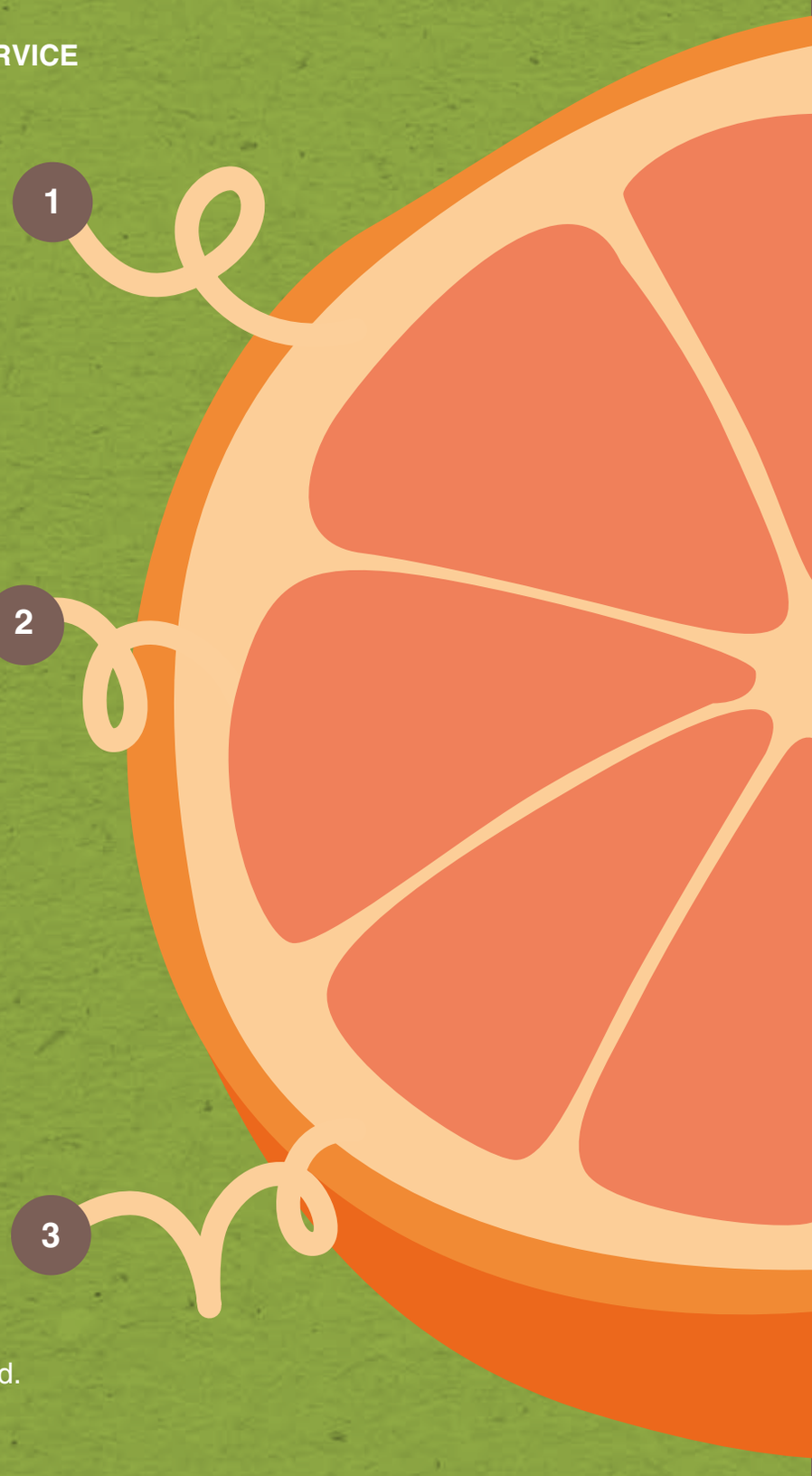
In the modern food industry, biotechnological innovation represents a fundamental lever for achieving excellence. Enzymes, in particular, play a crucial role in production processes, offering advanced solutions that improve the efficiency, quality, and sustainability of processing operations.

SUSTAINABILITY AND PROCESS EFFICIENCY

Thanks to their ability to increase extraction yield, stabilize treated substrates, and reduce viscosity, enzymes optimize the production process, reducing processing times and operational costs. Furthermore, the valorization of production waste through enzyme use allows transformation of by-products into useful ingredients or new products, contributing to a circular and sustainable approach.

QUALITY, STANDARDS, AND TRACEABILITY

Enzymes guarantee high standards of quality and traceability in food products. Their specific action enables obtaining products with improved functional and nutritional characteristics, meeting the needs of modern consumers. Moreover, enzyme use facilitates compliance with food safety regulations and standards, ensuring that every phase of the production process is monitored and controlled.



RELIABILITY AND FOOD SAFETY

Food safety is an absolute priority for food producers. The enzymes in the AEB ENDOZYM® range are designed to guarantee maximum reliability and safety at every production stage: enzymatic solutions developed with particular attention to sustainability that not only improve the quality of final products but also optimize production processes, contributing to reducing the environmental impact of food production, minimizing contamination risk, and ensuring **compliance with current regulations.**

QUALITY, INNOVATION, SUSTAINABILITY, OPTIMIZATION, EFFICIENCY.

ENDOZYM®: THE COMPLETE LINE OF AEB ENZYMES FOR THE FOOD INDUSTRY

SECTOR: VEGETABLE OILS

8723 A/SUPER | Pectinase, Beta-glucanase

Enzyme Type:

Multi-enzymatic disintegrating preparation for oil extraction composed of beta-glucanase, cellulase, hemicellulase, and pectinase derived from non-GMO *Aspergillus niger.*

Action:

Catalyzes the synergistic degradation of polysaccharide structures of plant cell walls through four complementary enzymatic mechanisms. Facilitates the disintegration of plant tissue and the breakdown of the colloidal reticular complex that traps intracellular lipids.

Application:

Resolves issues of inefficient oil extraction from plant matrices with high structural fiber content where cellulose, hemicellulose, and pectins form a physical barrier that hinders oil release. Particularly effective for olives, oil-bearing seeds, and compact-pulp fruits that require enzymatic destructuring to optimize oil-water separation and reduce centrifugation resistance. Also widely used in the treatment and extraction of essential oils such as citrus essential oils, where it increases extraction yield when added to the Florentine vessel.

Benefits:

- Increases oil extraction yield, significantly improving the economic efficiency of the process
- Reduces water and energy consumption thanks to greater extraction efficiency and decreased processing times required
- Improves oil-water separation during centrifugation, facilitating refining and purification operations of the extracted oil

SECTOR: PLANT RESIDUE TREATMENT

8723 A/SUPER | Pectinase, Beta-glucanase

Enzyme Type:

Multi-enzymatic complex for valorization of agro-food by-products composed of beta-glucanase, cellulase, hemicellulase, and pectinase of fungal origin derived from non-GMO *Aspergillus niger.*

Action:

The enzymatic system operates through coordinated hydrolysis of structural components of the plant cell wall. Cellulases attack beta-1,4-glucosidic bonds of cellulose, facilitating fiber disintegration and drastically improving filtration processes; hemicellulases degrade hemicelluloses; pectinases destructure the pectic middle lamella while beta-glucanases hydrolyze structural glucans. This synergistic action transforms rigid fibrous matrices into processable substrates.

Application:

Transforms plant residues such as spent grains, peels, pomace, and pulps into usable substrates, helping to resolve industrial by-product disposal problems and facilitating the recovery and valorization of dietary fiber. Enables the extraction of soluble and insoluble fibers previously considered waste, transforming them into marketable functional ingredients for food and nutraceutical applications. Cellulases are particularly effective in reducing the critical impact of fibers during filtration.

Benefits:

- Converts plant residues into functional ingredients, valorizing dietary fiber as a marketable component instead of waste to be disposed of
- Significantly facilitates filtration processes by reducing the critical impact of fibers and improving the operational efficiency of plants
- Increases recovery yield while reducing waste disposal costs and creating additional revenue streams from waste valorization
- Limits the formation of undesirable by-products during treatment, contributing to environmental sustainability and the circular economy of the supply chain

Limitations:

Specifically formulated for plant substrates rich in polysaccharides (cereal processing residues, spent grains, fibrous fractions of plant-based beverages). Not suitable for complex lignocellulosic biomass (straw, corncobs, bagasse, woody residues) that require enzymatic systems with specific ligninolytic activities for lignin degradation.

ENDOZYM XLC | Beta-glucanase, Cellulase, Xylanase

Enzyme Type:

High-concentration liquid enzymatic preparation with beta-glucanase, cellulase, and xylanase activity, obtained from selected fungal strains of *Trichoderma* and *Penicillium*, non-GMO. Formulation free of synthetic preservatives (potassium sorbate and sodium benzoate), suitable for use in BIO-certified productions. Optimal enzymatic activity at 60°C with extended operating range 20-70°C and pH 3.5-6.0.

Action:

The enzyme specifically degrades structural polysaccharides of cereals, including beta-glucans, hemicelluloses, and cellulose, hydrolyzing glycosidic bonds responsible for viscosity and matrix resistance. Acts selectively on endo-1,4-β-D-xylan bonds of hemicelluloses, endo-1,4-β-glucan bonds of cellulose, and endo-1,3-β-D-glucans of oats and barley, solubilizing complex polysaccharide fractions and releasing low molecular weight oligosaccharides. Synergistic multi-enzymatic action allows deep disintegration of plant fibers.

Application:

The enzyme promotes fiber disintegration in cereals, reducing viscosity and preventing fiber-protein aggregations that cause instability or sedimentation. Optimizes processing of cereals rich in beta-glucans, facilitating solid-liquid separation, improving texture, homogeneity, and the soluble fiber fraction in the final product.

Benefits:

- Increases extractive yield and the fraction of soluble substances from cereals
- Rapidly reduces viscosity, facilitating filtration and liquid-solid separation and reducing times and costs
- Standardizes the process independent of raw material quality
- Wide operating range of pH (3.5-6.0) and temperature (20-70°C), with direct application without pre-dilution
- Compatible with BIO processes, without synthetic preservatives
- Prevents fiber-protein aggregations, improving stability and shelf-life
- Enhances nutritional profile by increasing bioavailable soluble fibers

SECTOR: PLANT RESIDUE TREATMENT

ENDOZYM PE 90 | PME

Enzyme Type:

High-concentration liquid enzymatic preparation based on Pectinmethylesterase (PME) from submerged fermentation of selected non-GMO *Aspergillus niger* strains. Free of secondary pectinase activities, allows controlled pectin modification without degrading the polymer. Active between 15-60°C and pH 3.0-6.5, often used with calcium salts to crosslink pectins, increasing product consistency and resistance in fruit-based products.

Action:

Pectinmethylesterase (PME) performs selective hydrolysis of methyl ester bonds of pectins, reducing the degree of methoxylation and increasing available carboxyl groups (-COOH) along the chain. This promotes interaction with calcium present in apple juice, promoting formation of stable pectin-calcium networks that facilitate particle flocculation. The result is a significant improvement in clarification and filterability through sedimentable aggregates, without degrading the polymeric structure, preserving pectic chain integrity and controlling juice viscosity and rheological properties.

Application:

- Resolves technological problems in fruit juice and cider production, offering a sustainable alternative to traditional methods
- Allows standardization of functional characteristics of pectins naturally present in apple juice
- Optimizes gelling and rheological properties of concentrated fruit juices
- Improves natural clarification of apple juice for production of superior quality clear cider

Benefits:

- High specificity and enzymatic purity with targeted action on pectins without undesired side activities
- Ensures high purity, being free of degradative pectinase activities (polygalacturonase and pectinlyase)
- Operates under mild conditions (20-40°C, pH 4.5-5.5 typical of apple juice), preserving thermosensitive compounds
- Preserves original organoleptic characteristics of apple juice (aroma, flavor, polyphenolic profile)
- Technological efficiency with notable improvement in clarification and colloidal stability of juice
- Significantly reduces filtration times and costs, increasing plant productivity
- Optimized and reduced dosages (0.5-1 g/hL) with high enzymatic efficacy
- Flexible contact times (3-15 hours) adaptable to specific production needs and processing cycles
- Total compatibility with natural apple juice conditions without need for process adjustments

SECTOR: FRUIT JUICES

ENDOZYM Cellofruit | Cellulase

Enzyme Type:

Multi-enzymatic mixture of cellulase and pectinase of fungal origin, formulated for processing fiber-rich fruits and cereals and for complete degradation of plant cell walls.

Action:

The enzyme acts on multiple targets simultaneously: cellulases hydrolyze beta-1,4-glycosidic bonds of cellulose into glucose and oligosaccharides, while pectinases degrade pectins, facilitating middle lamella breakdown and disintegrating the fibrous matrix. This combined action releases cellular contents, reduces viscosity, and facilitates filtration.

Application:

Resolves problems of turbidity, gelification, and sedimentation during processing of plant-based beverages and clear juices without pulp. Improves the soluble fiber fraction, increases total fibers in the finished product, and optimizes filterability and product stability, even at low temperatures. Particularly effective on whole grain cereals, oats, brown rice, legumes, and fiber-rich fruits.

Benefits:

- Increase in extractive yield up to 4-8% during pressing and extraction
- Improved filterability and reduced process times
- Production of drier waste, reusable for pectin extraction
- Stabilization of the final product against precipitation and cloudiness
- Complete fiber hydrolysis in 60-120 minutes at optimal temperatures of 60-67°C
- Overall improvement in finished product quality, with greater natural sweetness and uniform consistency

Endozym Cloudy Plus | Pectinase

Enzyme Type:

High-concentration pectolytic enzymatic preparation based on purified pectinlyase produced from non-GMO *Aspergillus niger*, specific for the production of citrus cloudy juices, mainly obtained from processing first pressing waste.

Action:

Selective hydrolysis of pectic substances through controlled pectinolytic activity, reducing medium viscosity without compromising the natural suspension of pulp particles.

Application:

Stabilization of dense cloudy juices, preventing sedimentation and phase separation phenomena, maintaining the characteristic cloudy appearance required by the market.

Benefits:

- Obtaining more stable and less viscous cloudy juices
- Effective prevention of pulp particle sedimentation
- Maintenance of particles in suspension for visually appealing appearance
- Valorization of first pressing waste by transforming them into high-added-value products

SECTOR: FRUIT JUICES

ENDOZYM Protease NA | Protease

Enzyme Type:

Enzymatic preparation based on acid protease of fungal origin from *Aspergillus niger*, specifically formulated for protein hydrolysis in fruit juices.

Action:

Specific hydrolysis of structural and unstable proteins through enzymatic attack of peptide bonds, degrading protein groups that generate instability during clarification and preservation processes.

Application:

Specialized clarification of red fruit juices and kiwi juices, prevention of protein turbidity, and improvement of colloidal stability of the final product during storage.

Benefits:

- Specific application for clarification of red fruit and kiwi juices particularly rich in proteins
- Effective prevention of protein turbidity and instability during storage
- Versatile use in combination with other enzymatic preparations at pressing time
- Improvement of filterability and final product stability

ENDOZYM Apple Press | Pectinase

Enzyme Type:

Super-concentrated pectolytic enzyme for maceration and pressing of apples with difficult extraction.

Action:

Hydrolyzes structural pectins of cell wall through polygalacturonase and arabanase activity. Degrades branched pectin zones by breaking galacturonic bonds and arabinan side chains, destructuring the matrix that cements cells and facilitating juice release.

Application:

Resolves problems of apples with poor yield due to high tissue resistance, slow pressing requiring high pressures, low yields with losses in pomace, and excessive juice viscosity. Effective on mature varieties or with resistant fibro-woody tissues.

Benefits:

- Increases total juice yields, reducing losses in pomace
- Accelerates pressing speed, decreasing cycle times
- Reduces necessary mechanical pressures, limiting equipment wear
- Improves juice quality by reducing viscosity and facilitating clarification

ENDOZYM Apple Plus | Pectinase

Enzyme Type:

Enzymatic preparation based on pectinase and arabanase, produced by fermentation of selected strains of *Aspergillus niger* of natural origin. Multi-enzymatic pectinase complex specific for clarification of apple juices, both direct and pre-concentrated. Formulation containing polygalacturonase, pectinlyase, pectinmethylesterase, and arabanase for complete synergistic action.

Action:

The system combines pectinase enzymes (polygalacturonase, pectinlyase, pectinmethylesterase) and arabanase that synergistically degrade the pectic matrix. Polygalacturonase hydrolyzes α-1,4-galacturonic bonds, pectinlyase fragments polysaccharides through β-elimination, pectinmethylesterase removes methoxyl groups enhancing other enzyme action, while arabanase eliminates lateral arabinan branching. Joint activity drastically reduces viscosity, eliminates protective colloids responsible for turbidity, and ensures rapid destructuring of pectic substances, favoring subsequent processing phases.

Application:

Indicated for direct or pre-concentrated apple juices (12–16 °Brix), particularly effective on juices from aged apples and those destined for cider production, where clarification is determining. Prevents formation of unstable pectic gels, facilitates pumping and transfers, eliminates filtration difficulties caused by high molecular weight colloids, and ensures stability during thermal concentration and storage. Additionally, improves efficiency of conventional clarification with mineral and protein aids.

Benefits:

- Rapid viscosity reduction (1–2 hours), with ease of pumping and handling
- Improved clarification, with more compact lees and less clarifying aid use
- Greater efficiency in ultrafiltration and concentration, with reduced membrane fouling
- Prevention of cloudiness and guarantee of long-term colloidal stability
- Versatile on direct and pre-concentrated juices (up to 16 °Brix), effective also on aged and pectin-rich apples

SECTOR: FRUIT JUICES

ENDOZYM PE 90 | PME

Enzyme Type:

High-concentration liquid enzymatic preparation based on Pectinmethylesterase (PME), obtained from submerged fermentation of selected strains of non-GMO *Aspergillus niger*. Formulation free of secondary pectinase activities (polygalacturonase, pectinlyase), ideal for applications requiring controlled pectin modification without polymer degradation. Operating activity in temperature range 15-60°C and pH 3.0-6.5.

Action:

Pectinmethylesterase catalyzes the selective removal of methoxyl groups (-OCH_3) from galacturonic acid residues of pectins, modifying their degree of esterification (DE) without altering molecular weight or polymeric structure integrity. This action allows progressive and controlled conversion of high methoxyl pectins to low methoxyl pectins, enabling achievement of a precise final degree of esterification as a function of reaction time and operating conditions. The enzyme generates pectins with specific functional properties, adaptable to various industrial applications.

Application:

Enzymatic treatment enables controlled and natural demethoxylation of pectins extracted from plant residues, avoiding the use of acids or alkalis employed in traditional chemical processes. Improves final product quality by preserving the polymeric matrix and simplifies wastewater management, reducing environmental impact and disposal costs. Valorizes fruit processing by-products, such as citrus, apple, and beet peels, promoting circular economy and allowing extraction of high-added-value pectins. This approach enables obtaining pectins with standardized degree of esterification, required in food, pharmaceutical, and cosmetic sectors, in a sustainable, safe, and environmentally compliant manner.

Benefits:

- Pectinmethylesterase (PME) with high specificity, free of contaminating activity (PL, PG), capable of precisely modulating pectin methoxylation degree without altering its polymeric structure
- Functions in wide temperature range (15-60°C) and pH (3.0-6.5)
- Reduces chemical substance use and environmental impact
- Transforms plant waste into high-added-value pectins
- Increases extraction yield and optimizes co-product recovery
- Simplifies wastewater management and reduces disposal costs

ENDOZYM Pectofruit BR | Pectinase

Enzyme Type:

High-efficacy pectolytic preparation for depectinization of juices and concentrates composed of pectinlyase (PL), polygalacturonase (PG), and pectinmethylesterase (PME) derived from selected strains of *Aspergillus niger*. Multi-enzymatic formulation with coordinated synergistic action for complete degradation of pectic substances. Specific for treatment and optimization of extractive yield in fruit processing.

Action:

The juice depectinization process is based on a coordinated tri-enzymatic mechanism in which pectinmethylesterase (PME) selectively removes methoxyl groups from pectic chains, creating attack sites for other enzymes. Polygalacturonase (PG) hydrolyzes alpha-1,4-galacturonic bonds of main chains, while pectinlyase (PL) completes degradation through beta-elimination on de-esterified polymers. This synergistic action causes rapid reduction of juice viscosity, promotes disintegration of cell walls and pulp, and facilitates juice release, completely degrading pectic structures responsible for viscosity and mechanical tissue resistance.

Application:

In concentrated juices with high sugar content (12–16 °Brix), high viscosity limits plant efficiency. Pectin hydrolysis relaxes fruit structure, facilitating juice release, reduces pressing times, and increases productivity. Viscosity decrease improves clarification and filtration, prevents cloudiness and colloidal instabilities during storage and concentration, and limits membrane fouling in ultrafiltration plants.

Benefits:

- Significant increase in extractive yield, allowing extraction of greater juice quantity from the same fruit amount
- Reduction of pressing times with increased productivity and operational plant efficiency
- Drastically reduces viscosity and colloidal fraction of concentrated juices, improving fluidity, pumpability, and ultrafiltration efficiency in industrial plants
- Optimizes synergy with traditional clarifying aids (bentonite, gelatin, silica sol)
- Contained dosages (2-5 mL/hL) with high enzymatic efficacy, reducing usage costs
- Reduced contact times (60 minutes), allowing rapid and flexible processing cycles
- Improves colloidal stability of finished product, preventing phase separation during storage

SECTOR: FRUIT JUICES

ENDOZYM Lemon | Pectinase

Enzyme Type:

ENDOZYM Lemon is a highly concentrated and purified pectolytic enzymatic preparation, composed primarily of pectinase and hemicellulase, produced from selected non-GMO *Aspergillus niger* strains. The preparation has been specifically formulated to promote clarification of citrus juices, particularly lemon juice.

Action:

Despite lemon containing a relatively reduced quantity of pectin compared to other fruits, its polysaccharide fraction is rich in complex hemicelluloses, which contribute to juice turbidity and poor filterability. ENDOZYM Lemon acts by hydrolyzing pectins and numerous polysaccharides present, including: arabinogalactans, galactomannans, galacto-glucomannans, arabinoxylans (especially in insoluble fractions). This enzymatic specificity allows degradation of complex structures that would otherwise hinder clarification and filtration processes.

Application:

The use of ENDOZYM Lemon in lemon juice treatment enables obtaining a significantly superior final product, characterized by more intense visual brilliance and colloidal and organoleptic stability maintained longer over time. Targeted enzymatic action notably improves efficiency of clarification, filtration, and ultrafiltration processes, reducing difficulties related to complex polysaccharide presence and thus facilitating obtaining clear, stable, and high-quality juice. For optimal results, it is necessary to dilute the preparation up to ten times its volume in demineralized water and ensure the solution is homogeneous before adding to juice.

Benefits:

- Targeted polysaccharide hydrolysis: effectively eliminates substances responsible for turbidity
- Technological process optimization: reduces times and improves filtration and ultrafiltration phase yields
- Increased juice quality: increases brilliance, clarity, and stability over time
- Operational flexibility: maintains enzymatic activity in wide pH range (2–5) and temperatures (8–55 °C), with optimal conditions at pH 3.5–5 and 50–55 °C

ENDOZYM Pectofruit PR | Pectinase

Enzyme Type:

Ultra-concentrated multi-activity enzymatic preparation for fruit maceration treatments before pressing, containing pectinlyase, polygalacturonase, pectinmethylesterase, and cellulase.

Action:

Synergistic degradation of fruit structure through hydrolysis of pectins and other pulp polysaccharides, with coordinated attack of middle lamella and cell wall for extraction facilitation.

Application:

Optimization of pre-pressing maceration phase for maximization of juice extraction from fruit, improvement of extractive yield, and facilitation of liquid-solid separatio.

Benefits:

- Significant increase in juice yield up to 15% compared to control
- Improvement of functional and aromatic compound extraction from pulp
- Reduction of maceration times with process cost optimization
- Facilitation of pressing operations with less mechanical effort required

NOTE: This product is specifically formulated for the pre-pressing maceration phase, distinguishing itself from ENDOZYM Pectofruit BR which is oriented toward post-extraction clarification.

ENDOZYM Polifruit S | Pectinlyase, Cellulase, Protease

Enzyme Type:

High-concentration multi-activity enzymatic preparation for pre-pressing maceration composed of pectinlyase (PL), cellulase, and acid protease derived from *Aspergillus niger*.

Action:

Simultaneously catalyzes the hydrolysis of middle lamella pectins through degradation of alpha-1,4-galacturonic bonds, disintegration of cellulosic fibers through breaking of beta-1,4-glucosidic bonds, and protein denaturation of cell membranes. This synergistic action causes complete destructuring of the fruit's plant matrix.

Application:

Resolves technological problems of low extractive yield in mechanical fruit pressing, high puree viscosity that compromises process plant efficiency, and difficulty of extraction from compact-pulp fruits or poorly performing varieties. Particularly effective on red fruits, soft and compact pulp apples, and summer fruit with high pectin content.

Benefits:

- Significantly increases juice yield up to 15% with proportional reduction of processing waste
- Drastically reduces compound viscosity, improving press operational efficiency and reducing process times
- Optimizes extraction parameters with flexible dosages of 20-70 mL/ton depending on process thermal conditions
- Ensures efficacy in wide operating range (15-65°C, pH 3.0-6.0), adapting to different fruit types and production processes

SECTOR: FRUIT JUICES

ENDOZYM Pectofruit XM | Pectinase

Enzyme Type:

Multi-activity pectolytic preparation composed of pectinlyase (PL), polygalacturonase (PG), pectinesterase (PE), and arabinogalactanase, specific for destructuring of complex polysaccharides.

Action:

Synergistic destructuring of pectic substances through coordinated hydrolysis of glycosidic bonds, with particular efficacy on complex citrus substrates.

Application:

Application versatility in multiple phases of citrus juice production process, from clarification to ultrafiltration, with particular efficacy in increasing extractive yield.

Benefits:

- Increased ultrafiltration performance with greater process efficiency
- Reduction of clarifying aid use during traditional filtration
- Significant improvement of colloidal stability over time of first pressing juice and concentrate
- Usage versatility in different production process phases according to specific needs

ENDOZYM Polifruit | Pectinlyase, Cellulase, Protease

Enzyme Type:

Multi-enzymatic mixture of fungal origin composed of cellulase, protease, and pectinase (PL, PG, PME) for complete fruit juice treatment during extraction.

Action:

Synergistic tri-enzymatic action through cell wall degradation, structural protein hydrolysis, and pectin destructuring, facilitating intracellular liquid release.

Application:

Increase of liquid recovery from presses and extractors through complete plant matrix degradation, optimizing extractive efficiency for different fruit types.

Benefits:

- Increase of total juice yield by 4-8% depending on fruit type and ripeness degree
- Significant improvement of liquid recovery from presses and extractors
- Versatile action on different fruit types thanks to multi-enzymatic formulation
- Optimization of extractive efficiency with reduction of processing waste

SECTOR: PLANT-BASED BEVERAGES

ENDOZYM Alphamyl SB1 | Thermostable Amylase

Enzyme Type:

Thermostable alpha-amylase of bacterial origin, derived from *Bacillus licheniformis* and formulated in liquid form. Active in a wide temperature range (65–90 °C) and pH (5.4–6.5), specifically designed for thermal processing of plant substrates and cereals.

Action:

The enzyme catalyses the hydrolysis of starch present in cereals, rapidly transforming it into maltose, glucose, and soluble dextrins through the attack of alpha-1,4-glycosidic bonds. Thermal stability allows operation at elevated temperatures, ensuring efficient and consistent starch degradation during the cooking phases of water-cereal mixtures and other thermal treatments necessary for plant-based beverage production.

Application:

In the production of cereal-based plant beverages such as oat, rice, and barley, it optimizes the conversion of starch into simpler sugars, facilitating the extraction of natural sweetness. Drastically reduces product viscosity, improving filterability and final texture; accelerates process times thanks to rapid enzymatic action; and limits the formation of undesirable residues, contributing to cleaner and more efficient processing.

Benefits:

- Efficiently extracts natural sweetness from cereals by converting starch into simple sugars
- Significantly reduces viscosity, improving substrate filterability and facilitating all subsequent processing operations
- Ensures energy efficiency with reduced process times thanks to the rapidity of action and thermal stability of the enzyme
- Increases yield and quality of the finished product by limiting the formation of undesirable by-products and processing residues

SECTOR: PLANT-BASED BEVERAGES

ENDOZYM Alphamyl SB2 | Non-thermostable Amylase

Enzyme Type:

ENDOZYM® Alphamyl SB2 is a liquid preparation whose composition is based on a non-thermostable alpha-amylase. Its enzymatic activities have been isolated from a specific fungal strain, *Aspergillus oryzae*.

Action:

The enzyme exerts a fundamental alpha-amylase action by catalyzing the hydrolysis of starch bonds present in cereal raw materials. This decomposition process transforms starch into simpler compounds, obtaining dextrins and maltose. The action occurs under pH conditions that optimize its functionality.

Application:

This product is essential in the treatment of cereal raw materials for the production of plant-based beverages and is particularly recommended in all cereal processing processes where natural starch conversion is insufficient or when a test indicates the presence of unconverted residual starch in the final product.

Benefits:

- Processing Optimization: The enzyme's activity increases the filterability of the aqueous cereal mixture, a key aspect for the consistency of the liquid base.
- Increased Production Efficiency and Extraction Yield: The improvement in fluidity and processing translates into increased yield and greater production capacity of plants.
- Product Composition Control: The enzyme's activity allows hydrolysis of residual starch, producing dextrins and maltose, which influence the final composition of the product.

ENDOZYM Protease NP | Protease

Enzyme Type:

Enzymatic preparation based on neutral protease obtained through submerged fermentation of a selected strain of *Bacillus subtilis*, specific for production of plant-based beverages from cereals, legumes, and pseudocereals.

Action:

Performs controlled hydrolysis of plant proteins during extraction phases, degrading protein complexes into soluble peptides and amino acids. Works in neutral pH environment (6.0 - 7.5) in a temperature range from 45 to 70°C.

Application:

The use of neutral protease in high-protein plant-based beverages improves protein solubility and digestibility through controlled hydrolysis. This process increases available protein quota, enriches nutritional profile, and ensures product stability, preventing sedimentation, phase separation, and filtration difficulties during shelf-life.

Benefits:

- Greater protein solubility and digestibility, increased available protein content, and better beverage stability
- Increases filtration and ultrafiltration yields, reducing process times
- Ensures prolonged colloidal stability over time of finished product
- Optimizes nutritional content extraction from cereals with dosages of 30-150 g/ton of raw material

SECTOR: PLANT-BASED BEVERAGES

ENDOZYM Alphamyl PF NaCl | Thermostable Amylase

Enzyme Type:

Highly concentrated liquid thermostable alpha-amylase obtained through submerged fermentation of selected strains of *Bacillus licheniformis*. Specifically formulated for use in food processes, it is active at elevated temperatures (80–95 °C) and in a pH range between 5.8 and 7.5, ideal conditions for plant-based beverage processing.

Action:

Catalyzes the hydrolysis of alpha-1,4-glycosidic bonds present in amylose and amylopectin chains, transforming starch into soluble dextrins, oligosaccharides, and maltodextrins. This action drastically reduces the viscosity of the water-cereal mixture, improving product fluidity during all processing operations.

Application:

Essential in the production of cereal-based plant beverages such as rice, oat, and barley, where high native starch concentration can compromise the filterability, homogeneity, and stability of the product. The enzyme enables controlled liquefaction, improving the texture and final quality of the plant beverage through optimized starch conversion.

Benefits:

- Significantly reduces viscosity, improving filterability and substrate workability during all production phases
- Maintains high thermal stability with optimal activity between 80-95°C, compatible with standard industrial thermal treatment
- Contributes to the natural sweetness of the beverage thanks to controlled production of oligosaccharides and dextrins
- Allows optimized dosages between 50 and 120 mL per quintal and reduced reaction times of 60-120 minutes, ensuring greater production efficiency

SECTOR: PLANT-BASED BEVERAGES

ENDOZYM AMG | Amyloglucosidase

Enzyme Type:

Liquid preparation based on amyloglucosidase (glucoamylase) of fungal origin, obtained from selected strains of *Aspergillus niger*. Enzyme active in a wide temperature range (50-75°C) and pH (3.0-5.5), with optimal conditions at 65°C and pH 4.0. Specialized for controlled extraction of natural sweetness from cereals in plant-based beverage production.

Action:

The enzyme catalyzes the sequential cleavage of α-1,4 and α-1,6 glycosidic bonds present in amylose and amylopectin chains, completely degrading starch branching and converting residual starch into glucose and maltose. It also acts on dextrins produced by alpha-amylase in previous stages, generating simple fermentable sugars that contribute to improving the organoleptic profile of the final product.

Application:

The use of the enzyme allows controlled extraction of the natural sweetness of cereals without resorting to added sugars, favoring the development of clean label formulations with balanced flavor. Viscosity reduction improves mixture fluidity during processing, while degradation of starch and dextrins stabilizes the product against retrogradation and formation of gels or precipitates. Simultaneously, enzymatic action optimizes digestibility and the nutritional profile of the beverage, ensuring uniform quality and consistency in the finished product.

Benefits:

- Maximum starch hydrolysis efficiency under moderate thermal conditions (50-75°C) with reduced energy consumption
- Enables controlled glucose production, improving organoleptic profile and reducing the need for added sugars or sweeteners in clean label formulations
- Long-term colloidal stability with prevention of sedimentation and phase separation
- Optimization of taste profile with balanced natural sweetness derived exclusively from the cereal matrix
- Greater product homogeneity and ease of management in subsequent packaging processes

ENDOZYM Cellofruit IF | Cellulase

Enzyme Type:

Preservative-free multi-enzymatic preparation for complete degradation of plant fibers composed of cellulase and pectinase derived from *Aspergillus niger*.

Action:

The enzyme simultaneously degrades the main structural polysaccharides of plant walls with a multi-target mechanism: cellulases hydrolyze cellulose into glucose and oligosaccharides, pectinases degrade pectins, and the combined action disintegrates the fibrous matrix of cereals and legumes, releasing cellular contents and reducing viscosity.

Application:

Resolves problems of suspensions, instability, and sedimentation in high-fiber beverages, improving the soluble fiber fraction and increasing total fibers in the finished product. Particularly effective on whole grain cereals, oats, brown rice, and legumes; facilitates filtration, optimizes the process, and reduces energy consumption, enhancing the nutritional profile.

Benefits:

- Increased extractive yield and improved colloidal stability, preventing post-bottling suspension formation
- Optimization of filtration and ultrafiltration, thanks to solid load reduction and fragmentation of complex polymeric structures
- Reduced process times, with complete fiber hydrolysis in 60-120 minutes at optimal temperatures of 60-67°C for plant-based beverages
- Low dosages required (8-20 mL/quintal), compatible with preservative-free formulations and suitable for organic and clean label products
- Overall improvement in finished product quality, with greater stability, natural sweetness, and uniform consistency

SECTOR: PLANT-BASED BEVERAGES

ENDOZYM Cellofruit | Cellulase

Enzyme Type:

Multi-enzymatic mixture of cellulase and pectinase of fungal origin, formulated for processing fiber-rich fruits and cereals and for complete degradation of plant cell walls.

Action:

The enzyme acts on multiple targets simultaneously: cellulases hydrolyze beta-1,4-glycosidic bonds of cellulose into glucose and oligosaccharides, while pectinases degrade pectins, facilitating middle lamella breakdown and disintegrating the fibrous matrix. This combined action releases cellular contents, reduces viscosity, and facilitates filtration.

Application:

Resolves problems of turbidity, gelification, and sedimentation during processing of plant-based beverages and clear juices without pulp. Improves the soluble fiber fraction, increases total fibers in the finished product, and optimizes filterability and product stability, even at low temperatures. Particularly effective on whole grain cereals, oats, brown rice, legumes, and fiber-rich fruits.

Benefits:

- Increase in extractive yield up to 4-8% during pressing and extraction
- Improved filterability and reduced process times
- Production of drier waste, reusable for pectin extraction
- Stabilization of the final product against precipitation and cloudiness
- Complete fiber hydrolysis in 60-120 minutes at optimal temperatures of 60-67°C
- Overall improvement in finished product quality, with greater natural sweetness and uniform consistency

ENDOZYM XLC | Beta-glucanasi, Cellulasi, Xilanasi

Enzyme Type:

High-concentration liquid enzymatic mixture with beta-glucanase, cellulase, and xylanase activity from selected fungal strains of non-GMO *Trichoderma* and *Penicillium*. Formulation free of synthetic preservatives (potassium sorbate and sodium benzoate), suitable for use in sustainable and BIO-certified processes. Optimal activity at 60°C with operating range 20-70°C and pH 3.5-6.0.

Action:

The enzyme performs targeted hydrolysis of structural polysaccharide components of plant fibers, specifically degrading beta-glucans, hemicelluloses, and cellulose present in cereal residues. It acts on selective cleavage of endo-1,4-beta-D-xylan bonds of hemicelluloses, endo-1,4-beta-glucan bonds of cellulose, and endo-1,3-beta-D-glucans typical of oats and barley, solubilizing complex polysaccharide fractions and releasing low molecular weight oligosaccharides. The synergistic multi-enzymatic action ensures deep disintegration of the fibrous matrix.

Application:

The enzyme is indicated for treatment of plant residues with high viscosity due to beta-glucans, promoting structural breakdown of fibers and release of soluble fractions. It improves medium fluidity, facilitates residue management, and optimizes filtration and pretreatments. Supports more sustainable waste management, reduces disposal costs, valorizes residues by transforming them into new usable matrices, and allows recovery of bioactive and nutritional components, promoting circular economy principles.

Benefits:

- Rapid viscosity reduction, improving residue workability and handling
- Significant increase in filterability, optimizing solid-liquid separation processes
- Wide operational versatility: effective activity between pH 3.5-6.0 and temperatures 20-70°C (peak at 60°C)
- Direct application without pre-dilution, with uniform distribution and immediate action
- Waste valorization, reduction of disposal costs, and recovery of high-added-value soluble fractions
- Formulation free of preservatives such as benzoate and sorbate, suitable for certified organic products
- Support for industrial sustainability and circular economy principles

Limitations:

Specifically formulated for plant substrates rich in polysaccharides (cereal processing residues, spent grains, fibrous fractions of plant-based beverages). Not suitable for complex lignocellulosic biomass (straw, corncobs, bagasse, woody residues) that require enzymatic systems with specific ligninolytic activities for lignin degradation.

SECTOR: CEREALS

ENDOZYM Alphamyl PF NaCl | Thermostable Amylase

Enzyme Type:

High-concentration liquid preparation containing thermostable alpha-amylase of bacterial origin, obtained from submerged fermentation of selected strains of *Bacillus licheniformis*. Enzyme designed to operate at elevated temperature conditions, with optimal activity between 90-95°C and significant activity up to 100°C, specific for cereal processes and plant-based beverage production.

Action:

The enzyme specifically hydrolyzes the α-1,4 bonds of starch, acting on amylose and amylopectin and converting gelatinized starch into low molecular weight soluble dextrins, reducing viscosity and improving workability. The thermoresistant structure maintains activity up to 100 °C, making it suitable for high-temperature processes.

Application:

Enables reduction of viscosity in starchy mixtures, ensuring controlled liquefaction that optimizes filterability and process management. Thermal stability allows inactivation of undesirable endogenous enzymes, prevents starch retrogradation, increases extraction of the soluble fraction, and improves yield and quality of the final product.

Benefits:

- Significant reduction of water-cereal mixture viscosity, improving substrate fluidity and workability
- Exceptional thermal stability with effective enzymatic activity up to 100°C for several hours during the process
- Optimization of hydrolysis efficiency with dosages between 50-120 mL per quintal of cereal and reaction times of 60-120 minutes
- Compliance with international food regulations (EC, WHO, FAO, JECFA, FCC) with production from non-GMO microorganisms and absence of microbiological contaminants

ENDOZYM AMG | Amyloglucosidase

Enzyme Type:

Glucoamylase (amyloglucosidase) of fungal origin derived from selected strains of *Aspergillus niger*, specific for complete saccharification of starch contained in cereals and pseudocereals. Enzyme active in a wide temperature range (50-75°C) and pH (3.0-5.5), with optimal conditions at 65°C and pH 4.0. Acts effectively on complex starchy substrates, including those from untreated raw materials.

Action:

The enzyme catalyzes the hydrolysis of α-1,4 and α-1,6 glycosidic bonds present in starch and dextrins, releasing glucose units from the non-reducing ends and progressively degrading amylaceous macromolecules with a sequential mechanism. It also acts on substrates partially hydrolyzed by alpha-amylase, ensuring complete conversion of residual starch and dextrins into simple sugars and improving overall process efficiency.

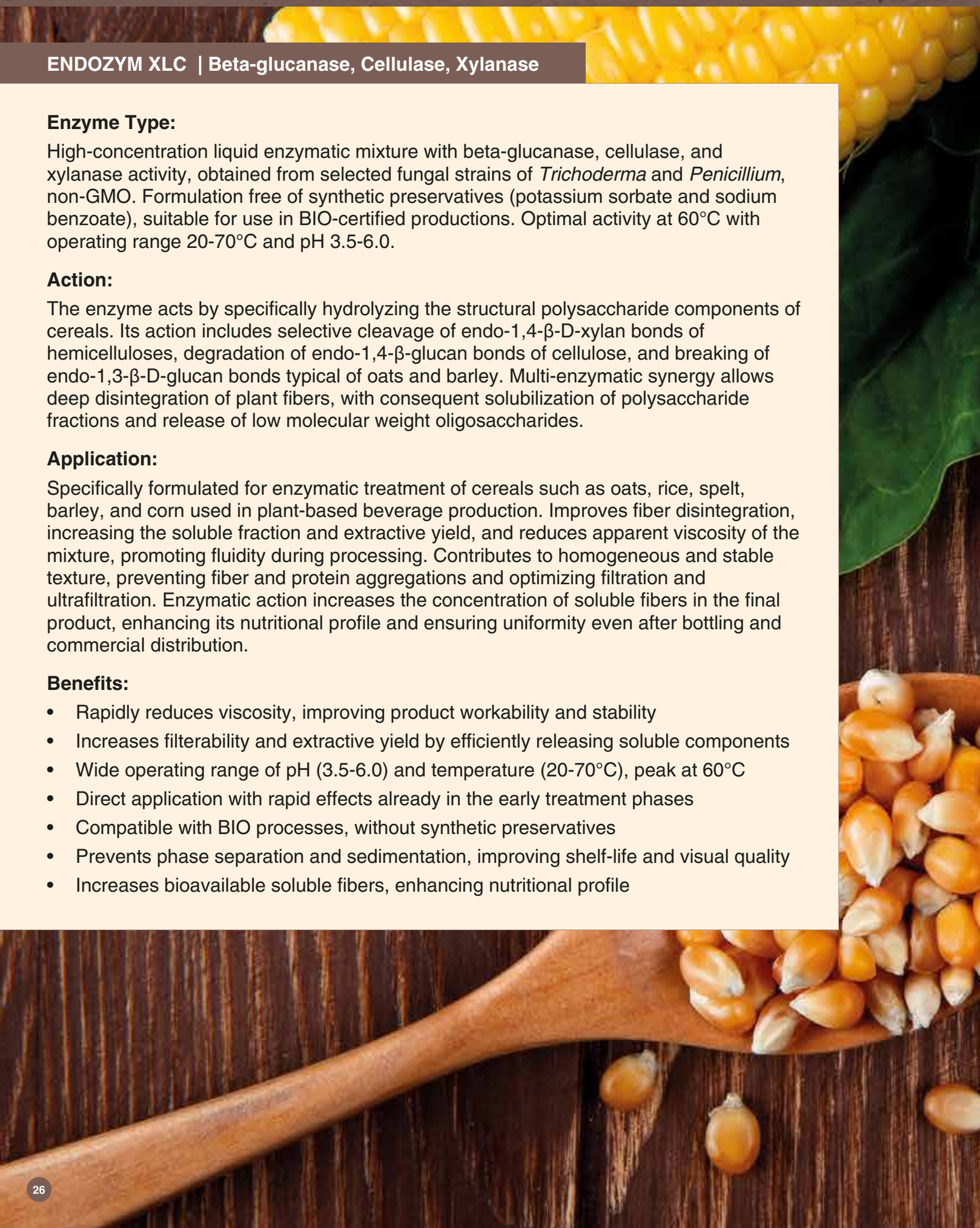
Application:

The use of the enzyme enables total conversion of starch into glucose, increasing the availability of simple sugars and reducing the content of complex carbohydrates in formulations, even when using unmodified raw materials. It promotes natural sweetness in plant-based beverages without adding sweeteners, improves physical stability by preventing retrogradation and gelification of starch, and ensures standardization of finished product composition, independent of raw material variations.

Benefits:

- Maximization of sugar yield with significant increase in extraction efficiency of simple sugars from starchy substrates
- Optimization of nutritional profiles, enabling production of foods or beverages with low residual carbohydrate content
- Process standardization, reducing variability related to raw material composition and quality
- Improved digestibility of the final product through complete conversion into easily assimilable monosaccharides
- Operational flexibility thanks to wide range of temperature and pH of enzymatic activity
- Compliance with market demands for clean label products with sweetness derived exclusively from the natural matrix

SECTOR: CEREALS



ENDOZYM XLC | Beta-glucanase, Cellulase, Xylanase

Enzyme Type:

High-concentration liquid enzymatic mixture with beta-glucanase, cellulase, and xylanase activity, obtained from selected fungal strains of *Trichoderma* and *Penicillium*, non-GMO. Formulation free of synthetic preservatives (potassium sorbate and sodium benzoate), suitable for use in BIO-certified productions. Optimal activity at 60°C with operating range 20-70°C and pH 3.5-6.0.

Action:

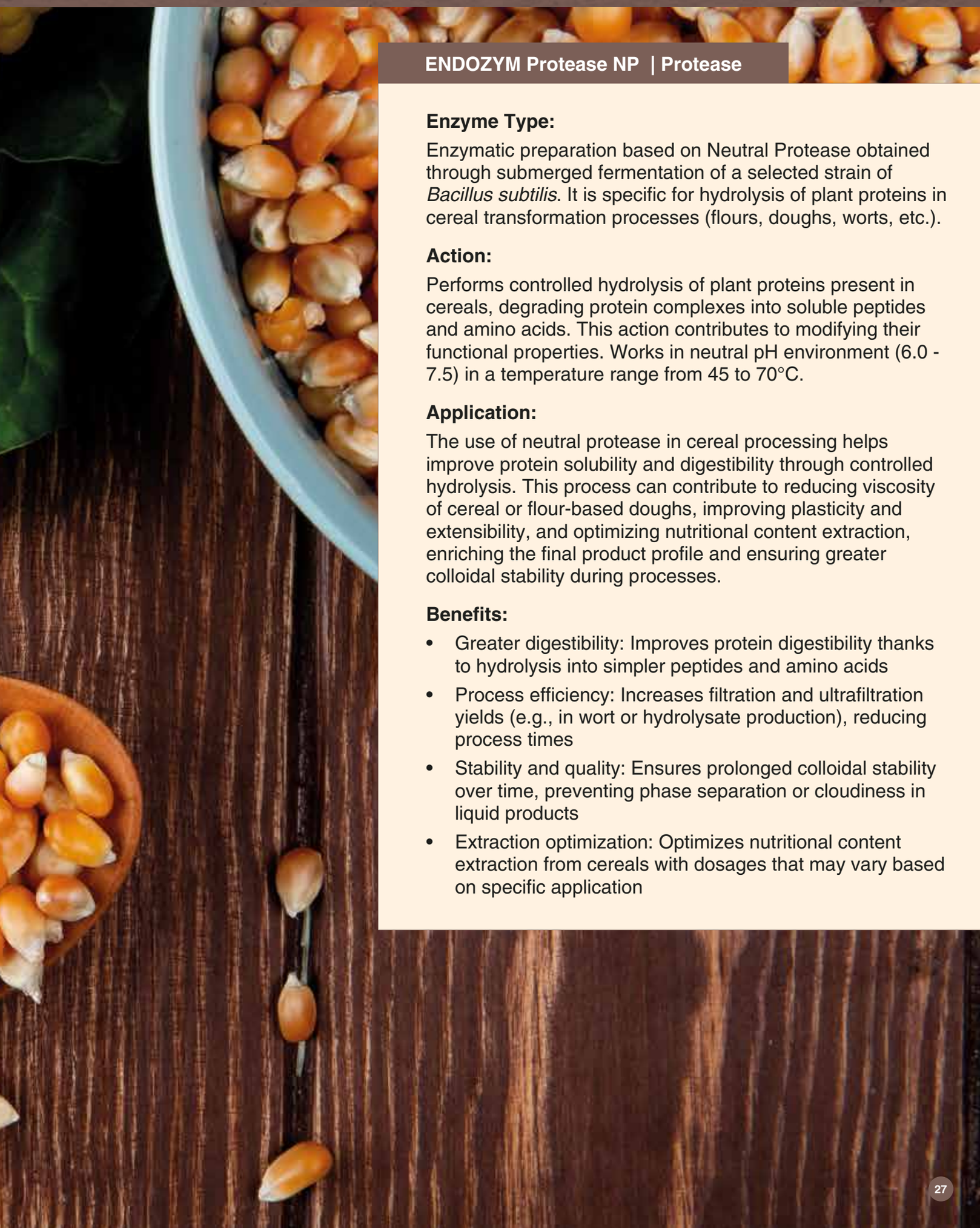
The enzyme acts by specifically hydrolyzing the structural polysaccharide components of cereals. Its action includes selective cleavage of endo-1,4-β-D-xylan bonds of hemicelluloses, degradation of endo-1,4-β-glucan bonds of cellulose, and breaking of endo-1,3-β-D-glucan bonds typical of oats and barley. Multi-enzymatic synergy allows deep disintegration of plant fibers, with consequent solubilization of polysaccharide fractions and release of low molecular weight oligosaccharides.

Application:

Specifically formulated for enzymatic treatment of cereals such as oats, rice, spelt, barley, and corn used in plant-based beverage production. Improves fiber disintegration, increasing the soluble fraction and extractive yield, and reduces apparent viscosity of the mixture, promoting fluidity during processing. Contributes to homogeneous and stable texture, preventing fiber and protein aggregations and optimizing filtration and ultrafiltration. Enzymatic action increases the concentration of soluble fibers in the final product, enhancing its nutritional profile and ensuring uniformity even after bottling and commercial distribution.

Benefits:

- Rapidly reduces viscosity, improving product workability and stability
- Increases filterability and extractive yield by efficiently releasing soluble components
- Wide operating range of pH (3.5-6.0) and temperature (20-70°C), peak at 60°C
- Direct application with rapid effects already in the early treatment phases
- Compatible with BIO processes, without synthetic preservatives
- Prevents phase separation and sedimentation, improving shelf-life and visual quality
- Increases bioavailable soluble fibers, enhancing nutritional profile



ENDOZYM Protease NP | Protease

Enzyme Type:

Enzymatic preparation based on Neutral Protease obtained through submerged fermentation of a selected strain of *Bacillus subtilis*. It is specific for hydrolysis of plant proteins in cereal transformation processes (flours, doughs, worts, etc.).

Action:

Performs controlled hydrolysis of plant proteins present in cereals, degrading protein complexes into soluble peptides and amino acids. This action contributes to modifying their functional properties. Works in neutral pH environment (6.0 - 7.5) in a temperature range from 45 to 70°C.

Application:

The use of neutral protease in cereal processing helps improve protein solubility and digestibility through controlled hydrolysis. This process can contribute to reducing viscosity of cereal or flour-based doughs, improving plasticity and extensibility, and optimizing nutritional content extraction, enriching the final product profile and ensuring greater colloidal stability during processes.

Benefits:

- Greater digestibility: Improves protein digestibility thanks to hydrolysis into simpler peptides and amino acids
- Process efficiency: Increases filtration and ultrafiltration yields (e.g., in wort or hydrolysate production), reducing process times
- Stability and quality: Ensures prolonged colloidal stability over time, preventing phase separation or cloudiness in liquid products
- Extraction optimization: Optimizes nutritional content extraction from cereals with dosages that may vary based on specific application

SECTOR: CEREALS

ENDOZYM Protease GF | Protease

Enzyme Type:

Enzymatic preparation based on prolyl-endopeptidase (PEP) and neutral protease, obtained through fermentation of selected microorganisms. The enzyme is specifically designed to hydrolyze proline-rich sequences present in protein fractions of gluten-containing cereals, making them soluble and inactive.

Action:

Acts in a targeted manner by cleaving peptide bonds adjacent to proline residues, which are difficult to attack by conventional proteases. This mechanism allows fragmentation of gluten proteins into smaller-sized peptides, eliminating sequences responsible for reactivity and drastically reducing residual gluten content in treated cereal matrices. Optimal activity is expressed under neutral or slightly acidic pH conditions and moderate temperatures, compatible with industrial cereal transformation processes.

Application:

The use of a deglutinating enzyme in generic cereal processing processes allows overcoming criticalities related to gluten presence, which can affect both food safety for sensitive categories and technological stability of products. Deglutination ensures significant reduction of immunoreactive protein fractions, improving quality of transformed matrices. Additionally, it promotes better protein solubilization, increasing filtration efficiency and derivative clarity. This approach expands cereal use possibilities in different food chains, with added value from both nutritional and functional perspectives.

Benefits:

- Effective and controlled reduction of gluten content in cereal-based raw materials and semi-finished products
- Greater safety and product adaptability for broader consumption, in line with specific consumer group needs
- Improvement of technological properties of treated matrices, with positive effects on clarity, filterability, and stability
- Possibility of versatile application in different types of industrial processes, with contained dosages and reduced contact times

ENDOZYM Alphamyl SB1 | Thermostable Amylase

Enzyme Type:

Thermostable alpha-amylase of bacterial origin, obtained from *Bacillus licheniformis*. Active in a wide temperature range (65–90 °C) and pH (5.4–6.5), formulated in liquid form for easy integration into industrial cereal processing processes.

Action:

Catalyses the hydrolysis of starch present in cereals by breaking alpha-1,4-glycosidic bonds and transforming it into maltose, glucose, and soluble dextrins. Thermal stability allows effective action even during high temperature cooking phases, maintaining consistent enzymatic activity.

Application:

Ideal for optimizing cereal treatment, particularly effective with raw materials low in endogenous enzymes. Facilitates the extraction of concentrated carbohydrate solutions and improves the workability of plant material during industrial process phases. Particularly useful for processes requiring conversion of starch into soluble sugarss.

Benefits:

- Rapidly reduces the viscosity of the water-cereal compound, improving fluidity and management of the production process
- Significantly increases extractive yield, ensuring greater availability of soluble sugars from the substrate
- Completely inactivates during the boiling phase, ensuring stability and precise process control

ENDOZYM Alphamyl SB2 | Non-thermostable Amylase

Enzyme Type:

ENDOZYM® Alphamyl SB2 is a liquid preparation whose composition is based on a non-thermostable alpha-amylase. Its enzymatic activities have been isolated from a specific fungal strain, *Aspergillus oryzae*.

Action:

The enzyme exerts a fundamental alpha-amylase action by catalyzing the hydrolysis of starch bonds present in cereal raw materials. This decomposition process transforms starch into simpler compounds, obtaining dextrins and maltose. The action occurs under pH conditions that optimize its functionality.

Application:

This product is essential in the treatment of cereal raw materials for the production of plant-based beverages and is particularly recommended in all cereal processing processes where natural starch conversion is insufficient or when a test indicates the presence of unconverted residual starch in the final product.

Benefits:

- Processing Optimization: The enzyme's activity increases the filterability of the aqueous cereal mixture, a key aspect for the consistency of the liquid base.
- Increased Production Efficiency and Extraction Yield: The improvement in fluidity and processing translates into increased yield and greater production capacity of plants.
- Product Composition Control: The enzyme's activity allows hydrolysis of residual starch, producing dextrins and maltose, which influence the final composition of the product.

AEB  


IZYMES

AEB ENDOZYM®: A SUSTAINABLE CHOICE

Our enzymatic preparations are developed according to the most advanced standards of **sustainability** and **safety**, guaranteeing high performance without compromising quality. Each batch undergoes rigorous quality control and traceability protocols, ensuring purity, consistent activity, and full compliance with international food regulations.

We offer specialized technical consulting services to help you find the path toward **yield optimization**, **stability**, and **operational efficiency of food plants**.

Relying on **AEB enzymes means maximizing raw material valorization while simultaneously reducing energy consumption, water usage, and processing waste.** Adoption of our enzymatic solutions contributes concretely to environmental sustainability and improvement of business competitiveness.

HIGHER SPEED

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water and electricity

LOWER COSTS

LOWER EMISSIONS
pollutants

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CERTIFIED MANAGEMENT SYSTEMS
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UNI EN ISO **9001:2015**
UNI EN ISO **14001:2015**
UNI ISO **45001:2018**
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