KERRY

Biotechnologies technical manual

Technologies for cell culture, fermentation, and diagnostic media

Introduction

For more than 80 years, we have earned our reputation for reliability and excellence in serving the biotech, pharmaceutical and fermentation markets by delivering unsurpassed product value, enhanced opportunities for supply chain consolidation, and new technology innovation.

We bring together our superior products with new innovative solutions and market-driving alternatives to help our customers succeed in today's challenging global marketplace.

Customers benefit from our application expertise and vast global resources of a $6 billion global leader. We have the worldwide resources and global technical platform to deliver consistent, high quality products backed by unparalleled service, technical support and formulation customization capabilities.

At Kerry, we make it our business to exceed your expectations every day. We have strong recognition in the Pharma and Biotech sectors, with a history of scientific references totaling more than 500. Our core technical expertise in bio-technology is combined with continued investment in validation, growth performance, regulatory compliance and application support; all of which enable us to meet the requirements of the pharmaceutical industry. Whether your goal is disease treatment, disease prevention, novel fermentation derivatives, or media innovation, Kerry understands the requirements and is the partner you can depend on. We prove it everyday.
Let us prove it to you.

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Manufacturing processes for protein hydrolysates

Manufacturing center

Kerry protein hydrolysates are manufactured primarily in Norwich (NY), but also Rochester (MN) USA and Utrecht, The Netherlands. The existence of these three sites offers unique flexibility in capabilities and contingency. Our sites are supported by product development groups and state of the art pilot plants to accommodate new development, process optimization and customer-specific projects.

Production standards

Kerry is committed to exceeding the cGMP expectations of our pharmaceutical customer base. We set the highest standards and expectations for our systems, written standard operating procedures (SOPs), and documentation.

Our Sheffield™ Brand protein hydrolysates have an extensive quality control program. Testing is not only done on the final product, but also during the manufacturing process. An overview of our standard testing methods can be found on page 30. In addition to the analysis of chemical and physical parameters, the performance of the hydrolysates in application is included in our quality control program.

Kerry has a dedicated Regulatory Group to ensure product compliance to global regulatory requirements and effective reaction to global developments. Regulatory capabilities include:

Regulatory compliance and documentation

- APHIS inspected and certified
- Sourcing from countries known to be BSE free
- No specified risk materials (SRM) used in a manufacturing facility free of specified risk material (SRM)
- Compliance of milk-derived products to CPMP requirements
- Formal cleaning validation
- Availability of certificate of suitability for meat-derived peptones
- Availability of certificate of origin for all products
- Traceability of raw materials

Supplier documentation

- Raw materials from approved suppliers
- Supplier program
- Kerry required health certificates for animal-derived materials

Customer care support can also assist with:

- Confidentiality agreements
- Import/export documents
- Completion of questionnaires
- Customer audits of the manufacturing facilities

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Protein hydrolysates

Protein hydrolysates are obtained by (enzymatic or acid) hydrolysis of protein. In this process, proteins are digested into smaller fragments via cleavage of the peptide bond (Fig. 1). Protein hydrolysates are also often referred to as peptides or peptones.

Kerry has many years of experience in protein hydrolysis and has built up in-depth knowledge on the control of the hydrolysis process. When combined with our international expertise in fermentation technology and microbiology, this knowledge gives Kerry the ability to produce protein hydrolysates that are optimally targeted for specific applications, providing unique solutions to our valued customers.

The manufacturing of protein hydrolysates involves several strictly controlled processes, including careful selection of the protein raw materials and enzymes (Fig 2).

The properties of a protein hydrolysate are largely determined by:

1. Protein raw material(s) selection
2. Type and amount of enzyme(s)
3. Reaction conditions during hydrolysis
4. Downstream processing after hydrolysis

Typical protein raw materials for the protein hydrolysates include:

- Milk
- Casein
- Whey protein
- Animal derived proteins
- Meat
- Collagen
- Vegetable proteins
- Wheat gluten
- Soy protein
- Rice protein
- Pea protein
- Cotton seed protein

FIG. 1: THE PEPTIDE BOND

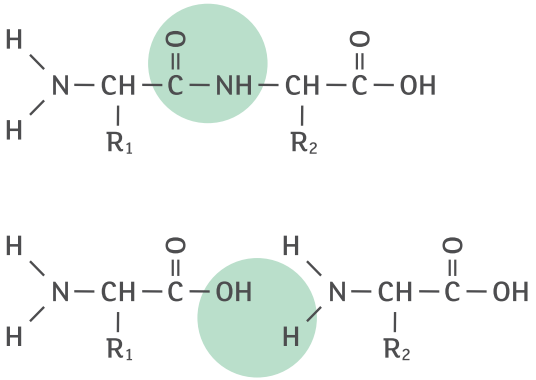
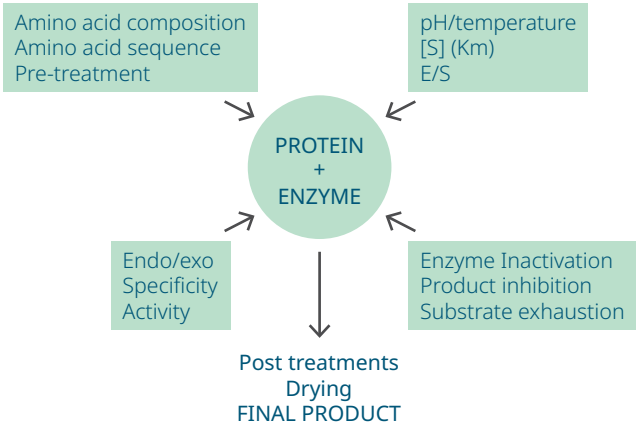


FIG. 2: THE PROTEIN HYDROLYSIS PROCESS



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Manufacturing processes for protein hydrolysates
continued

Protein hydrolysates

For the hydrolysis of these proteins, both endo- and exopeptidases can be used. Endopeptidases cleave internal bonds within the protein chain, and therefore generate (poly) peptides. Exopeptidases hydrolyze proteins and polypeptide chains from the ends of the chain and therefore release predominately amino acids.

The degree of hydrolysis (DH) is a key parameter in the hydrolysis process. It is defined as the percentage of the peptide bonds cleaved, and can be estimated from the ratio between the amino nitrogen (AN) and the total nitrogen (TN). The concentration of free amino acids is also an important parameter. The DH is affected by temperature, pH, time and the concentrations of protein and enzyme. Fig. 3 shows the relationships between the process time, the enzyme-protein ratio and the degree of hydrolysis. Longer hydrolysis and the use of more enzyme result in a higher DH. In-house enzyme research give Kerry the detailed knowledge of these relationships, and allows for tight control of the hydrolysis process. This enables us to make consistent, high quality products to meet our customers' requirements.

After the hydrolysis step, the enzyme is inactivated, and the hydrolysate may be further processed and purified. Industrially applied processes include centrifugation, plate and frame filtration and membrane filtration (Fig. 4). Centrifugation and plate and frame filtration are used to remove insoluble components to obtain a final product with very high clarity (important for diagnostic media) and filterability (important when the product has to be sterile filtered). Membrane filtration can be utilized to remove larger peptides and endotoxins (important for cell tissue culture media). The final process typically consists of drying the hydrolysate. Kerry, however, can also supply concentrated forms of some hydrolysates.

FIG. 3: THE DEGREE OF HYDROLYSIS IS A KEY PARAMETER IN THE HYDROLYSIS PROCESS

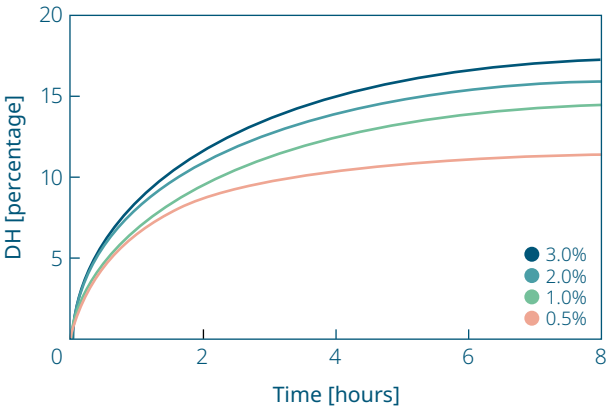
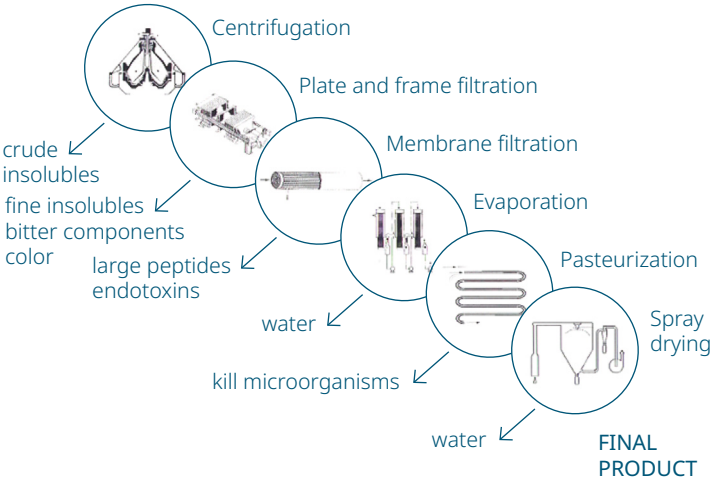


FIG. 4: DOWNSTREAM PROCESSING OF PROTEIN HYDROLYSATES



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Manufacturing processes of yeast for biotech applications

Manufacturing centre

Kerry's yeast specialties and yeast autolysates are derived from primary grown bakers yeast, propagated aerobically under controlled, reproducible conditions in our yeast fermentation plant in Menstrie, Scotland (UK) and Norwich, NY (USA).

Production standards

For more than thirty years, our factory in Menstrie has successfully supplied pharma customers. The standards demanded by our customer base are exceeded through investment in state-of-the-art hygienically designed equipment and control systems. Cleaning regimes have been developed as part of product safety risk assessments (HACCP) and GMP practices have been put in place throughout the manufacturing processes.

The management of GMP and HACCP is driven through strict auditing, monitoring and validation of CCP's and, where demanded, documented cleaning procedures. The quality system has been in place site-wide since the early 1990's and has provided a structure which delivers continuous improvement to all aspects of the Menstrie operation. Currently, the facility is certified to ISO 9001 which encompasses all activities relating to development, manufacturing, supply and delivery.

Our manufacturing facility in Menstrie uses only animal-free raw materials and provides a Kosher Pareve and Halal production range. This certification is achieved through compliance with the leading global assessment bodies.

Production details

Kerry yeast autolysates and extracts ensure optimal performance in the growth of a broad range of industrially significant microorganisms by providing essential peptides, amino acids, vitamins and minerals, as well as a complex mixture of yeast-derived metabolites. The extracts and autolysates from primary grown yeast (sold by Kerry) offer a distinct performance and consistency advantage over secondary, or brewer's yeast extracts. Brewer's yeast extracts (non Kerry) are produced from the waste streams of the brewing industry and thus are derived from a wide variety of yeast strains and fermentation processes.

After propagation, the baker's yeast cells are harvested and washed via centrifugation. The yeast obtained is then further processed into yeast specialties. In the production of autolyzed yeast, the yeast is heated to induce autolysis, pasteurized and roller dried. The dried product can be packaged directly after sieving as a granular/flake type material or milled to obtain a powder. In the production of yeast extracts, autolysis or digestion is followed by the removal of the insoluble components to give a soluble extract; this is concentrated by vacuum evaporation and filtered (where applicable). Products can be supplied as liquid, paste or non-dusting powder, depending on customer requirements.

Applications

People have used micro-organisms for centuries, e.g. to make beer, wine, cheese and bread. In the last century, many new applications have been added, resulting in a broad-based, ever-growing biotechnology industry. Kerry has over 65 years of experience in peptone optimization for a large range of bacteria, yeasts and molds. We have the knowledge and experience to meet the nutrient requirements of the biotechnology industry, and our products have a reputation for consistency and performance in:

- cell culture media
- vaccine media
- pharma fermentation media
- diagnostic media
- classical fermentation media
- stem cell, regenerative medicine

Cell culture media

Protein hydrolysates are routinely employed to enhance the overall performance of many biopharmaceutical production systems, providing a number of different benefits. Cell viability, cell proliferation and target protein production all may be improved. However, these effects might not be observed concurrently in a given system. As every cell culture platform is unique, so are the protein hydrolysates used to supplement the culture medium. Each may have its own distinctive effect on the growth and productivity of transfected cells. The contribution of protein hydrolysates to the system performance can be influenced by a number of factors including the specific cell line being employed, the raw material used to manufacture the hydrolysate, the manufacturing process, the hydrolysate dosage, and the composition of the basal growth medium.

Supplementation of cell culture media with protein hydrolysates can yield a number of benefits. However, due to the complexity of culture dynamics in supplemented systems, a certain degree of thoughtful experimentation is required to determine the appropriate supplementation scheme that will generate the desired balance among growth, cell viability and target protein titer. Once achieved, the proper supplementation regime can significantly enhance the productivity of any given system.

To develop a better understanding of our cell culture products and how they function in a variety of cell culture systems, we opened the Cell Nutrition Innovation Laboratory. With state-of-the-art equipment and in-house expertise, the laboratory is evidence of our growing capabilities, and the increasing scope of our activities. More importantly, it gives us increased capacity to collaborate with customers on medium optimization and supplement customization to provide process and cell line specific solutions.

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Vaccines

Since 1798 when Dr. David Edward Jenner developed the first vaccine against smallpox, the vaccine industry has gone through several ups and downs. Currently, the vaccine market is enjoying an explosive growth due to development of new technologies, increased awareness, expanded markets, and less government restrictions.

Vaccines can be categorized into human and veterinary. They are classified by how they are produced. The FDA classifies vaccines (prophylactic or therapeutic) based on the sources they come from. These sources include animal, viral, or cellular (microbial or animal cells). Animal sources include fertilized chicken eggs. Virus sourced vaccines are grown in cells or tissue culture.

Kerry offers products that can be used in various stages of vaccine production. These include:

1. Antigen generation by growing bacteria in fermentation, growing viruses on primary or continuous cell lines, or expression of recombinant proteins derived from disease causing bacteria or viruses in yeast, bacteria, or cell culture. The most common primary cell line used is Chicken Embryonic Fibroblast (CEF) cell line. Human diploid cell lines such as MRC-5 and WI-38 are also widely used. Transformed cell lines including VERO, MDCK, and BHK are also employed. The most frequently used microbes for recombinant bacterial vaccines are E. coli and S. cerevisiae.
2. Antigen isolation and purification
3. Vaccine formulation, which includes addition of adjuvant, stabilizers, and other excipients.

Kerry provides:

- Protein hydrolysates and yeast extracts for growing microbial, mammalian, and insect cells
- Animal-component-free (ACF) supplements for reduction or elimination of serum
- Protein hydrolysates as stabilizers and diluents in vaccine formulation
- Emulsifiers and surfactants for veterinary vaccine formulation
- Pharma grade multi-compendial lactose for vaccine stabilization

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Applications *continued*

Diagnostic medium

Kerry started producing Sheffield™ brand casein hydrolysates for use in laboratory media in 1940. Since then, many of our high quality peptones have been used in clinical diagnostics and quality control media formulations.

In 2004 we expanded our capabilities with the introduction of a fully equipped diagnostic application laboratory, located in Beloit, WI. The application lab enables us to specifically select and optimize peptones, yeast extracts and combinations for specific media applications (general purpose, chromogenic and blood agar medium) and allows us to optimize new products before we start commercializing them.

Kerry diagnostic media components: Typical characteristics

- Sourcing from countries known to be BSE free
- Low lot-to-lot variability
- High degree of clarity for accurate colony identification
- Unique content of peptides, growth factors, trace elements
- Minimal color contribution to medium
- Free of cytotoxic or hemolytic components
- High solubility
- Near neutral pH values
- Promote steady ionic environment
- Heat stable during autoclaving
- Shelf-life stability

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Pharma fermentation medium

Kerry has a long history of being the number 1 global supplier of nitrogen sources into medium for microbial expression of recombinant proteins. In 1977, N-Z-Amine™ A (enzymatically hydrolysed casein) was used in pioneering work with Charon phages as vectors for cloning DNA in Escherichia coli (Blattner, 1977). Since that time, countless researchers have reported the use of N-Z-Amine™ A in both bench level and large scale production of pharmaceuticals.

Today we are providing peptones in the production and/or feed medium of 50% of the top 12 blockbuster drugs produced by Escherichia coli (data 2009).

Although most commercially available biopharmaceuticals are still manufactured using casein-based peptones, there is a clear trend towards non-animal medium in this market. In the 1940's, Kerry introduced the first non-animal peptones based on soy based raw materials and expanded this product line in the early 90's with yeast extracts and in 2002 with hydrolysates based on pea, rice, wheat gluten and cottonseed raw materials.

In 2005, we opened a GMO application lab where we work with our in-house recombinant model systems an customer strains to optimize their media to reach maximum productivity.

In our application laboratory, we have the resources to initiate and assist customers with media optimization projects. Medium screening studies can be carried out at three levels:

- Quick screening for growth optimization in microtiter plates
- Screening for growth and product formation in O2 and pH-regulated shake flasks
- Translation of shake flask results to fermentors to ensure customer compatibility

Kerry is the only medium ingredients supplier worldwide that manufactures both yeast extracts and peptones. This provides us with the unique opportunity to supply nitrogen source solutions optimized for maximum expression of recombinant product in specific expression systems.

It is our pleasure to complement your own expertise with ours, in designing a superior culture medium for your microbial expression system.

During registration of your new products or biosimilars, our dedicated global Kerry regulatory team is pleased to assist you with the information needed for your registration files.

Applications *continued*

Classical fermentation medium

In many commercial-scale fermentations, complex nitrogen sources are used. These ingredients contain a mixture of amino acids, peptides and proteins that can simultaneously supply a variety of vitamins, growth factors and metals. Dependent on the application, various grades of complex ingredients are preferred. If a microorganism is known to harbor significant proteolytic capabilities, then unhydrolysed proteins might be a good source of nitrogen, whereas less proteolytic organisms prefer more hydrolysed nitrogen sources. Furthermore, the purity of the nitrogen source used has a large effect on the downstream processing of the bioprocess. When the overall production costs are considered, a more expensive ingredient may prove to have a better cost in use effectiveness than a low cost alternative. Factors that influence the cost in use include, but are not limited to: production yield, purification, consistency, storage, transportation, plant productivity and capacity.

Kerry has specifically developed technical grades of yeast extracts (Hy-Yest™ 413) and peptones (Hy-Soy™ T) that have special requirements such as:

- Kosher
- Food grade
- Non allergenic
- Non GMO (IPS)

We are pleased to provide you with the right ingredient for your application.

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Product evolution

New generation of hydrolysates

Traditionally, protein hydrolysates have been produced via the proteolytic digestion of a given raw material, followed by iterative filtration and evaporation steps ultimately yielding a spray-dried powder. Certain factors inherent to this type of processing may have limiting or negative effects on the performance of the final product in eukaryotic cell systems. Historical data have shown a direct link between lot-to-lot variability in product composition, and lot-to-lot variability in hydrolysate performance in cell culture systems.

UltraPep™ protein hydrolysates are manufactured using a novel approach to the digestion and processing of plant-derived raw materials that yields high-quality hydrolysates, with increased lot-to-lot consistency and enhanced performance characteristics, for use in eukaryotic biopharmaceutical production systems.

Animal-Component-Free (ACF) defined supplements

Much success has been achieved using plant-derived protein hydrolysates in combination with other supplements such as albumin, normally derived from FBS or other animal sources. To further meet the challenging needs of the market by enhance performance and consistency, Kerry offers high-quality and cost effective recombinant supplements for the supplementation of cell culture media.

Complete supplement solutions

Leveraging our technical and manufacturing expertise of cell culture medium supplements, our application labs developed carefully optimized formulations to further enhance the performance of a variety of cell lines. These highly optimized systems are rapid cost effective supplements that streamline the screening process and while providing customers with requirement options such as protein free or chemically defined.

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Bio-science product selection

PRODUCT SELECTION: CELL CULTURE

	Cell Lines			
Supplement System	**CHO**	**CHO Fed Batch**	**HEK**	**PerC6**
Bio Production Systems				
Sheff-CHO ACF	✪	●	✪	●
Sheff-CHO Plus ACF	✪	●		●
Sheff-CHO PF ACF	✪	●		●
Sheff-CHO Plus PF ACF	✪	●	✪	●
Sheff-Pulse I		✪		
Sheff-Pulse II		✪		

* Insect cells can be used for bioproduction. We recommend the same products that are used for vaccines in the table below

	Cell Lines									
Supplement System	**HEK**	**VERO**	**PerC6**	**MRC-5**	**BHK**	**CEF**	**MDCK**	**SF-9**	**High-Five**	**S2**
Vaccines										
Sheff-Vax ACF	●	●	✪					✪	✪	✪
Sheff-Vax PF ACF	●	●	✪		✪	✪		✪	✪	✪
Sheff-Vax Plus ACF	●	●	✪	●			✪	✪	✪	✪
Sheff-Vax Plus PF ACF	●	●	✪			✪		✪	✪	✪
Sheff-Vax Plus PF ACF VP	✪	✪	✪	✪	✪	✪	✪	✪	✪	✪
Sheff-Vax PB10					✪	✪				

Chart Key: ● Effective ✪ Most effective

Notes: Plus: includes supplementation with trace elements

PF: protein free

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Product	Cell Lines													
	CHO	CHO Fed Batch	HEK	Hybridoma	VERO	PerC6	MRC-5	BHK	CEF	MDCK	SF-9	High-Five	S2	Stem Cells
Defined Supplements														
Sheffield™ rTrypsin ACF	●*		●*		●	●	●	●*	●	●*	●*	●*		●
Sheffield™ rAlbumin ACF**	✪	●	●	●	●	●	●	●	●	●	●	●	●	●
Sheffield™ rAlbumin LE	●	✪		●	●	●	●	●	●	●	●	●	●	●
Sheffield™ rAlbumin EG														●
Complex Inhibitor														
Sheffield™ TrypStop ACF					●	●	●		●	●				●
Ultra-Filtered, Non-Animal Hydrolysates														
HyPep™ 1510	●	●	●	●	●	●	●	●	●	●				
HyPep™ 1511**		●												
HyPep™ 1512	●	●	●	●	●	●	●		●	●	●			
HyPep™ 4601N	●		●	●	●			●	●					
HyPep™ 5603N**	●			●	●	●	●			●				
HyPep™ 7504	●	●	●	●	●	●	●	●	●	●				●
UltraPep™ Soy**	●	●	●		●	●				●				
Ultra-Filtered Yeast Extracts														
HyPep™ YE	●			●	●	●	●				●	●	●	●
UltraPep™ YE	●	●		●	●		●				●	●	●	●
Primatone™ HS/UF								●	●	●				
Primatone™ RL/UF								●	●	●	●			

Chart Key: ● Effective ✪ Most effective

Notes: CHO: K-1, S, DG44, dhfr-, DXB11
Hybridoma: Myeloma, NSO,SP2/0, NS1
* adherent
** also recommended for Vaccines

Bio-science product selection *continued*

PRODUCT SELECTION: FERMENTATION

We provide total nitrogen sources optimized for your application

Microorganism	Application		Non-Animal																										Dairy & Meat													
			Hy-Express™ System I	Hy-Express™ System II	Hy-Express System IV	Hy-Express System V	Hy-Express System VII	Amisoy™ **	Amisoy™ BF **	Hy-Express™ Peptone I	Hy-Express™ Peptone II	Hy-Pea™ 7404 **	Hy-Soy™ **	Hy-Soy™ T **	N-Z Soy™ BL 4	Hy-Peptone 1007-K	Hy-Peptone 1009-K	Sheff TSA/TSB Complete	Hy-Yest™ 101 **	Hy-Yest™ 412 **	Hy-Yest™ 413 **	Hy-Yest™ 444 **	Hy-Yest™ 455 **	Hy-Yest™ 466 **	Hy-Yest™ 502 **	Hy-Yest™ 503 **	Hy-Yest™ 504 **	Hy-Yest™ 555 **	Sheftone™ R	Amicase™	Hy-Case™ Amino **	Hy-Case™ Sf	N-Z-Amine™ A	N-Z-Amine™ AS	N-Z-Amine™ EKC **	N-Z-Case™ TT	Edamin™ F	Pepticase™	Peptonized Milk	Primatone™ HS	Sheftone™ EK **
Aspergillus	Various													●		●	●	●	●	●	●								●				●						●			
Bacillus	Various	A		✪	✪	✪			●		●		●	●		●	●	●		●	●	●	●	●	●			●	●				●									
Bifidobacterium sp.	Cultures															●	●		●	●	●						●	●							●							
Bordetella pertussis	Vaccines	A											●																				●	●								
Candida albicans	Various												●					●		●													●									
Clostridium sp.	Various												●	●	●	●	●	●															●	●		●	●	●				
Clostridium tetanii	Vaccines												●	●	●	●	●																			●		●				
Corynebacterium diphteriae	Vaccines												●																				●	●								
Escherichia coli	rProtein	A	✪	✪	✪*	✪*	✪			●	●		●*					●		●			●	●		●	●	●					●	●								
Haemophilus influenzae	Vaccines											●	●																				●	●								
Lactobacillus sp.	Cultures											●	●			●	●			●					●		●								●							●
Lactobacillus acidophilus	Probiotics	A																		●					●		●	●														
Lactobacillus plantarum	Cultures	A											●	●		●	●			●					●		●	●							●							●
Lactobacillus casei	Probiotics	A												●		●	●		●		●		●		●			●			●											●
Lactobacillus bulgaricus	Cultures	A											●	●		●	●			●					●		●	●							●							●
Lactococcus lactis sp.	Various	A											●	●		●	●		●				●		●		●	●			●				●					●		
Leuconostoc mesenteroides	Cultures	A						●					●						●	●			●	●●	●		●	●			●											
Micromonospora sp.	Antibiotics																																●					●				
Mycobacterium sp.	Vaccines																																●	●								
Neisseria meningitidis	Vaccines							●					●																				●	●								
Nocardia sp.	Antibiotics												●							●										●		●	●									
Pasteurella sp.	Vaccines																														●		●	●								
Pediococcus pentosaceus	Cultures	A											●	●		●	●		●	●	●						●													●		●
Penicillium sp.	Antibiotics													●		●	●		●		●								●	●			●									
Pichia pastoris	rProtein												●							●		●																					
Pseudomonas sp.	Various												●					●		●													●				●	●		●		
Saccharomyces cerevisiae	rProtein				✪	✪							●							●				●							●		●									
Salmonella sp.	Vaccines																	●				●										●		●	●			●	●			
Shigella sp.	Vaccines																																●	●								
Staphylococcus sp.	Vaccines																	●															●	●			●			●		
Staphylococcus carnosus	Cultures	A											●	●		●	●		●		●				●		●					●				●						
Streptococcus sp.	Various												●					●		●												●		●	●			●				
Streptococcus thermophilus	Cultures	A											●							●						●		●	●						●							
Streptomyces sp.	Various	A				✪							●	●		●	●		●	●	●								●			●	●								●	
Trichoderma	Enzymes													●		●	●			●	●								●				●									
Vibrio cholerae	Vaccines																															●										
Xanthomonas campestris	Xanthan gum												●	●		●	●					●											●									

Chart Key: ● Effective ✪ Most effective * see product info sheet

Notes: ** Kosher and/or IPS version of this product is available

A - Application note available

For more specific strain recommendations, please contact your Account Director.

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PRODUCT SELECTION: DIAGNOSTICS

		Hy-Peptone TSA/TSB ACF	Hy-Soy™	N-Z-Soy™ BL4	Hy-Peptone TSA/CASO	N-Z-Case™ Plus	N-Z-Amine™ AS	N-Z-Case™ M	N-Z-Case™ ME	Peptic ase™	Edamin™ F	Peptonized Milk	Primatone™ RL
B. subtilus[3]	Count[4]	++	+++	+	+++	+++	+++	+++	+++	+++	+++	++	++
	Size[4]	+++	+++	+	++	+++	+	+	+	+	±	+	++
E. coli	Count	+++	+++	+++	+++	+++	+++	+++	++	+++	+++	++	+++
	Size	+++	++	+++	++	++	++	++	++	+	++	++	+++
E. faecalis	Count	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	Size	+++	+++	±	++	++	+	±	±	±	+	+	+
C. albicans	Count	+++	+++	++	+++	+++	+++	++	++	+++	+	+++	+++
	Size	+++	++++	+	+++	+++	++	+	+	±	++	++	++
P. aeruginosa	Count	+++	+++	+++	+++	+++	+++	+++	++	+++	+++	+++	++++
	Size	+++	+++	++++	+++	+++	++	++	++	++	+++	++	+++
S. typhimurium	Count	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	Size	+++	++	++	++	++	++	+	++	+	++	++	+++
S. aureus	Count	++	+	++	+++	+++	++	+++	+++	+++	++	+++	+++
	Size	+++	+	±	++	+++	+	+	+	±	+	++	+++
S. epidermidis	Count	+++	++	++	+++	+++	++	+	+	+	++++	+++	+++
	Size	+++	++	+	+++	++	+	±	±	±	++	++	+++
S. pyogenes	Count	+++	+++	++	+++	+++	++++	++++	+++	+++	+++	+++	++
	Size	++	++	+	++	++	+	+	+	+	++	++	+
S. agalactiae	Count	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	Size	+++	+++	+	++	++	+	+	+	+	++	++	+
S. pneumoniae	Count	++++	+++	+++	+++	+++	+++	+++	+++	+++	++++	+++	+++
	Size	+++	+++	++	++	+++	++	++	+++	++	+++	++	++

CASO-agar (Casein-Soy Agar a.k.a. TSA; Tryptic Soy Agar) was used as reference medium; per test the typical colony diameter and total plate count of the CASO plates were set to 100% for the separate test organisms. The scores are based on a minimum of 8 separate measurements. Samples were tested at a concentration of 2% (with 0.5% NaCl 1.25% Agar Agar; pH adjusted to 7.3 before autoclaving for 15 minutes at 121°C). 1) Bacillus subtilus ATCC6633, Escherichia coli ATCC25922, Enterococcus faecalis ATCC29212, Pseudomonas aeruginosa ATCC27853, Salmonella typhimurium ATCC14028 and Staphylococcus aureus ATCC25923 were cultivated aerobically at 37°C for 24 hours. Candida albicans ATCC10231 and Staphylococcus epidermidis ATCC12228 were cultivated aerobically at 37°C for 48 hours. Streptococcus pyogenes ATCC19615, Streptococcus pneumoniae ATCC6305 and Streptococcus agalactiae ATCC12386 were cultivated under CO2 atmosphere at 37°C for 48 hours on agar plates supplemented with 5% defibrinated sheep blood). 2) - represents no detected growth, ± represents moderate growth (colony size or count up to 25% relative to the reference plates), + represents fair growth (25 to 50%), ++ represents good growth (50 to 80%), +++ represents very good growth (80 to 120%) and ++++ represents excellent growth (more than 120%).

Bio-science product selection *continued*

NON-ANIMAL CHEMICAL AND PHYSICAL PROPERTIES: TYPICAL VALUES

Product	Source	Digestion	AN (%)	TN (%)	AN/ TN ratio	Ash (%)	Moisture (%)	Molecular Weight Distribution (%)					
								>10 kDa	5-10 kDa	2-5 kDa	1-2 kDa	1k-500 Da	<500Da
Supplement Systems													
Sheff-CHO ACF	Various non animal	Enzymatic	---	11	---	8	4.1	26.1	6.5	7.7	10.4	12.5	36.8
Sheff-CHO Plus ACF	Various non animal	Enzymatic	---	7.5	---	6.9	3.5	16.6	5.2	7.4	12	14.8	44.1
Sheff-CHO PF ACF	Various non animal	Enzymatic	---	10.2	---	9.5	4	0	0.6	5.1	14.6	21.1	58.6
Sheff-CHO Plus PF ACF	Various non animal	Enzymatic	---	6.2	---	6.6	3	0	0.9	5.3	13.9	19.6	60.3
Sheff-Pulse I	Various non animal	Enzymatic	---	6.7	---	8.3	6	13.1	6.9	8.1	11.4	13.5	47.0
Sheff-Pulse II	Various non animal	Enzymatic	---	3.5	---	4.5	6	0	0	1.7	9.3	18.1	70.9
Sheff-Vax ACF	Various non animal	Enzymatic	---	9.8	---	10.5	3.4	27.9	5.6	6.3	10.2	13.1	36.9
Sheff-Vax Plus ACF	Various non animal	Enzymatic	---	8	---	6.4	3.2	43.2	6.2	6.4	8.3	9.5	26.4
Sheff-Vax PF ACF	Various non animal	Enzymatic	---	8.8	25	11.6	2.8	0.0	0.2	4.1	14.5	23.5	57.7
Sheff-Vax Plus PF ACF	Various non animal	Enzymatic	---	6.5	---	7.1	4.2	0	0	2.7	15.3	21.6	60.4
Sheff-Vax Plus PF ACF VP	Various non animal	Enzymatic	---	2.9	---	3.2	2	0	0.01	3.7	15.6	21.8	58.8
Hy-Express™ Systems													
Hy-Express™ System I	Various non animal	Enzymatic	3.0	12.0	24.2	9.0	3.7	0.4	2.0	10.4	17.3	20.8	49.1
Hy-Express™ System II	Various non animal	Enzymatic	3.0	13.0	25.0	5.0	4.0	0.0	0.1	2.5	10.4	18.2	68.9
Hy-Express™ System IV	Various non animal	Enzymatic	1.9	9.8	19.7	9.0	6.0	0.0	0.1	4.3	15.2	21.1	59.3
Hy-Express™ System V	Various non animal	Enzymatic	2.4	8.2	29.5	5.8	6.0	0.0	0.0	3.1	14.5	21.4	61.0
Hy-Express™ System VII	Various non animal	Enzymatic	4.9	11.4	43.2	9.2	5.5	0.0	0.8	6.5	14.7	17.0	61.0

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Product	pH	Minerals (%)					
		Calcium	Iron	Magnesium	Phosphorus	Potassium	Sodium
Supplement Systems							
Sheff-CHO ACF	7.1	0.05	0.0040	0.257	0.46	1.9	2.4
Sheff-CHO Plus ACF	6.5	0.03	0.0026	0.186	0.47	1.67	1.63
Sheff-CHO PF ACF	7.1	0.058	0.0035	0.299	0.49	2.22	2.45
Sheff-CHO Plus PF ACF	6.8	0.04	0.0032	0.217	0.47	1.78	1.69
Sheff-Pulse I	6.2	0.07	0.0012	0.481	1.03	1.95	1.63
Sheff-Pulse II	5.6	0.052	0.0000	0.266	0.67	1.3	0.04
Sheff-Vax ACF	7.2	0.0289	0.0034	0.152	0.35	2.51	3.13
Sheff-Vax Plus ACF	7.2	0.018	0.0039	0.0914	0.24	1.45	2.06
Sheff-Vax PF ACF	7.7	0.02	0.0040	0.142	0.41	2.52	3.44
Sheff-Vax Plus PF ACF	7.3	0.0546	0.0033	0.311	0.52	2.22	2.51
Sheff-Vax Plus PF ACF VP	7.3	0.0123	0.00297	0.0398	0.123	0.868	1.13
Hy-Express™ Systems							
Hy-Express™ System I	4.9	0.04	0.009	0.2	1.04	2.2	1.20
Hy-Express™ System II	6.6	0.04	0.0018	0.061	0.951	0.172	1.68
Hy-Express™ System IV	6.2	0.10	0.0053	0.224	1.01	3.02	2.17
Hy-Express™ System V	6.1	0.04	0.0011	0.0329	0.154	0.173	0.946
Hy-Express™ System VII	6.3	0.03	0.005	0.0597	0.836	3.0	1.28

Bio-science product selection *continued*

NON-ANIMAL TOTAL AMINO ACIDS (MG/G): TYPICAL VALUES

Product	Alanine	Arginine	Aspartic Acid	Cysteine	Glutamic Acid	Glycine	Histidine	Isoleucine	Leucine	Lysine
Supplement Systems										
Sheff-CHO ACF	28	46	54	2	156	20	17	16	54	37
Sheff-CHO Plus ACF	17	28	36	1	106	14	10	13	29	21
Sheff-CHO PF ACF	24	53	64	1	191	25	15	23	44	30
Sheff-CHO Plus PF ACF	15	29	39	1	109	15	9	14	25	18
Sheff-Pulse I	18	37	39	N/A	88	12	9	11	24	21
Sheff-Pulse II	7	18	16	1	39	5	4	5	9	6
Sheff-Vax ACF	21	30	49	2	87	16	12	14	36	31
Sheff-Vax Plus ACF	26	30	57	1	100	15	13	13	42	43
Sheff-Vax PF ACF	25	37	66	3	112	24	13	22	38	32
Sheff-Vax Plus PF ACF	20	27	41	0	67	20	11	19	27	26
Sheff-Vax Plus PF ACF VP	8	14	25	0	45	10	5	8	15	13
Hy-Express™ Systems										
Hy-Express™ System I	43	53	84	0	176	27	15	26	46	58
Hy-Express™ System II	25	24	37	N/A	240	20	11	23	44	22
Hy-Express System IV	24	27	59	0	104	16	9	15	28	32
Hy-Express System V	26	38	64	0.7	85	16	16	24	41	30
Hy-Express System VII	24	28	43	0.7	73	19	10	21	35	26

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Product	Methionine	Phenylalanine	Proline	Serine	Threonine	Tyrosine	Valine	Total Amino Acids	Total Free Amino Acids
Supplement Systems									
Sheff-CHO ACF	26	36	37	28	23	25	80	685	50
Sheff-CHO Plus ACF	6	22	28	21	15	14	42	423	59
Sheff-CHO PF ACF	10	32	46	36	23	22	73	712	58
Sheff-CHO Plus PF ACF	5	18	25	21	14	12	49	418	65
Sheff-Pulse I	4	19	16	18	13	9	58	396	92
Sheff-Pulse II	2	8	8	9	5	4	30	176	63
Sheff-Vax ACF	6	19	21	23	19	17	50	453	67
Sheff-Vax Plus ACF	5	26	21	24	20	19	37	492	42
Sheff-Vax PF ACF	7	24	27	29	22	20	24	525	68
Sheff-Vax Plus PF ACF	13	22	23	24	20	19	126	505	46
Sheff-Vax Plus PF ACF VP	3	9	10	13	8	1	79	266	25
Hy-Express™ Systems									
Hy-Express™ System I	9	28	34	37	28	22	92	778	41
Hy-Express™ System II	9	33	68	32	20	20	136	763	72
Hy-Express™ System IV	59	18	19	24	18	15	15	482	145
Hy-Express™ System V	11	30	25	26	21	22	51	528	52
Hy-Express™ System VII	8	24	18	23	20	30	65	468	229

Bio-science product selection *continued*

NON-ANIMAL CHEMICAL AND PHYSICAL PROPERTIES: TYPICAL VALUES

Product	Source	Digestion	AN (%)	TN (%)	AN/ TN Ratio	Ash (%)	Moisture (%)	Molecular Weight Distribution (%)					
								>10 kDa	5-10 kDa	2-5 kDa	1-2 kDa	1k-500 Da	<500Da
Ultra-filtered, Non-Animal Hydrolysates													
HyPep™ 1510	Soy	Enzymatic	2.0	9.2	21.7	9.7	3.6	0.0	0.2	4.6	14.3	22.8	58.1
HyPep™ 1511	Soy	Enzymatic	2.7	13.6	20.0	8.6	2.6	0.1	1.4	10.1	19.7	25.0	43.7
HyPep™ 1512	Soy	Enzymatic	2.2	8.8	25	11.6	2.8	0.0	0.1	3.2	13.5	21.1	62.1
HyPep™ 4601N	Wheat	Enzymatic	2.7	13.4	20.1	2.4	4.2	.17	1.25	5.5	13.1	21.1	58.1
HyPep™ 5603	Rice	Enzymatic	2.3	12.8	18.0	3.9	3.8	0.5	1.6	9.7	19.7	24.6	43.9
HyPep™ 7504	Cotton	Enzymatic	1.9	9.9	19.5	10.7	3.2	0.1	2.0	9.9	19.1	21.9	47.0
UltraPep™ Soy	Soy	Enzymatic	2.5	8.0	31.3	11.0	5.2	0.2	1.4	5.1	12.0	18.4	62.9
Ultra-Filtered Yeast Extracts													
HyPep™ YE	Yeast	Enzymatic	5	10	50	9	4.3	0.0	0.1	3.4	10.2	13.7	72.6
UltraPep™ YE	Yeast	Enzymatic	4.4	9.6	45.8	13	2.9	0.0	0.6	6.0	14.7	19.3	59.4
Hy-Peptone													
Hy-Peptone TSA/TSB (ACF)	Various non animal	Enzymatic	3.0	10.0	30.0	15.0	6.0	0.2	1.2	6.9	15.4	19.4	56.9
Hy-Peptone 1007-K	Various	Enzymatic	3.2	7.9	41.0	10.7	6.0	3.4	6.1	10.6	12.2	14.0	53.7
Hy-Peptone 1009-K	Various	Enzymatic	1.6	5.6	28.1	8.7	6.0	9.3	10.5	12.4	12.2	11.1	44.5
Non-Animal Hydrolysates													
Amisoy™	Soy	Acid	8.6	13.0	66.0	10.1	3.7	0.0	0.0	0.4	4.5	18.5	76.6
Amisoy™ BF	Soy	Acid	6.7	9.3	72.1	14.0	5.0	0.0	0.0	0.9	7.3	16.5	75.3
Hy-Soy™	Soy	Enzymatic	1.9	9.1	21.0	10.7	2.5	0.0	0.3	5.3	16.4	23.5	54.6
Hy-Soy™ T	Soy	Enzymatic	1.8	7.9	22.8	6.6	3.9	0.0	0.2	5.0	16.3	23.8	54.7
N-Z-Soy™ BL4	Soy	Enzymatic	2.7	14.3	18.9	8.2	3.3	0.5	3.1	13.0	20.5	25.2	37.7
Hy-Express™ Peptone I	Various	Enzymatic	2.0	14.0	15.9	5.3	3.0	0.2	1.8	8.1	15.1	21.0	53.8
Hy-Express™ Peptone II	Various	Enzymatic	2.0	12.0	16.8	5.0	6.0	0.1	1.4	8.7	17.4	21.1	51.3
Hy-Pea™ 7404	Pea	Enzymatic	3.0	13.2	23.0	6.1	4.0	0.1	2.6	16.8	27.1	23.6	29.8
Yeast Products													
Hy-Yest™ 101	Yeast	Enzymatic	1.1	8.0	13.9	6.7	3.3	4.0	6.5	9.0	7.9	10.1	62.5
Hy-Yest™ 412	Yeast	Enzymatic	4.9	10.9	44.6	13.0	2.7	0.2	0.1	3.6	14.4	17.2	64.4
Hy-Yest™ 413	Yeast	Enzymatic	3.6	8.7	41.3	8.8	2.8	0.0	0.0	3.2	15.1	18.4	63.3
Hy-Yest™ 444	Yeast	Enzymatic	5.5	11.3	48.7	15.3	4.1	0.0	0.1	3.5	13.1	16.3	67.1
Hy-Yest™ 455	Yeast	Enzymatic	5.2	11.6	44.9	15.3	4.2	0.0	0.1	5.8	15.9	15.1	63.1
Hy-Yest™ 466	Yeast	Enzymatic	5	11.9	42.4	14.1	4.2	0.0	0.1	5.5	15.8	15.1	63.5
Hy-Yest™ 502	Yeast	Enzymatic	2.7	8.9	30.0	15.9	3.1	0.0	0.7	6.3	13.8	18.1	61.1
Hy-Yest™ 503	Yeast	Enzymatic	3.0	9.7	31.4	11.0	2.9	0.3	0.5	6.2	14.3	19.1	59.6
Hy-Yest™ 504	Yeast	Enzymatic	4.1	10.6	39.1	11.0	3.8	0.3	0.6	6.2	14.0	18.0	60.9
Hy-Yest™ 555	Yeast	Enzymatic	3.5	10.8	32.7	14.8	4.4	0.3	1.3	10.5	18.7	17.2	51.9
Sheftone™ Series													
Sheftone™ R	Various	Minimal	1.1	8.8	12.8	8.0	5.4	40.1	10.7	8.3	7.2	5.9	27.9

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Product	pH	Minerals (%)					
		Calcium	Iron	Magnesium	Phosphorus	Potassium	Sodium
Ultra-filtered, Non-Animal Hydrolysates							
HyPep™ 1510	7.2	0.14	0.0004	0.28	0.03	3.40	3.30
HyPep™ 1511	7.0	0.03	0.0	0.02	0.25	0.70	4.04
HyPep™ 1512	7.7	0.02	0.004	0.142	0.41	2.52	3.44
HyPep™ 4601N	6.5	0.04	0.0014	0.039	0.17	0.16	1.03
HyPep™ 5603	6.3	0.13	0.0002	0.003	0.21	2.10	1.20
HyPep™ 7504	7.1	0.03	0.004	0.15	2.86	3.47	3.79
UltraPep™ Soy	6.4	0.06	0.003	0.31	1.05	3.63	1.68
Ultra-Filtered Yeast Extracts							
HyPep™ YE	6.1	0.02	0.0061	0.051	1.02	3.21	1.50
UltraPep™ YE	6.7	0.25	0.0016	0.27	1.63	3.56	2.33
Hy-Peptone							
Hy-Peptone TSA/TSB (ACF)	7.0	0.04	0.0028	0.141	0.93	3.2	2.8
Hy-Peptone 1007-K	4.4	0.08	0.0186	0.81	2.46	3.51	0.95
Hy-Peptone 1009-K	4.4	0.12	0.0107	0.59	1.5	2.61	0.35
Non-Animal Hydrolysates							
Amisoy™	5.8	2.00	0.0009	0.16	0.01	0.14	0.20
Amisoy™ BF	5.9	2.00	-	0.16	-	0.14	0.20
Hy-Soy™	7.1	0.20	0.006	0.25	0.27	3.00	2.70
Hy-Soy™ T	6.0	0.37	0.008	0.29	0.75	2.36	1.78
N-Z-Soy™ BL4	4.8	1.37	0.003	0.04	0.14	0.15	0.93
Hy-Express™ Peptone I	5.1	0.30	0.00018	0.004	0.023	0.04	0.13
Hy-Express™ Peptone II	5.2	0.06	0.0094	0.048	0.51	0.17	1.58
Hy-Pea™ 7404	4.7	0.30	0.02	0.02	0.69	0.40	1.70
Yeast Products							
Hy-Yest™ 101	6.4	0.15	0.0262	0.24	1.31	2.72	0.04
Hy-Yest™ 412	5.6	0.20	0.0004	0.03	3.10	3.60	1.70
Hy-Yest™ 413	7.1	0.12	0.0124	0.16	1.98	2.34	0.89
Hy-Yest™ 444	6.7	0.02	0.003	0.13	3.23	3.10	3.58
Hy-Yest™ 455	5.5	0.21	0.074	0.20	1.25	2.21	2.44
Hy-Yest™ 466	5.6	0.15	0.064	0.15	0.96	1.82	1.51
Hy-Yest™ 502	5.3	0.22	0.0156	0.268	1.89	3.17	4.59
Hy-Yest™ 503	5.1	0.17	0.0146	0.275	1.74	3.47	1.01
Hy-Yest™ 504	5.2	0.144	0.01	0.262	2.15	3.19	1.03
Hy-Yest™ 555	5.6	0.25	0.052	0.16	1.00	2.20	1.83
Sheftone™ Series							
Sheftone™ R	4.9	N/A	N/A	N/A	N/A	N/A	N/A

Bio-science product selection *continued*

NON-ANIMAL TOTAL AMINO ACIDS (MG/G): TYPICAL VALUES

Product	Alanine	Arginine	Aspartic Acid	Cysteine	Glutamic Acid	Glycine	Histidine	Isoleucine	Leucine	Lysine
Ultra-filtered, Non-Animal Hydrolysates										
HyPep™ 1510	26	41	73	4	122	25	14	23	40	38
HyPep™ 1511	30	62	92	1	166	29	17	28	53	52
HyPep™ 1512	25	37	66	3	112	24	13	22	38	32
HyPep™ 4601N	21	27	24	11	319	27	15	32	57	11
HyPep™ 5603	48	72	81	8	174	37	20	34	66	35
HyPep™ 7504	27	71	58	4	113	26	14	18	33	21
UltraPep™ Soy	19	30	51	0	79	13	9	19	30	33
Ultra-Filtered Yeast Extracts										
HyPep™ YE	40	30	69	0	113	23	10	30	44	54
UltraPep™ YE	35	42	64	0	127	22	10	24	40	44
Hy-Peptone										
Hy-Peptone TSA/TSB (ACF)	35	37	62	1	186	23	11	24	41	39
Hy-Peptone 1007-K	32	22	36	2	70	18	9	17	33	25
Hy-Peptone 1009-K	20	14	21	0	48	12	6	10	22	11
Non-Animal Hydrolysates										
Amisoy™	51	66	82	N/A	176	33	15	36	61	54
Amisoy™ BF	38	46	69	N/A	126	23	12	30	49	45
Hy-Soy™	23	37	74	1	123	22	13	20	38	39
Hy-Soy™ T	25	44	74	1	119	20	13	21	41	42
N-Z-Soy™ BL4	30	65	90	0	170	35	17	25	50	106
Hy-Express™ Peptone I	27	50	65	N/A	259	25	17	29	56	42
Hy-Express™ Peptone II	23	48	55	0	221	25	15	24	51	34
Hy-Pea™ 7404	38	69	82	4	140	28	17	24	51	59
Yeast Products										
Hy-Yest™ 101	35	23	45	2	81	20	9	39	31	32
Hy-Yest™ 412	49	31	63	3	102	27	12	29	43	46
Hy-Yest™ 413	28	24	46	0	71	15	8	20	30	40
Hy-Yest™ 444	45	29	64	0	138	27	12	29	42	44
Hy-Yest™ 455	40	21	45	0	72	19	9	23	33	37
Hy-Yest™ 466	47	23	52	0	81	23	11	26	39	43
Hy-Yest™ 502	40	24	54	3	100	25	10	20	32	37
Hy-Yest™ 503	41	27	59	5	114	27	10	22	34	41
Hy-Yest™ 504	41	27	56	1	104	21	10	22	33	45
Hy-Yest™ 555	50	24	48	0	119	23	8	18	30	38

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Product	Methionine	Phenylalanine	Proline	Serine	Threonine	Tyrosine	Valine	Total Amino Acids	Total Free Amino Acids
Ultra-filtered, Non-Animal Hydrolysates									
HyPep™ 1510	7	26	28	31	24	21	25	568	45
HyPep™ 1511	10	33	37	41	29	26	65	767	28
HyPep™ 1512	7	24	27	29	22	20	24	525	68
HyPep™ 4601N	12	46	115	38	21	29	32	835	63
HyPep™ 5603	15	43	38	44	31	43	49	838	14
HyPep™ 7504	7	30	20	26	20	19	26	533	34
UltraPep™ Soy	2	20	39	21	17	17	19	418	96
Ultra-Filtered Yeast Extracts									
HyPep™ YE	9	26	24	30	28	14	99	641	319
UltraPep™ YE	8	25	21	29	24	16	72	601	208
Hy-Peptone									
Hy-Peptone TSA/TSB (ACF)	8	26	33	31	23	18	53	651	177
Hy-Peptone 1007-K	7	17	26	20	20	38	105	497	110
Hy-Peptone 1009-K	4	11	19	13	10	8	133	363	77
Non-Animal Hydrolysates									
Amisoy™	10	42	45	22	18	30	88	828	486
Amisoy™ BF	8	29	31	18	16	19	56	615	424
Hy-Soy™	5	26	29	32	22	18	22	542	63
Hy-Soy™ T	8	27	28	29	22	21	76	609	35
N-Z-Soy™ BL4	9	34	39	46	27	25	75	843	20
Hy-Express™ Peptone I	10	40	76	42	26	28	130	919	19
Hy-Express™ Peptone II	8	41	61	38	22	27	69	762	30
Hy-Pea™ 7404	6	32	28	40	28	26	27	699	7
Yeast Products									
Hy-Yest™ 101	6	18	17	23	23	14	23	441	54
Hy-Yest™ 412	9	25	22	28	28	21	35	573	255
Hy-Yest™ 413	5	18	36	19	19	18	23	421	86
Hy-Yest™ 444	9	24	23	26	27	18	33	590	299
Hy-Yest™ 455	9	20	16	22	23	15	25	429	200
Hy-Yest™ 466	10	23	18	26	26	18	29	495	295
Hy-Yest™ 502	7	18	19	20	21	15	25	470	107
Hy-Yest™ 503	5	20	20	26	27	14	26	518	95
Hy-Yest™ 504	7	22	21	24	23	35	27	521	142
Hy-Yest™ 555	6.5	17	16	24	24	12	22	479	133

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Bio-science product selection *continued*

DAIRY & ANIMAL CHEMICAL AND PHYSICAL PROPERTIES: TYPICAL VALUES

Product	Source	Digestion	AN (%)	TN (%)	AN/ TN Ratio	Ash (%)	Moisture (%)	Molecular Weight Distribution (%)					
								>10 kDa	5-10 kDa	2-5 kDa	1-2 kDa	1k-500 Da	<500Da
Supplement Systems													
Sheff-Vax PB10	Various	Enzymatic	3	7	---	32	6	0	0.5	3.9	9.3	17.2	69.1
Hy-Peptone													
Hy-Peptone TSA-CASO	Various	Enzymatic	4.4	12.0	36.8	9.8	6.0	0.0	0.4	3.6	11.6	23.7	60.7
Dairy Hydrolysates													
Amicase™	Casein	Acid	9.5	13.4	70.5	1.9	2.8	0.0	0.0	0.1	3.8	22.9	73.3
Hy-Case™ Amino	Casein	Acid	6.6	8.5	77.0	34.9	2.4	0.0	0.0	0.0	3.0	20.8	76.1
Hy-Case™ M	Casein	Acid	5.5	8.0	68.8	37.3	2.4	0.0	0.0	0.1	5.5	21.3	73.1
Hy-Case™ SF	Casein	Acid	10.6	13.6	77.6	0.4	2.9	0.0	0.0	0.0	2.7	30.2	67.1
N-Z-Amine™ A	Casein	Enzymatic	6.4	13.1	49.0	5.4	3.4	0.0	0.0	0.7	5.3	17.3	76.7
N-Z-Amine™ AS	Casein	Enzymatic	6.2	13.4	46.5	5.2	3.5	0.0	0.0	0.7	6.2	20.6	72.4
N-Z-Amine™ EKC	Casein	Enzymatic	3.7	13.3	28.0	5.1	4.5	0.0	0.0	1.0	6.6	20.5	71.9
N-Z-Case™ M	Casein	Enzymatic	4.9	13.4	36.2	6.5	3.1	0.0	0.0	2.4	9.8	28.6	59.2
N-Z-Case™ ME	Casein	Enzymatic	4.4	13.8	32.2	5.5	3.4	0.0	0.2	6.4	12.5	26.5	54.5
N-Z-Case™ Plus	Casein	Enzymatic	6.5	13.3	49.3	5.6	3.3	0.0	0.1	4.0	7.6	17.8	70.5
N-Z-Case™ TT	Casein	Enzymatic	5.3	13.3	39.6	5.6	3.2	0.0	0.0	1.5	7.6	24.1	66.9
Pepticase™	Casein	Enzymatic	4.1	13.2	31.4	9.7	3.3	0.0	0.0	4.2	12.0	27.5	56.3
Edamin™ F	Lactalbumin	Enzymatic	4.7	12.6	37.7	5.5	2.8	0.0	0.0	2.3	11.1	25.4	61.2
Peptonized Milk	Milk Solids	Enzymatic	1.7	5.7	29.8	7.5	3.9	0.0	0.2	4.6	11.7	23.8	59.7
Animal Hydrolysates													
Primatone™ HS	Meat	Enzymatic	4.6	12.5	36.8	12.3	2.6	2.2	4.0	9.7	11.4	15.1	57.6
Primatone™ HS/UF	Meat	Enzymatic	5.1	12.2	41.9	12.8	3.3	0.2	1.4	6.9	11.8	16.7	63.1
Primatone™ RL	Meat	Enzymatic	5.6	12.1	46.4	13.5	2.8	0.3	1.1	3.4	6.5	16.0	72.8
Primatone™ RL/UF	Meat	Enzymatic	5.9	11.8	49.6	13.8	2.6	0.0	0.3	2.2	5.8	15.7	76.0
Sheftone™ Series													
Sheftone™ EK	Various	Minimal	1.4	5.9	23.1	10.0	4.0	11.0	11.0	9.0	10.6	9.8	48.5

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Product	pH	Minerals (%)					
		Calcium	Iron	Magnesium	Phosphorus	Potassium	Sodium
Supplement Systems							
Sheff-Vax PB10	7.0	0.0252	0.0013	0.0198	1.52	3.0	9.32
Hy-Peptone							
Hy-Peptone TSA-CASO	6.9	0.03	0.0015	0.08	1.03	0.85	3.19
Dairy Hydrolysates							
Amicase™	6.6	0.03	-	0.002	0.03	0.01	0.99
Hy-Case™ Amino	5.7	0.03	0.001	0.03	-	0.02	14.40
Hy-Case™ M	6.9	0.02	0.001	0.01	0.48	0.07	13.70
Hy-Case™ SF	6.4	0.03	<0.0004	0.01	0.05	0.01	0.31
N-Z-Amine™ A	6.8	0.02	0.003	0.01	0.89	0.08	2.56
N-Z-Amine™ AS	6.8	0.04	0.004	0.02	0.97	0.08	2.49
N-Z-Amine™ EKC	6.8	0.04	0.002	0.02	0.76	0.22	1.69
N-Z-Case™ M	7.2	0.03	0.002	0.02	0.96	0.09	2.20
N-Z-Case™ ME	7.2	0.03	0.001	0.005	0.83	0.04	2.82
N-Z-Case™ Plus	6.8	0.03	0.002	0.1	0.82	0.13	1.40
N-Z-Case™ TT	7.2	0.02	0.003	0.006	0.76	0.09	2.30
Pepticase™	7.2	0.03	0.001	0.02	1.52	0.03	3.34
Edamin™ F	6.9	0.14	0.0029	0.035	0.52	0.41	2.26
Peptonized Milk	6.3	1.23	0.004	0.19	1.02	1.71	0.53
Animal Hydrolysates							
Primatone™ HS	7.3	0.03	0.004	0.04	0.65	1.50	4.92
Primatone™ HS/UF	7.1	0.03	0.002	0.03	0.69	1.39	5.15
Primatone™ RL	7.3	0.03	0.004	0.04	0.85	1.78	5.31
Primatone™ RL/UF	7.3	0.01	0.022	0.02	1.09	1.45	5.45
Sheftone™ Series							
Sheftone™ EK	4.9	0.46	0.0116	0.604	1.89	2.95	0.42

Bio-science product selection *continued*

DAIRY & ANIMAL TOTAL AMINO ACIDS (MG/G): TYPICAL VALUES

Product	Alanine	Arginine	Aspartic Acid	Cysteine	Glutamic Acid	Glycine	Histidine	Isoleucine	Leucine	Lysine
Supplement Systems										
Sheff-Vax PB10	32	31	51	3	119	32	16	30	55	51
Hy-Peptone										
Hy-Peptone TSA-CASO	23	36	59	0	167	20	21	36	62	56
Dairy Hydrolysates										
Amicase™	63	42	35	NA	175	22	27	57	88	104
Hy-Case™ Amino	25	22	44	NA	140	11	14	30	53	58
Hy-Case™ M	16	21	44	NA	135	10	14	27	49	54
Hy-Case™ SF	48	41	52	NA	151	18	25	52	92	109
N-Z-Amine™ A	23	31	58	0	170	13	19	40	76	72
N-Z-Amine™ AS	25	34	63	0	187	14	21	41	68	80
N-Z-Amine™ EKC	24	32	60	0	176	13	20	36	69	73
N-Z-Case™ M	24	35	59	1	180	15	21	41	71	73
N-Z-Case™ ME	26	35	67	1	196	14	21	42	69	81
N-Z-Case™ Plus	25	34	58	1	171	15	20	40	70	71
N-Z-Case™ TT	23	33	59	1	178	13	21	38	73	77
Pepticase™	24	35	60	1	178	15	18	38	73	74
Edamin™ F	26	24	68	0	139	12	14	38	66	68
Peptonized Milk	18	21	41	0	103	16	11	21	42	37
Animal Hydrolysates										
Primatone™ HS	51	45	73	1	117	57	17	26	59	66
Primatone™ HS/UF	43	29	60	0	106	45	14	23	53	111
Primatone™ RL	47	43	68	0	92	35	23	19	66	68
Primatone™ RL/UF	49	39	73	0	105	34	22	21	63	74

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Product	Methionine	Phenylalanine	Proline	Serine	Threonine	Tyrosine	Valine	Total Amino Acids	Total Free Amino Acids
Supplement Systems									
Sheff-Vax PB10	16	27	56	32	27	14	38	630	215
Hy-Peptone									
Hy-Peptone TSA-CASO	19	40	71	43	32	21	94	800	210
Dairy Hydrolysates									
Amicase™	29	46	130	21	27	37	73	977	655
Hy-Case™ Amino	15	28	63	24	20	10	39	596	418
Hy-Case™ M	14	26	59	32	23	16	36	577	540
Hy-Case™ SF	26	42	117	36	33	20	87	948	703
N-Z-Amine™ A	17	37	122	40	32	49	48	847	414
N-Z-Amine™ AS	12	40	95	44	35	50	53	861	401
N-Z-Amine™ EKC	7	41	94	43	33	42	48	811	109
N-Z-Case™ M	17	40	88	45	35	17	58	819	234
N-Z-Case™ ME	10	43	95	47	36	19	51	854	186
N-Z-Case™ Plus	13	40	91	45	34	46	49	823	382
N-Z-Case™ TT	17	43	96	40	34	62	45	852	244
Pepticase™	12	42	93	44	33	87	47	873	132
Edamin™ F	16	27	55	37	39	17	145	791	256
Peptonized Milk	10	22	36	28	19	23	115	563	38
Animal Hydrolysates									
Primatone™ HS	13	28	44	34	30	14	24	698	261
Primatone™ HS/UF	12	27	35	31	27	16	110	743	280
Primatone™ RL	12	33	30	33	31	18	44	661	401
Primatone™ RL/UF	12	32	30	35	32	21	44	686	366

Appendix

Methods used to determine typical data

Degree of Hydrolysis

The degree of hydrolysis was estimated by the AN/TN ratio. Total Nitrogen (TN) values were determined using a Dumas or Kjehldahl method (2). The concentrations of alpha-amino nitrogen (AN) was determined by the formaldehyde titration method described in the U.S. Pharmacopoeia (1). The ratio of AN/TN is an estimate of the degree of hydrolysis of the protein.

Amino Acids

Total amino acids were determined with an HPLC after acid hydrolysis. With this method tryptophan is completely destroyed. Cysteine is partly destroyed and is reported as the dimer cystine. Glutamine and asparagine are converted into glutamic acid and aspartic acid respectively.

Ash

Ash values were measured after heating at 650 °C.

> Details of each analytical method are available upon request.

> The product specification does not necessarily include all above described analysis.

Moisture

The moisture level was determined as the loss on drying upon heating at 100-103 °C.

Minerals

Minerals were determined with ICP.

pH

The pH was measured in a 2% solution at 25 °C.

Molecular Weight Distribution

The molecular weight distribution was determined by HPLC/Size Exclusion Chromatography using acetonitrile/water eluent and absorbance at 220 nm for detection. It should be noted that other methods will yield different results therefore these values should only be used to compare products utilizing the same method. Molecular weight distribution was determined of the soluble fraction of the sample only.

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List of microorganisms

Organism	Product	Application	References
Absidia glauca	Edamin™	oxygenation of steroids	15
Achyla ambisexualis	Edamin™	growth medium	123
Achyla heterosexualis	Edamin™	growth medium	119
Actinomadura ferruginea	N-Z-Amine™ A	production of antitumor antibiotic	629
	N-Z-Case™	production of antitumor antibiotic	629
Actinomadura hibisca	N-Z-Amine™ A	production of antibiotics	478, 483-484
	N-Z-Case™	production of antibiotics	478, 483-484
Actinomadura kijaniata	N-Z-Amine™ A	synthesis of antibiotics	223
Actinomadura luzonensis	N-Z-Amine™ A	antibiotic production	205
Actinomadura madurae	N-Z-Amine™ A	production of antibiotics	450, 476
Actinomadura melliaura	N-Z-Amine™	antibiotic production	357
Actinomadura oligospora	N-Z-Amine™ A	antibiotic production	434, 436
Actinomadura sp	N-Z-Amine™	production of antibiotics	323
	N-Z-Amine™ A	antibiotic production	448, 482, 503
	N-Z-Case™	antibiotic production	367
	Peptonized Milk	antibiotic production	367
Actinomadura verrucosopora	N-Z-Amine™ A	antibiotic production	366, 412
	N-Z-Case™	antibiotic production	366, 412
Actinomyces griseus	N-Z-Amine™	production of Streptomycin	11, 13
Actinomycete spp.	N-Z-Amine™ A	growth medium	394
Actinoplanacete sp.	Hy-Case™ SF	fermentation medium	507, 529, 558
Actinoplanes sp.	Hy-Case™ SF	fermentation medium	540, 556
	N-Z-Amine™ A	growth medium	428
Actinopolyspora sp.	Amicase™	growth medium, antibiotic production	620
	Hy-Soy™	growth medium, antibiotic production	620
	N-Z-Amine™ A	growth medium, antibiotic production	620
Actinosynnema mirum	N-Z-Amine™	growth medium	175
Aerobacter aerogenes	N-Z-Amine™	hydrolysis of penicillins	63
Aeromonas punctata	Edamin™ S	production of L-serine dehydratase	154
	Hy-Case™ SF	production of L-serine dehydratase	154
	N-Z-Amine™ A	production of L-serine dehydratase	154
	N-Z-Amine™ AS	production of L-serine dehydratase	154
	Primatone™	production of L-serine dehydratase	154
Agrobacterium tumefaciens	N-Z-Case™	cobalamin production	463
Alcaligenes faecalis	N-Z-Amine™	hydrolysis of penicillins	63
	N-Z-Amine™	production of vitamin B12	30
Alcaligenes sp	N-Z-Amine™ A	kalimantacin production	589
Amorphosporangium globisporum	N-Z-Amine™ A	growth medium	272
Amycolata sp.	Amicase™	growth medium, antibiotic production	620
	Hy-Soy™	growth medium, antibiotic production	620
	N-Z-Amine™ A	growth medium, antibiotic production	620
Aspergillus fumigatus	N-Z-Amine™ A	production of farnesyltransferase inhibitor	584
Aspergillus nidulans	N-Z-Amine™ A	antibiotic production	240
	N-Z-Case™	antibiotic production	240
Aspergillus niger	N-Z-Amine™ A	growth medium	392
Aspergillus rugulosus	N-Z-Amine™ A	production of antifungal agent	165
	N-Z-Case™	production of antifungal agent	165
Aspergillus spp.	Edamin™	growth medium	25
	N-Z-Amine™	growth medium	25
Aspergillus tamarii	Hy-Soy™ T	antibiotic production	147, 162
	N-Z-Amine™ A	antibiotic production	147, 162
Aspergillus terreus	N-Z-Amine™	production of a hypocholesteremic	225, 241, 275, 277
	Peptonized Milk	production of a hypocholesteremic	225, 241, 275, 277
Aspergillus variecolor	N-Z-Amine™ A	production of variecolin	527
Aureobasiduim pullulans	N-Z-Amine™ A	growth medium	392
Bacillus cereus	Hy-Case™ SF	growth medium	183
Bacillus pumilis	N-Z-Case™	production of antiviral agent	480
	Pepticase™	production of peroxidase	530, 624
Bacillus sp.	Primatone™	production of alternanase	614
Bacillus sphaericus	Peptonized Milk	growth medium	412
Bacillus subtilis	Hy-Soy™ T	growth medium	634, 655
	N-Z-Amine™	growth medium	309

List of microorganisms *continued*

Organism	Product	Application	References
Bacillus thuringiensis	Amisoy™	production of antibiotics	550
	N-Z-Amine™ A	production of antibiotics	313
Bacteroides fragilis	N-Z-Amine™ A	growth medium	398
Bifidobacterium infantis	N-Z-Amine™ A	growth medium	635
	N-Z-Case™ Plus	growth medium	635
Bifidobacterium longum	N-Z-Amine™ A	growth medium	635
	N-Z-Case™ Plus	growth medium	635
Bortedella bronchiseptica	N-Z-Amine™ AS	vaccine stabilization	383
Bortedella pertussis	Hy-Pep™	production of toxin	689
	Hy-Soy™	cultivating pathogenic bacteria	618
	N-Z-Amine™	hydrolysis of penicillins	63
Botryosphaeria spp.	Edamin™	hydroxylation of steroids	408
Botyrodiplodia theobromae	Edamin™	hydroxylation of steroids	408
Brevibacterium spp.	N-Z-Amine™	production of tryptophan	413
	Pepticase™	mononitrilase production	395
Brucella abortus	N-Z-Amine™ A	growth medium	398
Candida albicans	N-Z-Amine™ A	growth medium	398
Caryophanon latum	Edamin™	growth medium	80
Catenuloplanes japonicus	N-Z-Amine™ A	growth medium	310
Cephalosporium sp.	Edamin™	production of cephalosporin	355
Chainia spp.	N-Z-Amine™ A	growth medium	428
Chromobacterium violaceum	N-Z-Amine™ A	antibiotic production	234, 257
Citrobacter freundii	N-Z-Amine™ A	synthesis of colicins	230
Cladobotryum varium	N-Z-Amine™ A	antibiotics production	662
Clostridium acetobutylicum	Hy-Case™	production of acetone and butanol	553
Clostridium botulinum	Edamin™ S	growth medium	79
	Hy-Soy™	growth medium	79
	N-Z-Amine™ A	protease involved in toxin production	491
Clostridium diphteriae	HyPep™ 5603	production of toxin	689
Clostridium novyi	N-Z-Amine™ A	growth medium	398
Clostridium perfringens	Edamin™ S	growth medium	79
	Hy-Soy™	growth medium	79
	N-Z-Amine™	growth medium	401
	N-Z-Amine™ A	growth medium	398
	N-Z-Amine™ YT	growth medium	43
	N-Z-Case™	growth medium	393
Clostridium sporogenes	Edamin™ S	growth medium	79
	Hy-Soy™	growth medium	79
Clostridium tertium	N-Z-Amine™ A	growth medium	38
Clostridium tetani	Amisoy™	production of tetanus toxin in animal free media	658
	HyPep™ 5603	production of toxin	689
	HyPep™ 4601	production of toxin	689
	Hy-Soy™	production of tetanus toxin in animal free media	658, 687, 688, 690
	Hy-Soy™ T	production of tetanus toxin in animal free media	658
	N-Z-Case™	production of tetanus toxin	7,12, 18, 27,49, 658
	N-Z-Case™ TT	production of tetanus toxin in animal free media	658, 687
	N-Z-Soy™	production of tetanus toxin in animal free media	658
	NZ-Soy	cultivating pathogenic bacteria	618
	N-Z-Soy™ BL 4	production of tetanus toxin in animal free media	658
	N-Z-Soy™ BL 7	production of tetanus toxin in animal free media	658
	Pepticase™	production of tetanus toxin	7,12, 18, 27,49
Conidiobolus coronatus	Edamin™	synthesis of diphtheria toxins	552
Coniothyrium fuckelii	Amicase™	production of iovastin	577
Corynebacterium diphtheriae	Hy-Soy™	cultivating pathogenic bacteria	618
	N-Z-Amine™ A	synthesis of diphtheria toxins	1, 67, 111
Corynebacterium fascians	N-Z-Amine™	hydrolysis of penicillins	63
Crithidia fasciculata	N-Z-Amine™ AS	assay for biopterin	115, 124, 213
Crithidia spp.	N-Z-Amine™ AS	growth medium	117
Dactylosporangium spp.	N-Z-Amine™ A	growth medium	428
Dermatophilus spp.	N-Z-Amine™ A	growth medium	69
Dictyostelium discoideum	N-Z-Case™	growth medium	430
Dictyostelium mucoroides	N-Z-Case™	growth medium	430
Diplococcus pneumoniae	N-Z-Amine™ A	growth medium	398

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Elactomyces cylindrosporae	N-Z-Case™	antibiotic production	369
Empedobacter haloabium	N-Z-Case™	antibiotic production	326
Erwinia aroideae	Hy-Soy™ T	synthesis of L-asparaginase	92
Escherichia coli	Amisoy™	production of glycerol	616
	Amisoy™	DNA vaccine production	648
	Edamin™ S	synthesis of galactosidase	390
	Hy-Case™ Amino	growth medium	390
	Hy-Case™ Amino	production of human growth hormone	504
	Hy-Case™ M	production of human growth hormone	504
	Hy-Case™ SF	production of lysine (arginine) decarboxylase	20-22, 50, 109
	Hy-Case™ SF	antibody production with plasmid host cells	676
	HyPep™ 4601	DNA vaccine production	648
	Hy-Rice™ 5303	DNA vaccine production	648
	Hy-Soy™	growth medium	429, 625-626
	Hy-Yest™ 412	growth medium for plasmid host cells	666,653
	N-Z-Amine™ A	production of swine growth hormone	452
	N-Z-Amine™ A	genetic studies	161, 177-178, 188-189, 203, 210, 229, 260-261, 265-270, 284, 288-290, 328, 372-374, 377, 416, 418, 426, 443, 445-446, 455-456, 460, 462, 464, 473, 489-490, 492-494, 496-497, 499
	N-Z-Amine™ A	growth medium	596
	N-Z-Amine™ A	synthesis of bovine growth hormone	449
	N-Z-Amine™ A	synthesis of colicins	230
	N-Z-Amine™ AS	growth medium in the production of polypeptides	651
	N-Z-Case™	genetic studies	66, 99
	N-Z-Case™	mutation studies	39
	N-Z-Case™ Plus	growth medium for plasmid host cells	666
Frankia spp.	N-Z-Amine™ A	growth medium	254
Fungal sp.	N-Z-Amine™	production of cellulases	414
	N-Z-Case™	production of cellulases	414
Fusobacterium necrophorum	N-Z-Amine™ A	growth medium	398
Geodermatophilus obscurus	N-Z-Amine™ A	growth medium	68
Glycomyces harbinensis	N-Z-Amine™ A	antibiotic production	409
Haemopbilus influenzae	Hy-Soy™	growth medium	354
	N-Z-Amine™ A	growth medium	398
Halobacterium halobium	Hy-Case™ SF	growth medium	244
Halobacterium saccharovorum	Hy-Case™ SF	growth medium	244
Halobacterium spp.	Hy-Case™ SF	growth medium	96, 360, 399
Haloferax denitrificans	Hy-Case™ SF	Nitrite reductase preparation	597
Heliobacter pylori	Hy-Soy™	cultivating pathogenic bacteria	618
	N-Z-Soy™	cultivating pathogenic bacteria	618
Helminthosporium sativum	N-Z-Amine™ A	production of cochlioquinone	477
Herpes virus (Marek's Disease)	N-Z-Amine™ AS	stabilization during lyophilization	125
	N-Z-Amine™ AS	stabilization during lyophilization	125
Herpetomonas spp.	N-Z-Amine™ AS	growth medium	117
Klebsiella pneumoniae	Hy-Case™ SF	growth medium	361
Lactobacillus acidophilus	Peptonized Milk	growth medium	441
	Primatone™	growth medium	441
Lactobacillus amylovorus	Cottonseed	production of lactic acid	523
	Hy-Soy™	production of lactic acid	523
	N-Z-Soy™ BL	production of lactic acid	523
Lactobacillus arabinosus	Hy-Soy™	growth medium	43
	N-Z-Amine™ YT	growth medium	43
Lactobacillus bifidus	N-Z-Case™	growth medium	26
Lactobacillus casei	Edamin™ S	growth medium	652
Lactobacillus fermentum	N-Z-Case™	synthesis of glutamate dehydrogenase	348
Lactobacillus lactis	N-Z-Amine™	starter media for cheese cultures	468
	N-Z-Case™	synthesis of glutamate dehydrogenase	348
Lactobacillus reuteri	Hy-Soy™	growth medium in enzyme production	630
Lasiodiplodia theobromae	Edamin™	hydroxylation of steroids	408
Leptomonas spp.	N-Z-Amine™ AS	growth medium	117, 124
Leuconostoc mesenteroides	N-Z-Amine™ YT	growth medium	43
Metarhizium anisopliae	N-Z-Amine™ A	production of enzymes	646
Microbacterium sp.	Hy-Soy™	culture medium	587
Microbispora spp.	N-Z-Amine™ A	growth medium	69

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Organism	Product	Application	References
Micromonospora carbonacea	N-Z-Amine™ A	production of evernomicin	76
Micromonospora chalcea	N-Z-Amine™ A	antibiotic production	73, 134, 206
Micromonospora citrea	N-Z-Amine™ A	production of citreamicins	481
Micromonospora coerulea	N-Z-Amine™ A	growth medium	245
Micromonospora danubiensis	N-Z-Amine™ A	production of sisomicin	295-296
Micromonospora echinospora	N-Z-Amine™ A	antibiotic production	52, 56, 340
Micromonospora fusca	N-Z-Amine™ A	synthesis of gentamicins	52, 56
Micromonospora griseorubida	N-Z-Amine™ A	synthesis of mycinamicins	208
Micromonospora halophytica	N-Z-Amine™ A	production of halomicin	77
Micromonospora heviziensis	N-Z-Amine™ A	growth medium	311
Micromonospora lacustris	N-Z-Amine™ A	production of rifamycins	135
Micromonospora megalomicea	N-Z-Amine™ A	growth medium	102
Micromonospora olivoasterospora	N-Z-Amine™ A	growth medium	143
Micromonospora polytrota	N-Z-Amine™ A	growth medium	311
Micromonospora purpurea	N-Z-Amine™ A	production of gentamicins	144, 146, 166, 239, 300
Micromonospora purpureochromogenes	N-Z-Amine™ N-Z-Amine™ A	growth medium growth medium	420 83
Micromonospora rhodorangea	N-Z-Amine™ A	growth medium	118
Micromonospora rosaria	N-Z-Amine™ A Pepticase™	synthesis of rosamicin production of dienone macrolides	97 613
Micromonospora rosea	N-Z-Amine™	production of sisomicin	279
Micromonospora sagamiensis	N-Z-Amine™ A	antibiotic production	170
Micromonospora saitamica	N-Z-Amine™ A	antibiotic production	167
Micromonospora scalabitana	N-Z-Amine™ A	synthesis of gentamicins	237
Micromonospora viridifaciens	N-Z-Amine™ A	antibiotic production	148
Micropolyspora brevicatena	N-Z-Amine™ A	growth medium	47
Micropolyspora spp.	N-Z-Amine™ A	growth medium	69
Moraxella bovis	N-Z-Amine™ A	vaccine production	358
Mucor spp.	Edamin™	oxygenation of steroids	15
Mycobacterium avium	N-Z-Case™	growth medium	36
Mycobacterium spp.	N-Z-Amine™	transformations of sterols	93
Mycobacterium tuberculosis	N-Z-Amine™ A N-Z-Case™	growth medium growth medium	69 5, 36
Mycobacterium vole	N-Z-Case™	growth medium	36
Mycoplasma	Hy-Soy™	culture medium	53, 64
Mycoplasma pneumoniae	Hy-Soy™	growth medium	500
Myxovirus influenza	N-Z-Amine™ A	vaccine stabilization	384
Neisseria meningitidis	Amisoy™ N-Z-Amine™ A	cultivating pathogenic bacteria growth medium	618 398
Nocardia asteroides	N-Z-Amine™ A	growth medium	246
Nocardia autotrophica	Hy-Case™ SF	growth medium	514
Nocardia brasiliensis	N-Z-Amine™ A	growth medium	246
Nocardia canicruria	Hy-Case™ Hy-Soy™	hydroxylation of steroids hydroxylation of steroids	301 301
Nocardia orientalis	Amicase™ Hy-Case™ N-Z-Amine™ A	antibiotic production antibiotic production antibiotic production	421 421 421
Nocardia sp.	Hy-Yest™ 412 N-Z-Amine™ A N-Z-Case™	nocathiacin antibiotic production antibiotic production manufacture of naphthofuranone compounds	645 228, 236, 479 640
Nocardiopsis spp.	N-Z-Amine™ A	growth medium	428
Nodulisporium sp.	Amicase™	growth medium	615
Ochromonas danica	N-Z-Amine™	growth medium	100
Ochromonas malhamensis	N-Z-Amine™	growth medium	100
Oerskovia spp.	N-Z-Amine™ A	growth medium	428
Pasteurella haemolytica	Hy-Case™ Amino N-Z-Amine™ A	growth medium, vaccine production growth medium, vaccine production	382 382
Pasteurella multocida	Hy-Case™ Amino N-Z-Amine™ A	growth medium, vaccine production growth medium, vaccine production	382 382

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Penicilium simplicissimum	N-Z-Amine™ A	growth medium, antibiotic production	638
Penicillium adametzioides	Amicase™	production of compactin	602
Penicillium levitum	N-Z-Amine™ A	growth medium	392
Penicillium sp.	Edamin™	growth medium, hydroxylation of steroids	25
	N-Z-Amine™	growth medium, hydroxylation of steroids	25
	N-Z-Amine™ A	production of methionine-aminopeptidase inhibitor	637
	N-Z-Case™	growth medium	611
Penicillium waksmanii	N-Z-Amine™	growth medium	352
Peniophora affinis	N-Z-Amine™ A	antibiotic production	197
Peptococcus aerogenes	N-Z-Amine™ A	growth medium	398
Peptostreptococcus sp.	N-Z-Amine™ A	growth medium	398
Phycomyces spp.	Edamin™	oxygenation of steroids	15
Pichia pastoris	Hy-Yest™ 444	growth medium, production of recombinant proteins	675
Polyangium brachysporum	N-Z-Case™	antibiotic production	451
Prevotella ruminicola	Pepticase™	growth medium	639
Promicromonospora spp.	N-Z-Amine™ A	growth medium	428
Proteus rettgeri	N-Z-Amine™	hydrolysis of penicillins	63
Proteus sphingidis	N-Z-Amine™	hydrolysis of penicillins	63
Proteus vulgaris	Primatone™	synthesis of L-serine dehydratase	138
Pseudomonas aeruginosa	N-Z-Amine™ A	growth medium	398
Pseudomonas cepacia	N-Z-Amine™ A	antibiotic production	324, 410
Pseudomonas delafieldii	Edamin™	synthesis of L-serine dehydratase	173
	Hy-Soy™	synthesis of L-serine dehydratase	173
	Primatone™	synthesis of L-serine dehydratase	173
	Primatone™ HS	synthesis of L-serine dehydratase	173
Pseudomonas denitrificans	N-Z-Case™	cobalamin production	463
Pseudomonas spp.	N-Z-Amine™	production of vitamin B12	30
	N-Z-Amine™ A	production of antitumor substance	294
Pseudomonas testosteroni	Pepticase™	synthesis of glutaminase	129
Pseudonocardia sp.	Amicase™	growth medium, antibiotic production	620
	Hy-Soy™	growth medium, antibiotic production	620
	N-Z-Amine™ A	growth medium	428, 606
	N-Z-Amine™ A	growth medium, antibiotic production	620
Pycnidiophora dispersa	N-Z-Amine™ A	growth medium, antibiotic production	541
Rhizopus oligosporus	Hy-Soy™	growth medium	307
	N-Z-Amine™ A	growth medium	307
Rhizopus spp.	Edamin™	oxygenation of steroids	15
Rhodococcus rhodochrous	N-Z-Amine™	growth medium	498, 508
Rhodococcus spp.	N-Z-Amine™ A	growth medium	428
	Pepticase™	mononitrilase production	395
Rhodotorulla pilimanae	Hy-Soy™	growth medium	628
Saccharomonospora spp.	N-Z-Amine™ A	growth medium	428
Saccharomyces cerevisiae	Hy-Case™ Amino	culture medium	604
	Hy-Soy™	growth medium	644, 650, 654
	Hy-Soy™	Production of papillomavirus vaccines	627
	Hy-Yest™ 412	growth medium for plasmid host cells	653
	N-Z-Amine™	genetic studies	391
	N-Z-Amine™	steroid production	19
	N-Z-Case™	Production of fusion protein MGF and IL-3	573
Saccharopolyspora sp.	N-Z-Case™	Insecticide and miticide production	599
Saccharotrix sp.	Amicase™	growth medium, antibiotic production	620
	Hy-Soy™	growth medium, antibiotic production	620
	N-Z-Amine™ A	growth medium, antibiotic production	620
Salmonella choleraesuis	Edamin™ S	stabilization during lyophilization	656
	N-Z-Amine™ AS	stabilization during lyophilization	656
Salmonella newington	N-Z-Amine™	growth medium	81
Salmonella sp.	Pepticase™	diagnostic medium	551
Salmonella typhi	N-Z-Amine™ A	growth medium	81
Salmonella typhimurium	N-Z-Amine™ A	growth medium	81
Sebekia sp.	N-Z-Amine™ A	Cyclosporin production	612
Selenomonas spp.	Pepticase™	growth medium	423
Serratia marcescens	N-Z-Case™	growth medium	84, 87, 104
Shigella boydii	N-Z-Amine™ A	production of colicins	230

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Organism	Product	Application	References
Shigella dispar	N-Z-Amine™ A	production of colicins	230
Stachybotrys sp.	N-Z-Amine™	production of HIV protease inhibitors	586
Staphylococcus aureus	Edamin™ S	toxin production	105
	N-Z-Amine™	synthesis of enterotoxins	88, 113, 198, 221
	N-Z-Amine™ A	enterotoxin H production	600
	N-Z-Amine™ A	enterotoxin production	58, 61-62, 94, 106, 120, 137, 286, 315, 440, 470, 667
	N-Z-Amine™ A	growth medium	439, 510-511, 647
Staphylococcus spp.	Edamin™ S	enterotoxin production	54
	N-Z-Amine™ A	enterotoxin production	65, 74, 281
Streptococcus agalactiae	Hy-Soy™	growth medium	304
Streptococcus cremoris	Edamin™ S	lactic acid production	103
	N-Z-Amine™	starter media for cheese cultures	468
	N-Z-Amine™ A	lactic acid production	103
Streptococcus diacetilactis	N-Z-Case™	synthesis of glutamate dehydrogenase	348
Streptococcus equisimilis	N-Z-Amine™ A	streptokinase production	557
Streptococcus faecalis	N-Z-Case™	enzyme production	57, 122, 348
	N-Z-Case™	growth medium	335
Streptococcus mutans	N-Z-Amine™	growth medium	402
Streptococcus sobrinus	N-Z-Case™	growth medium	672
Streptococcus spp	Hy-Case™ SF	antigen production for vaccines	339
	Hy-Case™ SF	growth medium	204
	N-Z-Amine™	production of streptokinase, streptodornase	29
	N-Z-Amine™ A	antibiotic production	623
Streptomyces albidoflavus	N-Z-Amine™ A	production of biofertilizer	438
Streptomyces alboniger	Hy-Case™ SF	growth medium	258
Streptomyces albus	N-Z-Amine™ A	antibiotic production, albonoursin production	191, 302, 341, 636
Streptomyces ambofaciens	N-Z-Amine™ A	production of spiramycin	472
Streptomyces antibioticus	Hy-Soy™ T	antibiotic production	185
	N-Z-Amine™	synthesis of actinomycin	98, 132, 427
	N-Z-Amine™ A	production of antibiotics	185, 485
	N-Z-Amine™ A	growth medium	42, 75, 211, 437, 519
Streptomyces aureofaciens	Hy-Case™ Amino	production of narasin	153
	Hy-Soy™	production of narasin	153
	N-Z-Amine™ A	antibiotic production	141, 153, 164, 168, 179-180, 192
Streptomyces avermitilis	Hy-Case™ SF	growth medium	466
	N-Z-Amine™	production of ivermectin	388
	N-Z-Amine™ A	synthesis of ivermectin	322
	Peptonized Milk	growth medium	466
Streptomyces avidinii	N-Z-Amine™ A	production of streptavidin	501
Streptomyces azureus	N-Z-Amine™ A	growth medium	220, 351
Streptomyces cattleya	N-Z-Amine™ A	synthesis of thienamycin	253
Streptomyces chromofuscus	N-Z-Amine™ A	production of angiotensin	280
Streptomyces clavuligerus	N-Z-Amine™ A	cephalosporin production	90, 353
	N-Z-Amine™ A	clavulanic acid production	619
Streptomyces coelicolor	Hy-Case™ SF	inoculum medium	665
Streptomyces endus	N-Z-Amine™ A	antibiotic production	252, 387
Streptomyces erythreus	N-Z-Amine™ A	synthesis of erythromycin	23
Streptomyces fradiae	N-Z-Amine™ A	synthesis of neomycin	14, 17
	N-Z-Amine™ A	growth medium	437
Streptomyces gardneri	Hy-Case™ Amino	production of antibiotics	543
Streptomyces graminofaciens	Hy-Soy™	production of streptogramin	16
Streptomyces griseorubiginosus	N-Z-Case™	production of antibiotics	486
Streptomyces griseus	Hy-Case™ SF	growth medium	258
	N-Z-Amine™	sporulation medium	465
	N-Z-Amine™	antibiotic production	91, 169
	N-Z-Amine™ A	growth medium	150, 306
Streptomyces halstedii	N-Z-Amine™ A	antibiotic production	278, 338
Streptomyces humidus	N-Z-Amine™ A	antibiotic production	243
Streptomyces hygroscopicus	Hy-Case™ SF	fermentation medium	539
Streptomyces karnatakensis	N-Z-Amine™ A	growth medium	598
Streptomyces kasugaensis	N-Z-Amine™ A	synthesis of kasugamycin	247

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Streptomyces lavendulae	N-Z-Amine™	synthesis of moranoline for blood glucose control	349
Streptomyces lipmanii	N-Z-Amine™ A	antibiotic production	145
Streptomyces lividans	N-Z-Amine™ A	genetic studies	292
Streptomyces lomondensis	N-Z-Case™	antibiotic production	400
Streptomyces longwoodensis	N-Z-Amine™ A	growth medium	392
Streptomyces luridus	N-Z-Amine™ A	antibiotic production	342
Streptomyces malachitofucus	Hy-Soy™ T	antibiotic production	224
Streptomyces olivaceus	Primatone™ HS	growth medium	515
Streptomyces parvulus	N-Z-Amine™	growth medium	259, 444, 474
Streptomyces parvus	Hy-Soy™	production of fungicide, eulicin	48
Streptomyces plicatus	N-Z-Amine™ A	antibiotic production	663
Streptomyces pulveraceus	N-Z-Amine™ A	antibiotic production	381
	N-Z-Case™	antibiotic production	381
Streptomyces rochei	N-Z-Amine™	enzyme production	607
Streptomyces roseochromogenus	N-Z-Amine™ A	production of albocycline	248
Streptomyces roseosporus	N-Z-Amine™ A	antibiotic production	469
Streptomyces salvialis	N-Z-Amine™ A	antibiotic production	566
Streptomyces sp	Hy-Case™ SF	production of angiotensin-II antagonist	537, 549, 560-561
	Hy-Case™ SF	fermentation medium	559
	Hy-Soy™	synthesis of antibiotics	365
	N-Z-Amine™	production of angiotensin, converting enzyme inhibitor	319
	N-Z-Amine™	production of ACE inhibitor	318
	N-Z-Amine™	production of elastase inhibitors	571
	N-Z-Amine™	production of xylanase	347
	N-Z-Amine™ A	production of glucuronides	623
	N-Z-Amine™ A	production of nisamycin	564
	N-Z-Amine™ A	antibiotic production	46, 195, 318, 320, 325, 368, 370, 389, 424, 555, 568, 574
	Primatone™ HS	antibiotic production	513
Streptomyces tenebrarius	N-Z-Amine™ A	production of nebramycin	139, 201
Streptomyces tenjimariensis	N-Z-Amine™	growth medium	207
Streptomyces threomyceticus	N-Z-Amine™ A	threomycin production	249
Streptomyces toyocaensis	N-Z-Amine™ A	antibiotic production	386
Streptomyces virginiae	N-Z-Amine™ A	antibiotic production	364, 411
	N-Z-Amine™ A	growth medium	435
Streptomyces viridochromogenes	Hy-Case™	growth medium	142
	N-Z-Amine™ A	sulfomycin production	250
Streptomyces viridodiastaticus	N-Z-Amine™ A	antibiotic production	579, 590
Streptosporangium fragile	N-Z-Amine™ A	synthesis of fragilomycin	299
Streptosporangium spp.	N-Z-Amine™ A	growth medium	428
Streptoverticillium spp.	N-Z-Amine™ A	growth medium	428
Syncephalus nodosa	Edamin™	oxygenation of steroids	15
Tetrahymena pyriformis	Hy-Case™ SF	assay for riboflavin	60, 70
Thermoactinomyces spp.	N-Z-Amine™ A	growth medium	69, 428
Thermomonospora spp.	N-Z-Amine™ A	growth medium	428
Tilletta caries	Edamin™	growth medium	116
Tilletta controversa	Edamin™	growth medium	116
Trichoderma reesei	N-Z-Amine™ A	growth medium	392
Trichoderma viride	Edamin™	hydroxylation of steroids	32
Trypanosoma mega	N-Z-Amine™ AS	growth medium	117
Veillonella alcalescens	N-Z-Amine™ A	growth medium	398
Verticilium sp.	Pepticase™	growth medium	670
Vibrio cholerae	Hy-Case™ SF	growth medium	255, 520
Vibrio harveyi	N-Z-Amine™	genetic studies	459
Xanthomonas campestris	Hy-Soy™ T	production of xanthan gum	181, 238, 242
	N-Z-Amine™ A	production of xanthan gum	297
	N-Z-Amine™ YT	production of xanthan gum	181, 238, 242
Yersinia pestis	N-Z-Amine™	growth medium	209, 263, 330
	N-Z-Amine™ A	growth medium	287, 317

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Patents:

EP 0 811 056 B1 - Peptones for tissue culture media

US 5,741,705 - Method for in vitro growth of eucaryotic cells using low molecular weight peptones

US 5,885,835 - Kit for in vitro cell growth of eucaryotes using low molecular wieght peptone containing L-glutamine

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