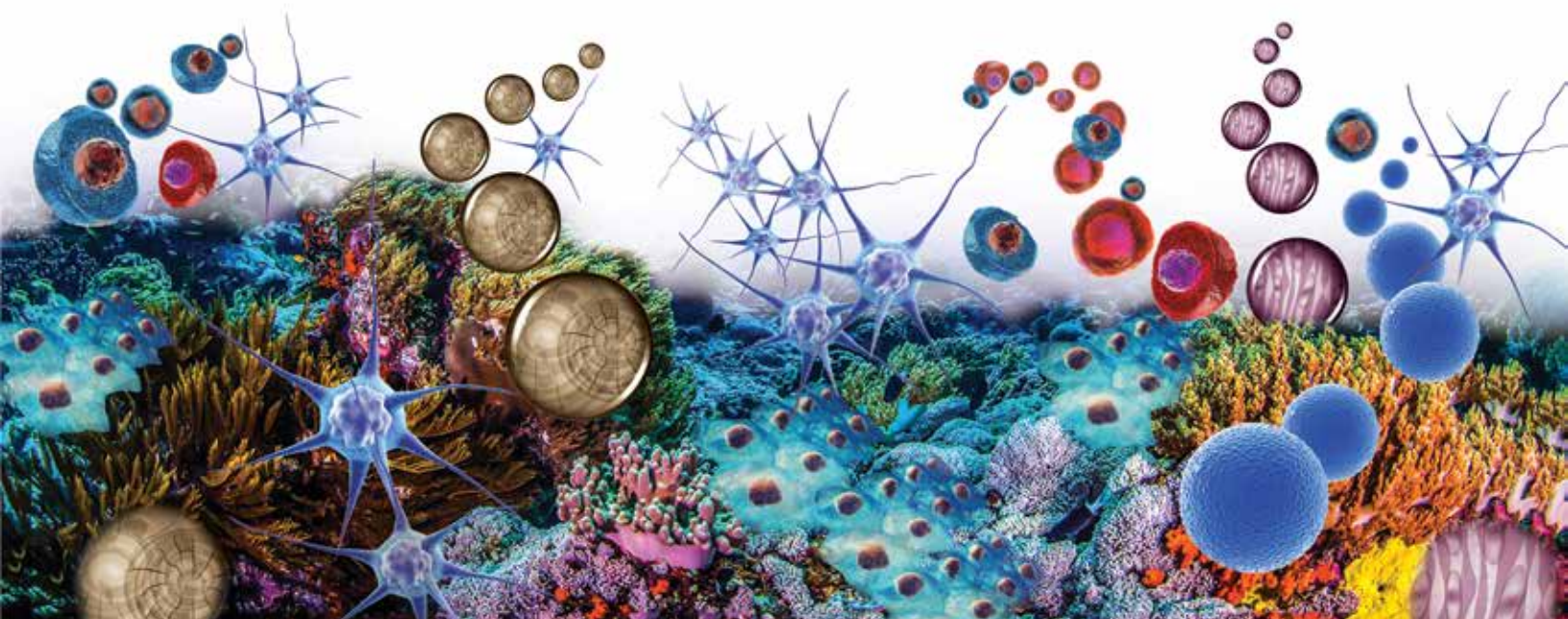


Stem Cell Research Products



COLLAGENASE

DNASE 1

PAPAIN

***STEMxyme*[®] COLLAGENASE/NEUTRAL PROTEASE BLENDS**

PAPAIN (NEURAL) DISSOCIATION SYSTEM

NEUTRAL PROTEASE (DISPASE[®])

CELEASE[®] GMP

Working Together

Opening the Potential for Stem Cell Research Innovation

Sharing Our Enzyme Expertise

Is a top priority at Worthington, and we have done so for over 70 years. Authoring technical manuals and guides both in print and digital formats. As well, we are cited in thousands of respected scientific journals across the globe.

To Support Your Research, We Provide Online Resources To Include:

- Advanced tissue search feature in the tissue dissociation guide section of our website
- Comprehensive citations listings at: Bioz.com by search for Worthington products to obtain article snippets with technique filtering capabilities
- Collagenase Sampling Program to pre-test a particular lot of enzyme you are planning to use in your experiment. This free service allows you to pre-sample several different lots of collagenase at a time and select the best of the group for the application.

We invite you to work with us hand-in-hand to enhance our stem cell research technical library by submitting protocols, citations and articles referencing Worthington enzymes that can be shared with your colleagues. For details on submissions, contact your local Worthington Account Manager or forward suggestions to: techservice@worthington-biochem.com.



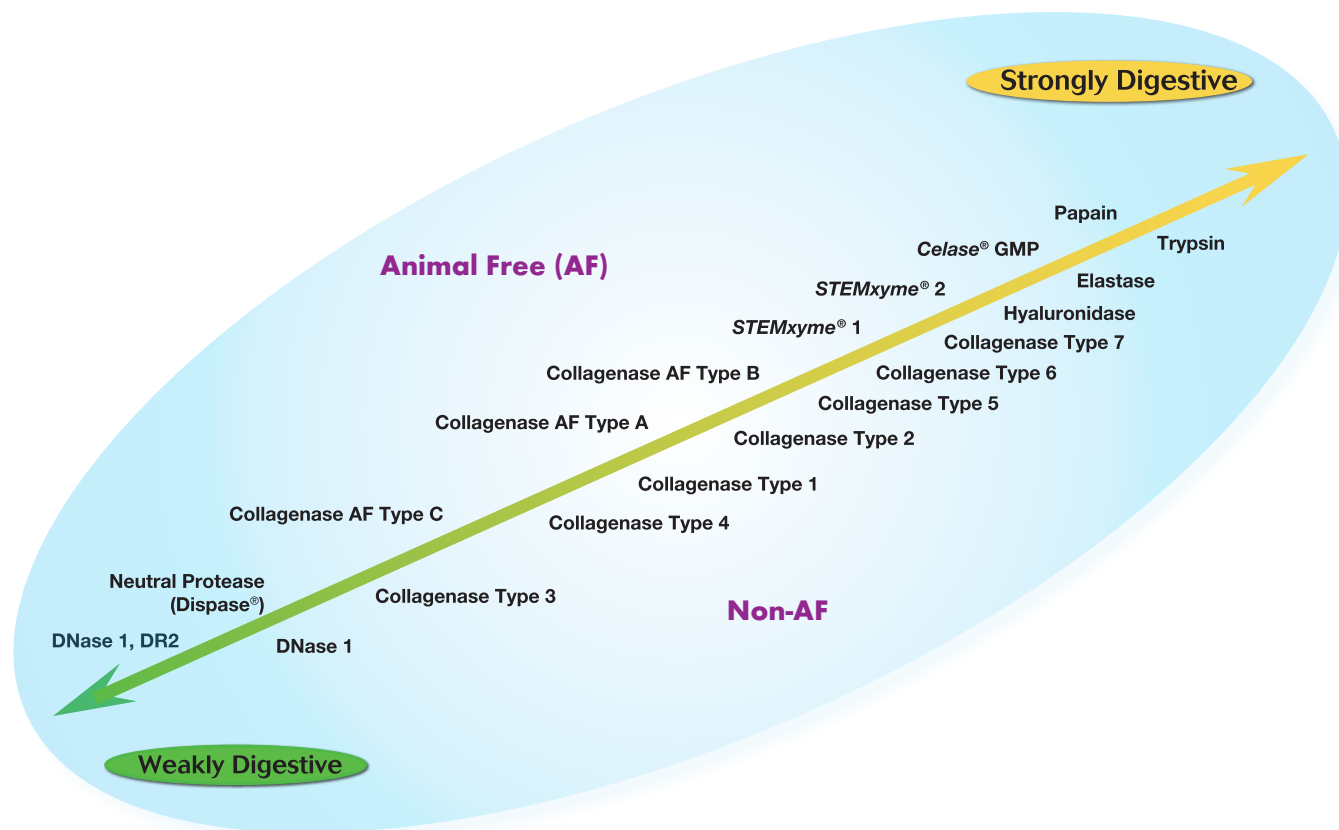
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Worthington Primary Cell Isolation Enzyme Digestion Scale



Tissue dissociation/primary cell isolation and cell harvesting are principal applications for enzymes in tissue culture, stem cell research and cell biology studies. The goal of a cell isolation procedure is to maximize the yield of functionally viable, dissociated cells. There are many parameters which may affect the outcome. The choice of enzyme is an important parameter. Worthington's Tissue Dissociation Guide summarizes our knowledge of how these enzymes accomplish the "routine" operations of tissue dissociation and primary cell harvesting. This technical guide describes standard lab procedures; offers a logical experimental approach for establishing a cell isolation protocol; and lists many tissue specific references to aid development of an effective method. For more information, go to: TissueDissociation.com

Name	Activity	Catalog Number	Package	Code
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Celase® GMP Collagenase Blend

Source: *Cl. histolyticum* Collagenase/*Bacillus* Neutral Protease

I.U.B.: 3.4.24.3/3.4.24.28

CAS Number: 42613-33-2

Celase® GMP is a proprietary, blended proteolytic enzyme designed for efficient, gentle and reproducible *in vitro* dissociation of nucleated cells from adipose tissue.

Convenience In Your Lab

- A single, sterile, ready-to-use vial containing both collagenase and a neutral protease can digest up to 280 gm of adipose tissue
- Best-in-class shelf life of up to 72 months

Clarity In Your Approach

- Research protocols are available from Cytori for dissociating canine, equine, human, ovine, porcine, rabbit and rodent adipose tissue
- Technical dossier is available from Cytori to ease the transition from research to clinical applications

Confidence In Your Result

- Included in IDE applications approved by U.S. FDA for alopecia, chronic heart failure, hamstring injuries, osteoarthritis of the knee, and hand manifestations of scleroderma
- Produced using avian and mammalian tissue-free raw materials, aseptic processes and sterile filtration under GMP guidelines to assure the lowest levels of impurities

Total Protein 34.4 - 51.6 mg/vial

Endotoxin < 50 EU / mg

Stability Lyophilized: 72 months at -25 to -15°C
Reconstituted: 6 months at -25 to -15°C and up to 2 freeze-thaw cycles

Appearance White lyophilizate

Celase®

A single, sterile, ready-to-use vial containing both collagenase and a neutral protease which can digest up to 280 gm of adipose tissue. Stable up to 72 months at -20°C. REQUIRES SPECIAL SHIPPING AND PACKAGING: DRY ICE.

Digests ≥ 280 gm of adipose tissue

1235-01

1 vial, 35 mg

CLAS

Next Level Research



Celase® GMP

- Same formulation, now available without Cellution
- Foundational and versatile for all research programs
- Eliminates time consuming, costly bridging studies

Expanding our commitment to convenience, clarity and confidence with the Celase® enzyme blend for pre-clinical applications.

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Name	Activity	Catalog Number	Package	Code
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Cell Isolation Optimizing System

A complete method development kit containing an assortment of enzymes most frequently used in enzymatic tissue dissociation and cell isolation procedures. Includes instructions, references, and strategies for the handling, use and optimization of enzymatic cell isolation methods for maximum yield of viable cells. Contains all enzymes commonly referenced in tissue dissociation and cell isolation procedures. Also contains the **Cell Isolation Guide** which describes the tissue types commonly used, the mode of action of the various enzymes, tissue culture techniques, and protocol optimization guidelines (with cell- and tissue-specific references for getting started in enzymatic cell isolation).

Tissue dissociation and cell harvesting are two principal applications for enzymes in tissue culture research and cell biology studies. Despite the widespread use of enzymes for these applications over the years, their mechanisms of action in dissociation and harvesting are not well understood. As a result, the choice of one technique over another is often arbitrary and based more on past experience than on an understanding of why the method works and what modifications could lead to even better results.

Investigators searching the scientific literature for information on the ideal enzymes and optimal conditions for tissue dissociation are often confronted with conflicting data. Much of the variation stems from the complex and dynamic nature of the extracellular matrix and from the historical use of relatively crude, undefined enzyme preparations for cell isolation applications. The extracellular matrix is composed of a wide variety of proteins, glycoproteins, lipids and glycolipids, all of which can differ in abundance from species to species, tissue to tissue and with developmental stage. The Worthington Cell Isolation Optimizing System provides an assortment of the widely used enzymes in purified form for establishing an optimized cell isolation procedure on a cost-efficient basis.

Kit Contents:

- Collagenase Type 1, CLS-1, 500 mgdw
- Collagenase Type 2, CLS-2, 500 mgdw
- Collagenase Type 3, CLS-3, 500 mgdw
- Collagenase Type 4, CLS-4, 500 mgdw
- Trypsin, TRL, 500 mgdw
- Neutral Protease (Dispase®), NPRO, 10 mgdw
- Hyaluronidase, HSE, 50,000 un
- Elastase, ESL, 100 mgP
- Papain, PAPL, 100 mgP
- Deoxyribonuclease I, DP, 25 mgdw
- Trypsin Inhibitor, SIC, 100 mgdw

Cell Isolation Optimizing System

A complete method development kit containing an assortment of enzymes most frequently used in tissue dissociation and cell isolation procedures. Includes instructions, references, and strategies or the handling, use and optimization of enzymatic cell isolation methods to achieve maximum yield of viable cells. Kit includes 500 mg of each of four types of collagenase, 500 mg trypsin, 50 ku hyaluronidase, 100 mg elastase, 100 mg papain, 25 mg DNase I, 10 mg neutral protease (Dispase®) and 100 mg trypsin inhibitor. Store at 2-8°C.

N/A

LK003200

1 bx

CIT

Name	Activity	Catalog Number	Package	Code
Chymotrypsin				
Source: Bovine Pancreas				
I.U.B.: 3.4.21.1 CAS Number: 9004-07-3				
Chymotrypsin preferentially catalyzes the hydrolysis of peptide bonds involving L-isomers of tyrosine, phenylalanine and tryptophan. It also readily acts upon amides and esters of susceptible amino acids. Chymotrypsin catalyzes the hydrolysis of bonds of leucyl, methionyl, asparaginy and glutamyl residues.				
Stability/Storage:: The enzyme is stable for days in solution at pH 3.0 and for years as a dry powder at 2-8°C. Protect from moisture.				
Unit Definition: One Unit hydrolyzes one micromole of benzoyl-L-tyrosine ethyl ester per minute at 25°C, pH 7.8 in the presence of calcium. An activity of 45 Units per mg using the above definition, is the equivalent of 10,000 optical density or 1330 N.F. units per mg using ATEE as a substrate.				
1 BTEE unit = 29.5 USP/NF units.				
Chymotrypsin, Alpha, TLCK Treated, Sequencing Grade Three times crystallized and treated with 1-chloro-3-tosylamido-7-amino-2-heptanone (TLCK) to inhibit trypsin activity (Shaw, <i>et al.</i> , <i>Biochemistry</i> , 4, 2219, 1965). Dialyzed against 1 mM HCl to remove autolysis products and low molecular weight contaminants. Supplied lyophilized in 25 ug and 100 ug high-recovery vials. Store at 2-8°C.	≥ 45 Units per mg protein	LS02130 LS02132	4 x 25 ug 4 x 100 ug	CDSEQ
Chymotrypsin, Alpha, TLCK Treated Three times crystallized and treated with 1-chloro-3-tosylamido-7-amino-2-heptanone (TLCK) to inhibit trypsin activity (Shaw, <i>et al.</i> , <i>Biochemistry</i> , 4, 2219 1965). Dialyzed against 1 mM HCl to remove autolysis products and low molecular weight contaminants. Supplied as a dialyzed, lyophilized powder. Store at 2-8°C.	≥ 45 Units per mg protein	LS001430 LS001432 LS001434 LS001438	25 mg 100 mg 1 gm Bulk	CDTLCK
Chymotrypsin, Alpha, Purified Chromatographically prepared by the procedure of Yapel <i>et al.</i> , <i>J. Amer. Chem. Soc.</i> , 88, 2573 (1966). A lyophilized powder. Store at 2-8°C.	≥ 45 Units per mg protein	LS001475 LS001479 LS001477	100 mg 1 gm Bulk	CDS
Chymotrypsin, Alpha, 3X Three times crystallized alpha chymotrypsin, which is an activation product of a three times crystallized zymogen. Dialyzed against 1 mM HCl and lyophilized. Store at 2-8°C.	≥ 45 Units per mg protein	LS001448 LS001450 LS001451 LS001453	250 mg 1 gm 10 gm Bulk	CDI
Chymotrypsin, Alpha, Crystallized Crystallized as zymogen and activated. Dialyzed against 1 mM HCl and lyophilized. Store at 2-8°C.	≥ 35 Units per mg protein	LS001333 LS001334 LS001332	1 gm 10 gm Bulk	CDAG

Name	Activity	Catalog Number	Package	Code
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Clostripain (Endoproteinase-Arg-C)

Source: *Clostridium histolyticum*

I.U.B.: 3.4.22.8 CAS Number: 9028-00-6

Clostripain (Endoproteinase-Arg-C) is a two chain cysteine proteinase associated with collagenase and isolated from *Clostridium histolyticum*. It is highly specific for the carboxyl peptide bond of arginine. Clostripain is activated by dithiothreitol, cysteine, or other sulfhydryl containing reagents. The presence of calcium ions is essential. The enzyme is inhibited by oxidizing agents, divalent cations such as Co^{2+} , Cu^{2+} , Cd^{2+} , and heavy metal ions. Citrate, borate, and Tris anions are less inhibitory.

Unit Definition: One Unit hydrolyzes one micromole of N-benzoyl-L-arginine ethyl ester per minute at 25°C, pH 7.6, in the presence of dithiothreitol.

Clostripain (Endoproteinase-Arg-C)

CPSEQ

Sequencing Grade

Chromatographically purified. A dialyzed, pre-activated, lyophilized powder. Supplied in 10 µg high recovery vials. Store at 2-8°C.

≥ 50 Units per
mg protein

LS02135

LS02139

10 µg

Bulk

Clostripain (Endoproteinase-Arg-C)

CP

Chromatographically purified. A dialyzed, pre-activated, lyophilized powder. Store at 2-8°C.

≥ 50 Units per
mg dry weight

LS001641

LS001643

LS001646

LS001647

1 mg

5 x 1 mg

10 mg

Bulk



Our mission is to provide superior tools from discovery research through larger scale bioprocessing applications.

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Worthington Collagenase Products, Specifications and Applications Table

Product Code	Collagenase	Caseinase	Clostripain	Tryptic	Comments/Applications*
	CDU/mgdw	u/mgdw	u/mgdw	u/mgdw	
Partially Purified					
CLS-1	≥125	≥200	≤4.0	≤0.5	Balanced activities/Adipose, Adrenal, Epithelial, Liver, Lung
CLS-2	≥125	≥200	≥3.5	≥0.1	Higher proteolytic activities/Bone, Heart, Liver, Thymus
CLS-3	≥100	≥50	≤3.0	≤0.3	Lower proteolytic activities/Mammary
CLS-4	≥160	≥100	≤3.0	≤0.1	Lower tryptic activity/Pancreatic Islets
CLS-5	≥450	≥450	≤3.0	≤0.3	Higher collagenase and caseinase activities
CLS-6	≥400	≥1,000	≤4.0	≤0.5	Higher activity with caseinase to collagenase ratio ~2:1, designated to be enriched for Type II (<i>col</i> /H) collagenase relative to Type I (<i>col</i> /G)
CLS-7	≥1,000	≥2,000	≤8.0	≤0.5	Contains collagenase and caseinase activities 4X higher than collagenase Types 1 and 2
CLSS-1	≥125	≥200	≤4.0	≤0.5	0.22μ Filtered CLS-1 in 50mg & 1gm Vials
CLSS-2	≥125	≥200	≥3.5	≥0.1	0.22μ Filtered CLS-2 in 50mg & 1gm Vials
CLSS-3	≥100	≥50	≤3.0	≤0.3	0.22μ Filtered CLS-3 in 50mg Vials
CLSS-4	≥160	≥100	≤3.0	≤0.1	0.22μ Filtered CLS-4 in 50mg & 1gm Vials
CLSS-5	≥450	≥450	≤3.0	≤0.3	Higher collagenase and caseinase activities
CLSH	≥125	≥200	≤4.0	≤0.5	0.22μ Filtered, ≥22,500U CLS-1 & 30U ESL component of HIS kit
Animal Free					
CLSAFA	≥150	≥150	≤8.0	≥0.1	Balanced Activities/AF Stem Cell & Tissue Bioprocessing
CLSAFB	≥300	≥300	≤5.0	≤0.5	Higher Activities/AF Stem Cell & Tissue Bioprocessing
CLSAFC	≥200	≥150	≤3.0	≤0.1	Lower Protease Activities/AF Stem Cell & Tissue Bioprocessing
CLSAFAS	≥150	≥150	≤8.0	≥0.1	0.22μ Filtered AF CLSAFA in 50mg vials
CLSAFBS	≥300	≥300	≤5.0	≤0.5	0.22μ Filtered AF CLSAFB in 50mg vials
CLSAFCS	≥200	≥150	≤3.0	≤0.1	0.22μ Filtered AF CLSAFC in 50mg vials
STEMxyme® Animal Free Blends of Collagenase and Neutral Protease					
STZ1	≥250	≥1,000	≤5.0	≤0.5	0.22μ Filtered CLSAFB & NPRO/AF Stem Cell & Tissue Bioprocessing
STZ2	≥250	≥2,000	≤5.0	≤0.5	0.22μ Filtered CLSAFB & NPRO/AF Stem Cell & Tissue Bioprocessing
Chromatographically Purified					
CLSPA	≥500	≤50	≤2.0	≤0.25	Low Protease/Collagen Studies, Tissue Digestion combined with other proteases
CLSPANK	≥500	≤50	≤2.0	≤0.25	0.22μ Filtered, ≥1,500U CLSPA component of NCIS kit

*Correlations between type and effectiveness with different tissues have been good, but not perfect, and may be dependent partly on parameters of use and objectives as well as lot-to-lot variations. For more information see the Collagenase Sampling Program information.

Name	Activity	Catalog Number	Package	Code
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Collagenase

Source: *Clostridium histolyticum*

I.U.B.: 3.4.24.3 CAS Number: 9001-12-1

Clostridium histolyticum contains two distinct but related genes for collagenase. The *col G* gene codes for a 936 amino acid protein designated Collagenase Type 1 and the *col H* gene codes for a 1021 amino acid protein designated Collagenase Type II. Partially purified preparations contain several isoforms of both these gene products, a sulfhydryl protease, clostripain, a trypsin-like enzyme, and an aminopeptidase. This combination of collagenolytic and proteolytic activities is effective at breaking down intercellular matrices, the essential part of tissue dissociation. One component of the complex is a hydrolytic enzyme that degrades the helical regions in native collagen preferentially at the Y-Gly bond in the sequence Pro-Y-Gly-Pro, where Y is most frequently a neutral amino acid. This cleavage yields products susceptible to further peptidase digestion. Partially purified collagenase is inhibited by metal chelating agents such as cysteine, EDTA or o-phenanthroline but not DFP. It is also inhibited by alpha-2-macroglobulin, a large plasma glycoprotein. Ca²⁺ is required for enzyme activity. Particular enzymatic profiles of each collagenase have been correlated with the tissues from which the cells for study were obtained (or with the uses to which the cells are put). As a result of the correlations, several types of partially purified collagenases have been established by Worthington: Types 1, 2, 3, 4, 5, 6 and 7.

- **Type 1** partially purified collagenase has the original balance of collagenase, caseinase, clostripain and tryptic activities.
- **Type 2** contains higher relative levels of protease activity, particularly clostripain.
- **Type 3** contains lowest levels of secondary proteases.
- **Type 4** is designed to be especially low in tryptic activity to limit damage to membrane proteins and receptors.
- **Type 5** contains higher collagenase and caseinase values.
- **Type 6** contains high collagenase activity with a caseinase to collagenase ratio ~2:1. Designed to be enriched for Type II (*col H*) collagenase relative to Type I (*col G*).
- **Type 7** contains collagenase and caseinase activities four-fold higher than collagenase Types 1 and 2.
- **CLSPA** Chromatographically purified collagenase, contains minimal secondary proteolytic activities along with high collagenase activity. Animal Free Types AFA, AFB and AFC collagenase are derived from cultures grown in medium completely devoid of animal based components and designed for bioprocessing applications where introduction of potential animal derived pathogens must be prevented.

Animal Free:

- **CLSAFA** is the original AF grade designed to have collagenase and secondary proteases similar to Types 1 and 2 collagenase.
 - **CLSafb** contains higher collagenase and caseinase activities than CLSAFA.
 - **CLSafc** has especially low tryptic activity similar to Type 4 collagenase.
- Worthington also offers 0.22 micron filtered preparations of many types in 50 mg/vial pre-packaged form for direct reconstitution and use in all isolation procedures.

The collagenase assay is a modification of Mandl wherein collagenase is incubated for five hours with native collagen and the extent of collagen breakdown is determined using the Moore and Stein, *J. Biol. Chem.*, 176, 367 (1948) colorimetric ninhydrin method. Amino acids released are expressed as micromoles leucine per milligram collagenase.

Uses: Partially purified collagenases are widely used in enzymatic primary cell isolation and tissue dissociation procedures. Most researchers employ either partially purified collagenase preparations such as Types 1–7 or chromatographically purified collagenase (Code: **CLSPA**); the latter is usually combined with secondary enzymes such as elastase, hyaluronidase, etc. For best results, the precise mixture of proteolytic activities must be tailored to the tissue to be dissociated. Correlations between type and effectiveness with different tissues have been good, but not perfect, and may be dependent partly on parameters of use and objectives, as well as lot-to-lot variations. For more information see the Collagenase Sampling Program information at the beginning of this catalog. Worthington also publishes a Tissue Dissociation Guide, which provides additional information regarding the enzymes used for these applications and specific references for numerous cell and tissue types. A complete copy is available on our website, Worthington-Biochem.com or may be requested through Customer Service at 800.445.9603/732.942.1660.

Collagenase Lot Selection Tool Available Online

Worthington's Collagenase Lot Selection Tool is available online at our website. This new feature was designed to help researchers select and evaluate current collagenase lots that match previous lots or desired activity profiles. Users may enter target values for collagenase, caseinase, clostripain, and tryptic activities or specify previous lot numbers. Each value can be weighted based on the relative level of importance to the application. After the search for matches is completed, a ranked list of collagenase lots currently available is generated. The selected lots can then be sampled simply by using the built in link to the Free Collagenase Sampling Program. As always, Worthington Customer and Technical Service personnel are available via phone at 800.445.9603 / 732.942.1660 and techservice@Worthington-Biochem.com to assist with collagenase or any other products.

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Name	Activity	Catalog Number	Package	Code
Collagenase (Continued)				
Unit Definition: One unit releases one micromole of L-leucine equivalents from collagen in 5 hours at 37°C, pH 7.5.				
Collagenase, Purified				CLSPA
Chromatographically purified.	≥ 500 units per	LS005275	4 ku	
≤ 50 caseinase units per milligram.	mg dry weight	LS005273	10 ku	
Supplied as a lyophilized powder.		LS005277	Bulk	
Store at 2-8°C.				
Collagenase Vial, NCIS				CLSPANK
A component of the NCIS kit.	≥ 1500 units	LK003240	1 vi	
This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials.	per vial	LK003245	5 vi	
A vial reconstituted with 5 ml of HBSS or equivalent yields a solution of 300 units/ml of collagenase, Code: CLSPA. Suitable for cell isolation and culture applications.				
Store at 2-8°C.				
Collagenase, Type 1				CLS-1
The original balance of enzymatic activities. Each lot assayed for collagenase, caseinase, clostripain and tryptic activities. Suggested for epithelial, liver, lung and adrenal primary cell isolations. A dialyzed, lyophilized powder.	≥ 125 units per	LS004194	100 mg	
	mg dry weight	LS004196	1 gm	
		LS004197	5 gm	
		LS004200	Bulk	
Store at 2-8°C.				
Collagenase, Type 2				CLS-2
Prepared to contain higher clostripain activity. Suggested for bone, heart, liver, thyroid and salivary primary cell isolation.	≥ 125 units per	LS004174	100 mg	
Supplied as a dialyzed, lyophilized powder.	mg dry weight	LS004176	1 gm	
		LS004177	5 gm	
		LS004179	Bulk	
Store at 2-8°C.				
Collagenase, Type 3				CLS-3
Lower in secondary proteolytic contaminant activities but with typical collagenase activity. Suggested for mammary primary cell isolation. A dialyzed, lyophilized powder. Store at 2-8°C.	≥ 100 units per	LS004180	100 mg	
	mg dry weight	LS004182	1 gm	
		LS004183	5 gm	
		LS004185	Bulk	
Collagenase, Type 4				CLS-4
Prepared to contain lower tryptic activity levels to limit damage to membrane proteins and receptors but with normal to above normal collagenase activity. Suggested for pancreatic islet primary isolation. A dialyzed, lyophilized powder. Store at 2-8°C.	≥ 160 units per	LS004186	100 mg	
	mg dry weight	LS004188	1 gm	
		LS004189	5 gm	
		LS004191	Bulk	
Collagenase, Type 5				CLS-5
Prepared to contain higher collagenase and caseinase activities. A dialyzed, lyophilized powder. Store at 2-8°C.	≥ 450 units per	LS005280	100 mg	
	mg dry weight	LS005282	1 gm	
		LS005283	5 gm	
		LS005284	Bulk	

Name	Activity	Catalog Number	Package	Code
Collagenase (Continued)				
Collagenase, Type 6 Prepared to contain high collagenase activity with a caseinase to collagenase ratio ~2:1. Designed to be enriched for Type II (<i>col</i> H) collagenase relative to Type I (<i>col</i> G). A dialyzed, lyophilized powder. Store at 2-8°C.	≥ 400 units per mg dry weight	LS005318 LS005319 LS005321 LS005323	100 mg 500 mg 2.5 gm Bulk	CLS-6
Collagenase, Type 7 Prepared to contain collagenase and caseinase activities four-fold higher than collagenase Type 1/2. A dialyzed, lyophilized powder. Store at 2-8°C.	≥ 1,000 units per mg dry weight	LS005332 LS005333 LS005335 LS005337	100 mg 500 mg 2.5 gm Bulk	CLS-7
Collagenase, Type 1, 0.22μ Filtered Collagenase, Type 1 (Code: CLS-1), which is filtered through a 0.22 micron membrane and lyophilized in vials. Store at 2-8°C.	≥ 125 units per mg dry weight	LS004214 LS004216 LS004217	50 mg 5 x 50 mg 1 gm	CLSS-1
Collagenase, Type 2, 0.22μ Filtered Collagenase, Type 2 (Code: CLS-2), which is filtered through a 0.22 micron membrane and lyophilized in vials. Store at 2-8°C.	≥ 125 units per mg dry weight	LS004202 LS004204 LS004205	50 mg 5 x 50 mg 1 gm	CLSS-2
Collagenase, Type 3, 0.22μ Filtered Collagenase, Type 3 (Code: CLS-3), which is filtered through a 0.22 micron membrane and lyophilized in vials to contain ≥ 50 milligrams per vial. Store at 2-8°C.	≥ 100 units per mg dry weight	LS004206 LS004208	50 mg 5 x 50 mg	CLSS-3
Collagenase, Type 4, 0.22μ Filtered Collagenase, Type 4 (Code: CLS-4), which is filtered through a 0.22 micron membrane and lyophilized in vials. Store at 2-8°C.	≥ 160 units per mg dry weight	LS004210 LS004212 LS004209	50 mg 5 x 50 mg 1 gm	CLSS-4
Collagenase, Type 5, 0.22μ Filtered Collagenase, Type 5 (Code: CLS-5), which is filtered through a 0.22 micron membrane and lyophilized in vials. Store at 2-8°C.	≥ 450 units per mg dry weight	LS005286 LS005287 LS005288	50 mg 5 x 50 mg 1 gm	CLSS-5
Collagenase/Elastase Vial, HIS Kit Worthington collagenase (Code: CLS-1) and elastase (Code: ESL), filtered through 0.22 μm pore size membrane, and lyophilized. A component of the HIS kit also contains 30 u/vial elastase. Store unconstituted vials at 2-8°C.	≥ 20,000 units per vial	LK002066 LK002067	1 vi 5 vi	CLSH

Name	Activity	Catalog Number	Package	Code
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STEMxyme® Collagenase/Neutral Protease Blends, Animal Free

STEMxyme®1, Collagenase/Neutral Protease (Dispase®), 0.22 Filtered Animal Free

STZ1



A specialized combination of Animal Free <i>Clostridium histolyticum</i> collagenase and Animal Free <i>Bacillus polymyxa</i> neutral protease with a minimum of 250 CLS units and 1,000 caseinase units per mg dry weight. Designed for stem cell and other primary cell isolations and bioprocessing applications where introduction of potential animal derived pathogens must be prevented. Store at 2-8°C	≥ 250 collagenase units per mg dry weight	LS004106	50 mg
	≥ 1,000 caseinase units per mg dry weight	LS004107	5 x 50 mg

STEMxyme®2, Collagenase/Neutral Protease (Dispase®), 0.22 Filtered Animal Free







STZ2



A specialized combination of Animal Free <i>Clostridium histolyticum</i> collagenase and Animal Free <i>Bacillus polymyxa</i> neutral protease with a minimum of 250 CLS units and 2,000 caseinase units per mg dry weight. Designed for stem cell and other primary cell isolations and bioprocessing applications where introduction of potential animal derived pathogens must be prevented. Store at 2-8°C.	≥ 250 collagenase units per mg dry weight	LS004112	50 mg
	≥ 2,000 caseinase units per mg dry weight	LS004113	5 x 50 mg



Animal free enzymes, exceeding expectations and meeting industry standards – quality assurance lot-to-lot.

Name	Activity	Catalog Number	Package	Code
Collagenases, Animal Free				
Collagenase, Animal Free, Type A				CLSAFA
Collagenase derived from cultures grown in animal free medium.	≥ 150 units per mg dry weight	LS004152	100 mg	
Suitable for applications needing to avoid introduction of animal derived pathogens into bioprocessing procedures.		LS004154	1 gm	
Store at 2-8°C.		LS004156	5 gm	
		LS004158	Bulk	
Collagenase, Animal Free Type A, 0.22 Filtered				CLSAFAS
Collagenase, Animal Free which is filtered through a 0.22 micron membrane and lyophilized in vials.	≥ 150 units per mg dry weight	LS004118	50 mg	
Store at 2-8°C.		LS004119	5 x 50 mg	
Collagenase, Animal Free, Type B				CLSAFB
Prepared from cultures grown in medium completely devoid of animal based components and designed for bioprocessing applications where introduction of animal derived pathogens must be prevented.	≥ 300 units per mg dry weight	LS004145	100 mg	
Store at 2-8°C.		LS004147	1 gm	
		LS004148	5 gm	
		LS004150	Bulk	
Collagenase, Animal Free, Type B, 0.22 Filtered				CLSAFBS
Collagenase, Animal Free which is filtered through a 0.22 micron membrane and lyophilized in vials.	≥ 300 units per mg dry weight	LS004124	50 mg	
Store at 2-8°C.		LS004125	5 x 50 mg	
Collagenase, Animal Free, Type C				CLSAFC
Prepared from cultures grown in medium completely devoid of animal based components and designed for bioprocessing applications where introduction of animal derived pathogens must be prevented.	≥ 200 units per mg dry weight	LS004138	100 mg	
Store at 2-8°C.		LS004140	1 gm	
		LS004141	5 gm	
		LS004143	Bulk	
Collagenase, Animal Free, Type C, 0.22 Filtered				CLSAFCS
Collagenase Animal Free which is filtered through a 0.22 micron membrane and lyophilized in vials	≥ 200 units per mg dry weight	LS004130	50 mg	
Store at 2-8°C.		LS004131	5 x 50 mg	

Name	Activity	Catalog Number	Package	Code
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Deoxyribonuclease I

Source: Bovine Pancreas

I.U.B.: 3.1.21.1 CAS Number: 9003-98-9

Bovine pancreatic deoxyribonuclease is an endonuclease that splits phosphodiester linkages, preferentially adjacent to a pyrimidine nucleotide, yielding polynucleotides with free hydroxyl group at the 3' position and a phosphate group at the 5' position. The average chain length of a limit digest is a tetranucleotide.

Uses: Worthington offers DNase at different levels of purity for different applications. Product Codes: DPRF and DPRFS are both especially designed for Molecular Biology applications and contain the lowest levels of RNase and protease activity. They are both suitable for use in techniques requiring digestion of DNA in the recovery of intact RNA or where the integrity of structural proteins or enzymes must be maintained. Applications have included nick translation, DNA mapping, isolation of nuclear RNA and protein, RNA polymerase synthesis of RNA probes and RT-PCR. DNase is also used in tissue culture work to digest DNA from damaged cells thereby reducing viscosity, and removing membrane bound DNA fragments. Worthington Codes: DP and DCLS are suitable for these applications.

Stability/Storage: When properly stored, all grades of Worthington deoxyribonuclease are stable for 2-3 years. Product code DPRFS may be stored at -20°C. For long term storage in solution, Product Codes D and DPFF may be dissolved in 5 mM acetate, 1 mM calcium, pH 4.5 and stored in single use aliquots at -20°C or -70°C for up to one year. Only freeze and thaw once; thawed aliquots are stable refrigerated at least several weeks. Addition of 50% glycerol will maintain a liquid state at -20°C without affecting stability. Material in 50% glycerol can be removed and returned to -20°C repeatedly. DPRF is unusually stable due to the absence of protease. For long term storage of DPRF after reconstitution, use water or any buffer pH 4.0 to 9.0 except phosphate; add 50% glycerol for storage as liquid at -20°C; avoid calcium chelators. Aliquot in single use containers; only freeze and thaw once; thawed aliquots are stable refrigerated at least several weeks.

Unit Definition: 1 unit causes an increase in absorbance at 260 nm of 0.001 per minute per ml at 25°C when acting upon highly polymerized DNA at pH 5.0. **Note:** Kunitz units as reported by other suppliers can be 2 to 4 times higher than Kunitz units as measured at Worthington. As measured at Worthington, one Kunitz unit digests 1 µg of calf thymus DNA in 10 minutes at 37°C in 50 mM Tris, 1 mM Mg²⁺, 1 mM Ca²⁺, pH 7.8. Correlation of digestion units with Kunitz units is different for other DNA and buffer systems.

Technical Note: Product Code DPRF: Each vial contains approximately 2 mg glycine and 2 µmoles calcium per 10,000 units of DNase I. Dissolving the entire vial in 5 ml provides the equivalent of a 1 mg/ml solution.



From research and development to manufacturing, continuous quality improvement is everyone's job.

Name	Activity	Catalog Number	Package	Code
Deoxyribonuclease I (Continued)				
Deoxyribonuclease I, Ribonuclease & Protease Free, Solution				DPRFS
Molecular Biology Grade.	≥ 2,000 Kunitz	LS006342	100 un	
Chromatographically purified to	units per ml	LS006344	500 un	
remove RNase and protease.		LS006348	Bulk	
Supplied as a solution at approximately 2 Kunitz units per microliter approximately 1 mg/ml containing 50% glycerol and 1 mM calcium chloride.				
Store at 2-8°C or -20°C.				
Deoxyribonuclease I, Ribonuclease & Protease Free				DPRF
Molecular Biology Grade.	≥ 2,000 Kunitz	LS006331	2500 un	
Chromatographically purified to remove	units per mg	LS006333	10 ku	
RNase and protease. Lyophilized in vials.	dry weight	LS006343	50 ku	
Each 10,000 unit vial contains 2 mg		LS006334	Bulk	
glycine, 2 μmoles calcium, and ≥ 10,000 units of DNase I. Each 2,500 unit vial contains 0.5 mg glycine, 0.5 μmoles calcium, and ≥ 2,500 units of DNase I. Dissolving the entire 10,000 unit vial in 5 ml, or the entire 2,500 unit vial in 1.25 ml, provides the equivalent of a 1 mg/ml solution. (ku = 1000 un).				
Store at 2-8°C.				
PROTECT FROM MOISTURE.				
Deoxyribonuclease I				DPFF
Chromatographically purified. A lyophilized	≥ 2,000 Kunitz	LS006330	25 ku	
powder containing glycine as a stabilizer.	units per mg	LS006328	125 ku	
Protease Free.	dry weight	LS006332	Bulk	
Contains ≤ 0.0005% RNase.				
Store at 2-8°C.				
PROTECT FROM MOISTURE.				
Deoxyribonuclease I				D
Chromatographically purified. A lyophilized	≥ 2,000 Kunitz	LS002004	5 mg	
powder with glycine as a stabilizer.	units per mg	LS002006	20 mg	
Store at 2-8°C.	dry weight	LS002007	100 mg	
PROTECT FROM MOISTURE.		LS002009	Bulk	
Deoxyribonuclease I, Filtered				DCLS
Filtered through a 0.22 micron	≥ 2,000 Kunitz	LS002058	11 mg	
membrane and lyophilized in vials.	units per mg	LS002060	25 mg	
Store at 2-8°C.				
PROTECT FROM MOISTURE.				
Deoxyribonuclease I, Standard Vial				DSV
Lyophilized in vials for assay	~2,000 Kunitz	LS002173	2 ku	
standardization. Labeled to show	units per vial	LS002172	5x2 ku	
established activity. Not suitable for				
assays at neutral pH.				
Store at 2-8°C.				

Name	Activity	Catalog Number	Package	Code
Deoxyribonuclease I (Continued)				
PDS Kit, DNase Vial				D2
A component of the Papain Dissociation System. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 0.5 ml of EBSS or equivalent yields a solution of 2000 units/ml of deoxyribonuclease (1 mg/ml). Store at 2-8°C.	≥ 1,000 units per vial	LK003170 LK003172	1 vi 5 vi	
Deoxyribonuclease I				DP
Partially purified. A lyophilized powder. Store at 2-8°C. PROTECT FROM MOISTURE.	≥ 2,000 Kunitz units per mg dry weight	LS002138 LS002139 LS002140 LS002141	25 mg 100 mg 1 gm Bulk	
Deoxyribonuclease I				DPB
Partially purified. A lyophilized powder. Store at 2-8°C. PROTECT FROM MOISTURE.	≥ 1,250 Kunitz units per mg dry weight	LS002145 LS002147 LS002149	100 mg 1 gm Bulk	



Bringing you new ways to stay abreast of current methods, applications and products.

Name	Activity	Catalog Number	Package	Code
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Elastase

Source: Porcine Pancreas

I.U.B.: 3.4.21.36 CAS Number: 39445-21-1

Porcine pancreatic elastase has a molecular weight of 25.9 kDa, and a pH optimum of 8.5. While elastase will hydrolyze a wide variety of protein substrates, it is unique among proteases in its ability to hydrolyze native elastin, a substrate not attacked by trypsin, chymotrypsin or pepsin. Soybean trypsin inhibitor and kallikrein inhibitor suppress proteolytic but not elastolytic activity. Elastase is assayed using a method adapted from that of Feinstein *et al.*, *Biochem. Biophys. Res. Comm.*, 50, 1020 (1973) and using the more soluble substrate of Bieth *et al.*, *Biochem. Med.*, 11, 350 (1974).

Stability/Storage: Elastase is unstable at pH \leq 3.5. When stored as a dry powder the enzyme is stable for 6-12 months at 2-8°C. Elastase product codes: ES and ESL have poor solubility at neutral pH and at concentrations greater than 0.25%. It is helpful to make primary solutions in KCl or alkaline buffers before diluting into the reaction mixtures or media, compensating for ionic strength or pH changes. Stable at pH 4.0-10.4.

Technical Notes: 1 SucAla₃NA unit is approximately equivalent to 6 elastin digestion units. Aqueous liquid suspensions should be aseptically handled to avoid bacterial contamination. Due to the viscous nature of the aqueous suspension (Code: ES) the vial should be rinsed to recover contents.

Unit Definition: One Unit cleaves one micromole of N-succinyl-L-alanyl-L-alanyl-L-alanine-p-nitroanilide per minute at 25°C, pH 8.0.

Elastase, Purified

ESFF

Chromatographically purified.	≥ 8 Units per	LS006363	5 mg
A lyophilized powder.	mg protein	LS006365	20 mg
Store at 2-8°C.		LS006367	Bulk

REQUIRES SPECIAL SHIPPING: ICE PACK

Elastase, Lyophilized

ESL

Two times crystallized, (Code: ESL),	≥ 3 Units per	LS002290	25 mg
supplied as a dialyzed, lyophilized powder.	mg protein	LS002292	100 mg
The enzyme should be 0.22 micron		LS002294	1 gm
filtered after reconstitution and prior		LS002298	Bulk

to use. Suitable for the isolation of Type II lung cells. Store at 2-8°C. Does not require special shipping.

Elastase, Suspension

ES

Two times crystallized. Supplied as an	≥ 3 Units per	LS002274	25 mg
aqueous suspension. This preparation	mg protein	LS002279	100 mg
must be diluted to dissolve the enzyme.		LS002280	1 gm
The diluted enzyme should be 0.22 micron		LS002276	Bulk

filtered before use. Suitable for the isolation of Type II lung cells. Store at 2-8°C. DO NOT FREEZE. REQUIRES SPECIAL SHIPPING: ICE PACK

Name	Activity	Catalog Number	Package	Code
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Hepatocyte Isolation System

Most traditional methods published for isolating hepatocytes use crude and partially purified enzyme preparations including various types of collagenase and other proteases. More recently the use of better characterized preparations of collagenase such as Worthington Types 1 - 7 (CLS-1-7) have provided better results. All partially purified collagenase preparations can contain lot-variable contaminating proteases, esterases and other enzymes requiring researchers to pre-screen several lots of enzyme and/or continually modify isolation parameters and protocols.

The Worthington Hepatocyte Isolation System has been developed to provide researchers with a reliable, convenient, and consistent hepatocyte cell isolation system. By using the pre-optimized combination of enzymes contained in this kit, it is possible to minimize the lot-to-lot variation and improve the quality of the isolated hepatocytes. In addition, Worthington use-tests each lot by isolating hepatocytes from adult rat to assure performance, reliability, and consistent yield of viable cells. The method is based on that described by Berry *et al.*, and modified by Seglen, *Methods in Cell Biology*, 13 (Prescott, D. ed.), Academic Press, 29 (1976), and further optimized in conjunction with several researchers.

Stability/Storage: The reagents are stable at ambient temperatures for the periods of time expected in normal shipping procedures, but the package should be refrigerated upon arrival. Contents may be stored at 2-8°C for 4-6 months before use. Store at 2-8°C.

Package Contents: The package contains sufficient materials for five separate adult rat liver perfusions. For larger or smaller tissue applications, prepare proportionate volumes of reagents at each step and combine them in the same ratio as described in the protocol.

- **Vial #1:** 10X CMF-HBSS Concentrate, 1 bottle, 500 ml

Sterile calcium- and magnesium-free Hank's Balanced Salt Solution (CMF-HBSS). The solution is used for washing and perfusing the liver prior to the addition of the dissociating enzyme solution.

- **Vial #2:** Collagenase/Elastase Enzyme Vial, 5 vials

Containing collagenase (Code: CLS-1) and elastase (Code: ESL) $\geq 20,000$ u/vial and ≥ 30 u/vial respectively.

Before use, reconstitute with the L-15/MOPS solution and swirl gently to dissolve contents.

Store unreconstituted vials at 2-8°C.

- **Vial #3:** 1,000 units DNase I each, 5 vials

Worthington DNase I (Code: D), filtered through 0.22 μ m pore size membrane, and lyophilized. Before use, reconstitute with L-15/MOPS solution and swirl gently to dissolve contents. Store unreconstituted vials at 2-8°C.

- **Vial #4:** 0.15 M MOPS, pH 7.5, 1 bottle, 75 ml

0.15 M MOPS, pH 7.5 buffer concentrate, used to buffer the reconstituted Leibovitz L-15 media.

- **Vial #5:** 7.5% Sodium Bicarbonate (NaHCO_3), 1 bottle, 100 ml

7.5% Sodium bicarbonate concentrate, used to buffer the diluted CMF-HBSS.

- **Pouch**, containing Leibovitz L-15 Media Powder, 1 x 1L

Reconstitute entire contents of pouch by cutting open top of envelope and pouring contents into beaker containing approximately 800 ml of cell culture grade water. Rinse pouch 2 - 3 times with an additional 100 ml water. Bring total volume to 1000 ml and filter through a 0.22 micron membrane.

Hepatocyte Isolation System

The package contains sufficient materials for five separate adult rat liver perfusions including five single use CLSH enzyme vials, five single use DNase vials, 10X CMF-Hank's Balanced Salt Solution, L-15 Media Powder, 0.15 M MOPS buffer, 7.5% sodium bicarbonate solution and optimized protocol. Store at 2-8°C.

N/A

LK002060

1 bx

HIS

Name	Activity	Catalog Number	Package	Code
Hepatocyte Isolation System (Continued)				
Collagenase/Elastase Vial, HIS Kit				CLSH
Worthington collagenase (Code: CLS-1)	≥ 20,000 u/vial	LK002066	1 vi	
and elastase (Code: ESL), filtered through 0.22 µm pore size membrane, and lyophilized. Before use, reconstitute with the L-15/MOPS solution and swirl gently to dissolve contents. Store unreconstituted vials at 2–8°C.	≥ 30 u/vial	LK002067	5 vi	
DNase Vial, HIS Kit				D2
A component of the Hepatocyte Isolation kit containing 1,000 units DNase I each, 5 vials Worthington DNase I (Code: D), filtered through 0.22 µ pore size membrane, and lyophilized. Before use, reconstitute with L-15/MOPS solution and swirl gently to dissolve contents. Store unreconstituted vials at 2–8°C.	≥ 1,000 units per vial	LK003170 LK003172	1 vi 5 vi	
Hank's Balanced Salt Solution (HBSS-CMF) 10X Solution, HIS Kit				HBSS10
10X CMF-HBSS Concentrate, 1 bottle, 500 ml. Sterile calcium- and magnesium-free Hank's Balanced Salt Solution (CMF-HBSS). The solution is used for washing and perfusing the liver prior to the addition of the dissociating enzyme solution. Store at 2–8°C.	N/A	LK002064	1 ea	



We keep a close eye on citations both peer-reviewed articles and open access publications to assist you in choosing the best protocol and products for your research.

Name	Activity	Catalog Number	Package	Code
Hepatocyte Isolation System (Continued)				
L-15 Media Powder, HIS Kit Leibovitz L-15 media powder, a component of the HIS kit. Reconstitute entire contents of pouch, QS to 1 liter with cell culture grade water, and 0.22 micron filter. Suitable for cell isolation and culture applications. Store at 2-8°C.	N/A	LK003250	1 ea	L15NK
0.15 M, MOPS Buffer, HIS Kit 0.15 M MOPS, pH 7.5, 0.22 µ filtered. Buffer concentrate used to buffer the constituted Leibovitz L-15 media in Hepatocyte Isolation System. Store at 2-8°C.	N/A	LK002070	1 ea	MOPS
Sodium Bicarbonate, 7.5%, HIS Kit 7.5% Sodium Bicarbonate (NaHCO ₃), 1 bottle, 100 ml 7.5% sodium bicarbonate concentrate, used to buffer the diluted CMF-HBSS. Store at 2-8°C.	N/A	LK002069	1 ea	NAH

Name	Activity	Catalog Number	Package	Code
Hyaluronidase				
Source: Bovine Testes				
I.U.B.: 3.2.1.35 CAS Number: 37326-33-3				
Testicular hyaluronidase is a glycoprotein containing 5% mannose and 2.7% glucosamine. Optimum pH range is 4.5-6.0. The enzyme catalyzes the hydrolysis of endo-N-acetylhexosaminic bonds of hyaluronic acid and chondroitin sulfate A and C (but not B), primarily to tetrasaccharide residues.				
Unit Definition: One unit is based on the change in absorbency (turbidity) at 540nm of an internal standard assayed concurrently with each lot. Internal standard replaces USP/NF reference no longer available.				
Hyaluronidase A partially purified, dialyzed, lyophilized powder. Store at -20°C.	≥ 300 units per mg dry weight	LS002594 LS002592 LS002591	50 ku 300 ku Bulk	HSE
Hyaluronidase, Purified Chromatographically purified. A dialyzed, lyophilized powder. Store at -20°C.	≥ 3,000 units per mg dry weight	LS005477 LS005475 LS005474 LS005479	5 ku 15 ku 30 ku Bulk	HSEP

Name	Activity	Catalog Number	Package	Code
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Neonatal Cardiomyocyte Isolation System

The Worthington Neonatal Cardiomyocyte Isolation System has been developed to provide researchers with a reliable, convenient, and consistent neonatal rat cardiomyocyte cell isolation method. By using purified, rather than crude enzyme preparations, it has been possible to minimize the lot-to-lot variation. In addition, Worthington use-tests the kits by isolating cardiomyocytes from neonatal rat hearts to assure performance, reliability and consistent yield of viable cells. The kit has been formulated in collaboration with Dr. Ronal MacGregor. The method is based on that described by Toraason *et al.*, *Toxicol.* 56, 107 (1988) in which the minced tissue is incubated overnight with purified trypsin at 2-8°C. As pointed out by Toraason, this step reduces the hands-on time required to harvest cells compared to the time involved in sequential incubations in warm trypsin or collagenase. Purified collagenase rather than crude collagenase is used to maximize yield and viability.

Contents of Kit

The package contains sufficient materials for five separate tissue dissociations, each containing up to twelve hearts. For larger or smaller tissue samples prepare proportionate volumes of reagents at each step and combine them in the same ratio as described in the protocol.

- **Vial 1:** 1 bottle, 500 ml: Sterile calcium- and magnesium-free Hank's Balanced Salt Solution (CMF HBSS), pH 7.4. The solution is used for reconstituting the contents of Vials #2 and #3 in addition to serving as the medium for the dissociation.
- **Vial 2:** 5 vials, 1000 µg each: Worthington Trypsin (Code: TRLS), chromatographically purified, dialyzed against 1 mM HCl, filtered through 0.22 micron pore size membrane, and lyophilized. Before use, reconstitute with 2 ml CMF HBSS (Vial #1) and swirl gently to dissolve contents. Store at 2-8°C.
- **Vial 3:** 5 vials, 2000 µg each: Worthington Soybean Trypsin Inhibitor (Code: SIC), a 0.22 micron pore size membrane-filtered, lyophilized powder. Before use, reconstitute with 1 ml CMF HBSS (Vial #1) and swirl gently to dissolve contents. Store at 2-8°C.
- **Vial 4:** 5 vials, 1500 units each: Worthington Purified Collagenase (Code: CLSPA), a 0.22 micron pore size membrane-filtered, lyophilized powder which has been chromatographically purified. It contains less than 50 caseinase units per milligram and is composed of two separable but very similar collagenases. Before use, reconstitute with 5 ml Leibovitz L-15 media (prepared as described below) and swirl gently to dissolve contents. Store at 2-8°C.
- **Pouch Containing Leibovitz L-15 Media Powder:** 1 x 1L, Reconstitute entire contents of pouch by cutting open top of envelope and pouring contents into beaker containing 800 ml of cell culture grade water. Rinse pouch 2-3 times with additional 100 ml. Bring total volume to 1 liter and filter through a 0.22 micron pore size filter.

The kit also includes 5 Cell Strainers (Falcon), a card correlating phenol red color with pH for checking balanced salt solutions and culture media.

Neonatal Cardiomyocyte Isolation System

Kit for performing five separate tissue dissociations, each containing up to twelve hearts. Contains single use vials of purified collagenase and trypsin, CMF-HBSS, Leibovitz L-15 media and Falcon cell strainers along with a detailed protocol. The kit is use-tested by Worthington to assure performance. Store at 2-8°C.

N/A

LK003300
LK003303

1 ki
3 ki

NCIS

Collagenase Vial, NCIS

A component of the NCIS kit. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 5 ml of HBSS or equivalent yields a solution of 300 units/ml of collagenase, Code: CLSPA. Suitable for cell isolation and culture applications. Store at 2-8°C.

≥ 1500 units
per vial

LK003240
LK003245

1 vi
5 vi

CLSPANK

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Name	Activity	Catalog Number	Package	Code
Neonatal Cardiomyocyte Isolation System (Continued)				
Trypsin Vial, NCIS				TRLSNK
A component of the NCIS kit.	≥ 180 Units	LK003220	1 vi	
This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials.	per vial	LK003225	5 vi	
A vial reconstituted with 2 ml of HBSS yields a solution of 500 µg/ml of trypsin, Code: TRLS. Suitable for cell isolation and culture applications. Store at 2-8°C.				
Inhibitor Vial, NCIS				SICNK
A component of the NCIS kit.	1 mg inhibits	LK003230	1 vi	
This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials.	at least 0.75	LK003235	5 vi	
A vial reconstituted with 1 ml of HBSS or equivalent yields a solution of 2 mg/ml of trypsin inhibitor, Code: SIC. Suitable for cell isolation and culture applications. Store at 2-8°C.	mg trypsin Code: TRL			
HBSS Solution				HBSS
Sterile calcium and magnesium free Hank's balanced salt solution (CMFHBSS), pH 7.4, as supplied in the NCIS kit; 1 x 500 ml. Store at 2-8°C.	N/A	LK003210	1 ea	
L-15 Media Powder				L15NK
Leibovitz L-15 media powder, a component of the NCIS kit. Reconstitute entire contents of pouch, QS to 1 liter with cell culture grade water, and 0.22 micron filter. Suitable for cell isolation and culture applications. Store at 2-8°C.	N/A	LK003250	1 ea	
Cell Strainers (Falcon)				CELSTRNK
Cell strainers (Falcon), components of the NCIS kit. Suitable for removal of tissue debris in cell isolation applications. Store at room temperature.	N/A	LK003265	5 ea	

Name	Activity	Catalog Number	Package	Code
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Neutral Protease (Dispase®), Animal Free

Source: *Bacillus polymyxa*

I.U.B.: 3.4.24.28 CAS Number: 42613-33-2

A metallo, neutral protease, purified by methods developed at Worthington. Its mild proteolytic action makes the enzyme especially suitable for the preparation of primary and secondary (subcultivation) cell culture. This protease is also used as a secondary enzyme in cell isolation and tissue dissociation applications.

Stability/Storage: Stable at 2-8°C for 12 months. Store at 2-8°C. After reconstitution with water or buffer, aliquot and store at -20°C.

Unit Definition: One Unit releases Folin positive amino acids equivalent to 1 micromole tyrosine per minute from casein at 37°C, pH 7.5.

Neutral Protease (Dispase®), Purified

Chromatographically purified.

A lyophilized powder.

Store at 2-8°C.

≥ 4 Units per
mg dry weight

LS02100

LS02104

LS02106

LS02108

10 mg

50 mg

250 mg

Bulk

NPRO



Neutral Protease, Partially Purified

Partially purified. A lyophilized powder.

Store at 2-8°C.

≥ 0.1 Units per
mg dry weight

LS02109

LS02111

LS02112

1 gm

5 gm

Bulk

NPRO2



Name	Activity	Catalog Number	Package	Code
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Ovalbumin

Source: Egg White

CAS Number: 9006-59-1

Ovalbumin is a glycoprotein with molecular weight of 45 kDa. The molecule consists of a polypeptide with up to two phosphate groups per mole and a side chain of mannose and glucosamine residues.

LowEndo™ Ovalbumin, Purified

Ovalbumin, purified to remove endotoxin.

A dialyzed, lyophilized powder.

Store at 2-8°C.

≥95% Purity
(SDS-PAGE)
≤1 Endotoxin
unit per mg

LS003059

LS003061

LS003062

LS003064

10 mg

100 mg

500 mg

Bulk

OAEF

Ovalbumin, Purified

Highly purified. Major protein of egg white, with a molecular weight of 45 kDa.

A dialyzed, lyophilized powder.

Store at 2-8°C.

N/A

LS003056

LS003054

LS003052

100 mg

1 gm

Bulk

OAC

Ovalbumin

Major protein of egg white, with a molecular weight of 45 kDa. A lyophilized powder.

Store at 2-8°C.

N/A

LS003049

LS003048

LS003050

1 gm

5 gm

Bulk

OA

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Name	Activity	Catalog Number	Package	Code
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Papain

Source: *Carica papaya* Latex

I.U.B.: 3.4.22.2 CAS Number: 9001-73-4

Papain is a sulfhydryl protease from *Carica papaya* Latex. It has a molecular weight of 23 kDa and an optimum pH range of 6.0-7.0. The action of papain on leucine methyl ester produces an insoluble polyleucine peptide. Papain breaks down the intercellular matrix of cartilage. Papain is activated by cysteine, sulfide, and sulfite. Stabilizing agents are EDTA, cysteine and dimercaptoethanol.

Stability/Storage: Stable for 6-12 months at 2-8°C. Do not freeze aqueous suspensions.

Technical Notes: Papain preparations should be incubated in the activation solution before use to ensure full activity. Applications include antibody fragmentation and primary/neural cell isolation.

Unit Definition: One Unit hydrolyzes one micromole of benzoyl-L-arginine ethyl ester per minute at 25°C, pH 6.2, after activation in a solution containing 1.1 mM EDTA, 0.067 mM mercaptoethanol and 5.5 mM cysteine-HCl for 30 minutes.

Papain, Suspension

PAP

Supplied as a 2X crystalline suspension in 50 mM sodium acetate, pH 4.5. To ensure full activity, the enzyme should be incubated in a solution containing 1.1 mM EDTA, 0.067 mM mercaptoethanol and 5.5 mM cysteine-HCl for 30 minutes. It is recommended that the enzyme be 0.22 micron filtered after dissolution and prior to use. Store at 2-8°C.	Activates ≥ 20 Units per mg protein	LS003124 LS003126 LS003127 LS003128	25 mg 100 mg 1 gm Bulk
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REQUIRES SPECIAL SHIPPING: ICE PACK

Papain, Lyophilized

PAPL

Supplied as a lyophilized powder prepared from a 2X crystalline suspension, Code: PAP. To ensure full activity, the enzyme should be incubated in a solution containing 1.1 mM EDTA, 0.067 mM mercaptoethanol and 5.5 mM cysteine-HCl for 30 minutes. It is recommended that the enzyme be 0.22 micron filtered after dissolution and prior to use. Store at 2-8°C.	Activates ≥15 Units per mg protein	LS003118 LS003119 LS003120 LS003122	25 mg 100 mg 1 gm Bulk
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PDS Kit, Papain Vial

PAP2

A component of the Papain Dissociation System, for use in the tissue dissociation method of Huettnner, J., and Baughman, R., <i>J. Neuroscience</i> , 6, 3044 (1986). Contains papain, L-cysteine, and EDTA. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 5 ml of EBSS or equivalent yields a solution at 20 Units of papain per ml in 1 mM L-cysteine with 0.5 mM EDTA. Store at 2-8°C.	≥ 100 Units per vial	LK003176 LK003178	1 vi 5 vi
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Name	Activity	Catalog Number	Package	Code
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Papain (Neural) Dissociation System

The Worthington Papain Dissociation System is a set of reagents intended for use in the neural cell isolation method of Huettnner and Baughman, *J. Neurosci.*, 6, 3044 (1986). The materials are designed for convenience and simplicity and are useful to the occasional user as well as the more experienced and frequent user. Each lot is use-tested for performance in rat spinal neural cell isolation and this kit provides freshly prepared enzyme solutions for each dissociation.

Stability/Storage: The reagents are stable at ambient temperatures for the periods of time expected in normal shipping procedures, but the package should be refrigerated upon arrival. Contents may be stored at 2-8°C for 4 months before use. Store at 2-8°C.

Package Contents

The package contains sufficient materials for dissociation of five separate tissue aliquots of up to 0.3-0.4 cm³ each. For larger tissue samples prepare proportionately larger volumes of reagents at each step and combine them in the same ratio as described in the protocol.

- **Vial 1:** Sterile Earle's Balanced Salt Solution (EBSS) with calcium, magnesium, bicarbonate and phenol red, one vial per package, 100 ml. Aliquots of this vial are used to reconstitute other vials and to prepare dilute inhibitor solution. Refrigerate between uses and equilibrate with sterile O₂:CO₂ before each use.
- **Vial 2:** Papain containing L-cysteine and EDTA, 5 x 100 Unit single-use vials per package. The material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 5 ml of EBSS (Vial 1) yields a solution at 20 Units of papain per ml in 1 mM L-cysteine with 0.5 mM EDTA. Brief incubation at 37°C is needed to insure full solubility and activity.
- **Vial 3:** Deoxyribonuclease I (DNase), 5 x 1000 unit single use vials per package. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 0.5 ml of EBSS (Vial 1) yields a solution at 2000 units of deoxyribonuclease per ml. Avoid vigorous mixing.
- **Vial 4:** Ovomucoid protease inhibitor with bovine serum albumin, one vial per package, 32 ml upon reconstitution. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 32 ml of EBSS (Vial 1) yields a solution at an effective concentration of 10 mg of ovomucoid inhibitor and 10 mg of albumin per ml. Aliquots of this vial are used for each dissociation. Refrigerate between uses and equilibrate with sterile O₂:CO₂ before each use. Stable after reconstitution when stored at 2-8°C.

Also included is a card correlating color with pH for use as a guide in O₂:CO₂ equilibration.

Papain Dissociation System

PDS

Set of five single use vials of papain and	N/A	LK003150	1 bx
five single use vials of DNase, 100 ml of		LK003153	3 bx
Earle's balanced salt solution (EBSS), and			
an inhibitor vial for use in the tissue			
dissociation method of Huettnner and			
Baughman, <i>J. Neuroscience</i> , 6, 3044			
(1986). Use-tested by Worthington			
using new-born rat pup spinal cord.			
The package contains sufficient materials			
for dissociation of five separate tissue			
aliquots of up to 0.3-0.4 cm ³ each.			
Store at 2-8°C.			

Papain Dissociation System, Without EBSS

PDS2

Complete kit as described for product Code:	N/A	LK003160	1 bx
PDS, but without the Earle's Balanced Salt		LK003163	3 bx
Solution (EBSS).			
Store at 2-8°C.			

Name	Activity	Catalog Number	Package	Code
Papain (Neural) Dissociation System (Continued)				
PDS Kit, Papain Vial				PAP2
A component of the Papain Dissociation System, for use in the tissue dissociation method of Huettnner and Baughman, <i>J. Neuroscience</i> , 6, 3044 (1986). Contains papain, L-cysteine, and EDTA. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 5 ml of EBSS or equivalent yields a solution at 20 Units of papain per ml in 1 mM L-cysteine with 0.5 mM EDTA. Store at 2-8°C.	≥ 100 Units per vial	LK003176 LK003178	1 vi 5 vi	
PDS Kit, DNase Vial				D2
A component of the Papain Dissociation System. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 0.5 ml of EBSS or equivalent yields a solution of 2000 units/ml of deoxyribonuclease (1 mg/ml). Store at 2-8°C.	≥ 1,000 units per vial	LK003170 LK003172	1 vi 5 vi	
PDS Kit, Inhibitor Vial				OI-BSA
Ovomucoid protease inhibitor and bovine serum albumin which is 0.22 micron filtered and lyophilized in autoclaved vials to contain 10 mg/ml each upon reconstitution with 32 ml of EBSS. Store at 2-8°C.	≥ 300 mg TRL inhibited per vial	LK003182	1 vi	
PDS Kit, EBSS Vial				EBSS
Earle's balanced salt solution (EBSS) as supplied in the Papain Dissociation System. Store at 2-8°C.	N/A	LK003188	1 vi	



We support the new generation of life science researchers, as well as STEM education programs.

Name	Activity	Catalog Number	Package	Code
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Pepsin

Source: Porcine Stomach

I.U.B.: 3.4.23.1 CAS Number: 9001-75-6

Pepsin is an acidic protease. Its inactive zymogen precursor, pepsinogen, is produced in the stomach mucosa. There are several pepsins designated A, B, C, and D. Pepsin A, the major component, has a molecular weight of 35 kDa and an optimum pH of approximately 1.0 for substrates such as casein or hemoglobin if the substrate is native protein. Pepsin cleaves proteins preferentially at carboxylic groups of aromatic amino acids such as phenylalanine and tyrosine. It will not cleave at bonds containing valine, alanine or glycine. Pepsin is assayed based on the method of Anson, *J. Gen. Physiol.*, 22, 79 (1938) using hemoglobin as the substrate. Pepsin is unstable above pH 6.

Stability/Storage: Pepsin is stable for 1-2 years at 2-8°C.

Unit Definition: One unit releases 0.001 A₂₈₀ as TCA soluble hydrolysis products from denatured hemoglobin per minute at 37°C. One FIP Unit, expressed as micromoles of tyrosine equivalents liberated per minute at 25°C, can be calculated as follows: 1 Worthington unit x 0.0071 = FIP Units.

Pepsin A

Two times crystallized from dilute alcohol.
A lyophilized powder.
Store at 2-8°C.

≥ 2,500 units
per mg dry
weight

LS003319
LS003317
LS003322

1 gm
10 gm
Bulk

PM



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Worthington Protease Products, Specifications and Applications Table

Enzyme	Specificity	Molecular Weight KDa	pH Optimum	Extinction Coefficient E1%, 280nm	Common Substrates	Activators	Inhibitors	Product Code/ Applications
Partially Purified for Tissue Dissociation and Protein Digestion								
Collagenase	-Pro-X- \uparrow -Gly-Pro-Y- X = neutral Y = nonspecific	68-130	6.3-7.5	13.20 (ColH, Theoretical) 13.40 (ColG, Theoretical)	Collagen FALGPA Wünsch	Ca ²⁺ , Zn ²⁺	α 2-macroglobulin Cysteine, histidine DTT, 2-mercapto EDTA, EGTA Hg ²⁺ & other heavy metal ions <i>o</i> -phenanthroline	See page 14 for Collagenase products Tissue dissociation/ Primary cell isolation applications (see Tissue Dissociation Guide for specific references)
Elastase	Elastin, -X- \uparrow -Y- X = uncharged, nonaromatic Y = nonspecific	25.9	8.0-8.5	21.8 (Theoretical)	Casein Denatured collagen Elastin, Fibrin Suc-Ala3-NA	None required	α -antitrypsin DFP α 2-macroglobulin PMSF	ES/ESL, suspension/lyo powder, p. 28 Tissue Dissociation/ Primary cell isolation applications (see Tissue Dissociation Guide for specific references)
Neutral Protease (Dispase®)	-X- \uparrow -Leu/Phe- \uparrow -Y- X/Y = nonspecific	36.0	5.9-7.0	13.96 (Theoretical)	BAEE Casein	Ca ²⁺ , Mg ²⁺ , Mn ²⁺ , Fe ²⁺ , and Al ³⁺	EDTA, EGTA Hg ²⁺ & other heavy metal ions <i>o</i> -phenanthroline	NPRO/NPRO2, p. 44 Tissue Dissociation/ Primary cell isolation and cell harvesting applications (see Tissue Dissociation Guide for specific references)
Papain	-X- \uparrow -Y- X = nonspecific but Arg, Lys and Phe preferred Y = nonspecific	23.0	6.0-7.0	22.88 (Theoretical)	BAEE	Cysteine EDTA Reducing agents GSH, NBS	AESF, Antipain Cystatin, Leupeptin α 2-macroglobulin Hg ²⁺ & other heavy metal ions DFP, PMSF TLCK, TPCK, E-64	PAP/PAPL, suspension/lyo powder, p. 46 Neural tissue dissociation/ primary cell isolation applications (see Tissue Dissociation Guide for specific references) Antibody cleavage RBC modification
Pepsin	-X- \uparrow -Y- X = nonspecific but aromatic & hydrophobic preferred Y \neq Ala, Gly, Val	34.6	1.0-4.0 unstable \geq 5	14.39 (Theoretical)	Casein Hemoglobin	None required	Pepstatin A Diazoketones Epoxides	PM, p.50 Collagen bioprocessing/ purification Antibody cleavage
Proteinase K	-X- \uparrow -Y- X = nonspecific but aliphatic, aromatic & hydrophobic preferred Y = nonspecific	28.9	7.5-12	12.6 (Theoretical)	Casein Hemoglobin Keratin	Ca ²⁺ Active in 0.5-1% SDS	DFP EGTA PMSF	PROK, PROKS, p. 59 DNA/RNA purification
Trypsin	-X- \uparrow -Y- X = Arg, Lys Y = nonspecific	23.8	7.5-8.5	14.3	BAEE Casein TAME	Ca ²⁺ Lanthanide	Aprotinin, Benzamidine DFP, EDTA, Leupeptin α 2-macroglobulin PMSF, TLCK Trypsin Inhibitors (LBI, OI, SI/SIC)	See page 66 for Trypsin products Protein Digestion/ Sequencing (purified) Tissue dissociation/ Primary cell isolation applications (see Tissue Dissociation Guide for specific references)

Worthington Protease Products, Specifications and Applications Table

Enzyme	Specificity	Molecular Weight KDa	pH Optimum	Extinction Coefficient E1%, 280nm	Common Substrates	Activators	Inhibitors	Product Code/ Applications
Proteases For Protein Sequencing								
Carboxy-peptidase B	H2-N-Rn-Y- \rightarrow -X-COOH X = basic amino acids (Arg, Lys, Orn) Y = nonspecific	34.3	7.0-9.0	21.4 (Folk 1971)	Hippuryl-L-arginine	None required	EDTA Hg ²⁺ & other heavy metal ions EDTA, EGTA α -phenanthroline	COBC/COBPMS, p.4 Sequence analysis by successive cleavage of C-terminal basic amino acids Insulin production
Carboxy-peptidase Y	H2-N-Rn-Y- \rightarrow -X-COOH X, Y = non-specific, prefers aromatic	64.0	4.5-6.0	15.0 (Hayashi <i>et al.</i> 1973, and Kuhn <i>et al.</i> 1973)	ATEE Bz-Phe-Ala-Leu Z-Phe-Ala	None required	APCK, Aprotinin DFP 4-Hydroxymercuribenzoate PMSF	COY, p. 5 C-terminal sequencing & Modification/labeling of peptides and proteins
Chymotrypsin TLCK treated	-X- \rightarrow -Y- X = aromatic Y = nonspecific	25.6	7.8-8.0	20.57 (Theoretical)	ATEE BTEE	None required	α -antitrypsin Aprotinin DFP, PMSF, TPCK α 2-macroglobulin	CDSEQ, CDTLCK, p. 10 Sequence analysis Peptide synthesis, mapping/finger-printing
Endo-Arg-C (Clostripain)	-Arg- \rightarrow -Y- Y = nonspecific	53	7.4-7.8	16.57 (Theoretical)	BAEE	Ca ²⁺ Reducing agents	EDTA, TLCK, Tris Hg ²⁺ & other heavy metal ions	CPSEQ, CP, p.12 Peptide mapping & synthesis Sequence analysis Hydrolysis/condensation of amide bonds
Endo-Glu-C (Staph. Protease V8)	-Glu- \rightarrow -Y- (NH4 buffers pH 4, 7.8) -Asp- \rightarrow -Y- (PO4 buffer pH 7.8)	27.0	4.0 & 7.8	4.26 (Houmard 1976)	Casein Z-Phe-Leu-Glu-4NA	None required	DFP F-, Cl-, Br-, CH3COO- NO3- α 2-macroglobulin	STSEQ, STAP, p. 58 Peptide mapping & sequence analysis
SequENZ® Trypsin, Sequencing Grade, Modified	-X- \rightarrow -Y- X = Arg, Lys Y = nonspecific	23.8	7.5-8.5	14.3	BAEE Casein TAME	Ca ²⁺ Lanthanide	Aprotinin, Benzamidine DFP, EDTA, Leupeptin α 2-macroglobulin PMSF, TLCK Trypsin Inhibitors (egg white, lima bean, pancreatic, soybean)	TRSEQZ, Modified Sequencing Grade, p. 66 chemically modified to reduce autolysis Peptide mapping & sequence analysis Cleavage fusion proteins
Trypsin, Sequencing Grade, Native								TRSEQII, Sequencing Grade, Native, p. 67 Peptide mapping & sequence analysis Cleavage fusion proteins
Trypsin, TPCK Treated								TRTPCK, TPCK Treated, p. 67 Peptide mapping & sequence analysis Cleavage fusion proteins

Name	Activity	Catalog Number	Package	Code
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Protease, *Staphylococcus aureus* (Endoproteinase Glu-C)

Source: *Staphylococcus aureus* V8

I.U.B.: 3.4.21.19 CAS Number: 66676-43-5

Protease *Staphylococcus aureus* V8 (Endoproteinase-Glu-C) specifically cleaves peptide bonds on the COOH-terminal side of either aspartic or glutamic acids. In the presence of ammonium, the enzyme specificity is limited to glutamic sites. It has a molecular weight of 27 kDa and optimum pH of 4.0 and 7.8 with hemoglobin as the substrate. Protease *Staphylococcus aureus* V8 is inhibited by diisopropylfluorophosphate and monovalent anions such as F⁻, Cl⁻, CH₃COO⁻ and NO₃⁻. Enzyme activity is determined by the casein digestion assay described by Drapeau, *Methods Enzymol.*, 45, 469 (1976).

Stability/Storage: Autolysis occurs at temperatures greater than 40°C. The enzyme is fully active in USP 0.2% SDS. Stable for 12 months at 2-8°C.

Unit Definition: One unit causes a change of 0.001 A₂₈₀ nm per minute at 37°C, pH 7.8 using casein as the substrate.

Protease, *S. aureus* Sequencing Grade

Chromatographically purified according to Drapeau, *et al.*, *J. Biol. Chem.*, 247, 6720 (1972). Supplied in vials containing 10 µg or 50 µg lyophilized powder for protein sequencing applications. Store at 2-8°C.

≥ 500 units
per mg dry
weight

LS02126
LS02128
LS02129

5x10 ug
5x50 ug
Bulk

STSEQ

Protease, *S. aureus* (Endoproteinase Glu-C)

Chromatographically purified according to Drapeau, G., Boily, Y., and Houmard, J., *J. Biol. Chem.*, 247, 6720 (1972). A lyophilized powder. Store at 2-8°C.

≥ 500 units
per mg dry
weight

LS003608
LS003605
LS003606

1 mg
5 mg
Bulk

STAP



Worthington employees take pride in developing the highest quality enzymes.

Name	Activity	Catalog Number	Package	Code
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Proteinase K

Source: *Tritirachium album limber*

I.U.B.: 3.4.21.64 CAS Number: 39450-01-6

Proteinase K (PROK) is a serine endopeptidase with a broad spectrum of action, isolated from the fungus *Tritirachium album limber*. Worthington Proteinase K is supplied as a highly purified lyophilized powder. It is tested to be free of DNase and RNase.

Characteristics of Proteinase K from *Tritirachium album limber*:

Molecular weight: 28.9 kDa.

Extinction Coefficient: 14.2

pH Optimum: Stable over a wide pH range: 4.0-12.5, optimum pH 7.5-8.0, using denatured hemoglobin as substrate.

Stability: Although calcium ions do not affect the enzyme activity, they do protect PROK against autolysis and increase thermal stability when present at a concentration of 1 - 5 μ moles. An interesting characteristic of PROK is that it retains its activity in the presence of sodium dodecyl sulphate (SDS) or urea. (0.5 - 1% SDS and 1 - 4 M urea). Raising the temperature of the reaction from 37°C to 50 - 60°C can increase the activity several folds. A special feature of PROK is its ability to digest native proteins, thereby inactivating enzymes such as DNase and RNase without recourse to a denaturation process.

PROK is inactivated by diisopropyl fluorophosphate (DFP) or phenyl methane sulphonyl fluoride (PMSF). Chelating agents such as citrate and EDTA have no effect on the enzyme activity. PROK can also be inactivated by heating above 65°C for 15-20 minutes or by extraction with phenol/chloroform.

Storage: The lyophilized powder is stable for ≥ 1 year at 2-8°C. Solutions in 50 mM Tris-HCl, pH 8.0 with 1 mM CaCl_2 are stable for months at 2-8°C. Store at 2-8°C.

Unit Definition: One unit releases one micromole of Folin positive amino acids per minute, measured as tyrosine, at 37°C, pH 7.5, using urea denatured hemoglobin as the substrate.

Specificity: In addition to cleavage of peptide bonds, it is able to catalyze peptide amide hydrolysis.

Application: The recommended working concentration for PROK is 0.05-1 mg/ml.

PROK is very useful in the isolation of highly native, undamaged DNAs or RNAs, since most microbial or mammalian DNases and RNases are rapidly inactivated by the enzyme, particularly in the presence of 0.2 - 1% SDS.

Proteinase K

A lyophilized powder. Purified to remove DNase and RNase. Store at 2-8°C.

≥ 20 units per
mg dry weight

LS004220
LS004222
LS004224
LS004226

25 mg
100 mg
1 gm
Bulk

PROK

Proteinase K, Solution, 20mg/ml

A concentrated, ready to use liquid formulation. Proteinase K prepared at 20 mg/ml in 10 mM Tris-HCl, 1 mM calcium acetate, pH 7.5 containing 50% glycerol. DNase and RNase free. Store at -20°C

REQUIRES SPECIAL SHIPPING: ICE PACK.

≥ 400 units
per milliliter

LS004240
LS004242
LS004244

5 ml
25 ml
Bulk

PROKS

Name	Activity	Catalog Number	Package	Code
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Trypsin

Source: Bovine Pancreas

I.U.B.: 3.4.21.4 CAS Number: 9002-07-7

Trypsin is a pancreatic serine protease with substrate specificity based upon positively charged lysine and arginine side chains. It is derived from a 34 kDa inactive precursor zymogen, trypsinogen, after enzymatic removal of an N-terminal 6-amino acid leader sequence resulting in the 23.8 kDa trypsin molecule. The optimum pH is 8.0. Trypsin is inhibited by organophosphorus compounds such as diisopropylfluorophosphate and natural inhibitors from pancreas. Soybean, lima bean, and egg white are also sources of natural inhibitors. Trypsin cleaves amide and ester bonds of Arg and Lys. The Worthington Sequencing Grade Trypsin has been further purified to remove trace contaminating proteases and autolysis products which could interfere in trypsin digestion experiments, and exhibits a single band on SDS PAGE.

Uses: For tissue culture work, Worthington trypsin, Codes: TRL, TRLS, TRLVMF and TRTVMF have been used by many researchers. Product Codes: TRSEQZ, TRSEQII and TRTPCK are typically used for protein sequencing, mapping and structure studies. Worthington modified sequencing grade trypsin, Product Code: TRSEQZ, is subjected to extensive purification to remove contaminating proteases and tryptic autolysis by-products which could affect the specificity of the digestion process. Subsequently, the enzyme is chemically modified to minimize the autolysis process as well as increase the stability. The modified trypsin is processed further to remove residual autodegradation products. The specificity of the enzyme is routinely checked after the chemical modification.

Stability/Storage: Most grades of Worthington trypsin are stable for 2-3 years when stored at 2-8°C. Protect from moisture.

Unit Definition: TAME Unit: One Unit hydrolyzes 1 micromole of *p*-toluene-sulfonyl-L-arginine methyl ester (TAME) per minute at 25°C, pH 8.2, in the presence of 10 mM calcium.
One TAME Unit = 19.2 USP/NF units = 57.5 BAEE units.

Technical Notes: The Virus and Mycoplasma Free trypsin (Code: TRTVMF) has been filtered through an 0.22 micron pore size membrane, lyophilized, subjected to gamma irradiation, and tested for virus and mycoplasma.

Worthington certifies that all lots of Trypsin products are subjected to a pH of less than 3.0 for greater than five (5) hours during processing.

SequENZ® Trypsin, Modified, Sequencing Grade

TRSEQZ

Trypsin, treated with	≥ 150 Units	LS02120	4 x 25 µg
L-(tosylamido-2-phenyl) ethyl	per mg protein	LS02122	4 x 100 µg
chloromethyl ketone to inhibit	(≥ 8,625	LS02123	1 mg
contaminating chymotryptic activity,	BAEE/2875	LS02124	Bulk
chemically modified to promote stability	USP/NF units		
and further purified to remove autolysis	per mg protein)		
fragments, resulting in a highly stable			
trypsin product resistant to autolysis			
while retaining specificity.			
Store at -20°C			
PROTECT FROM MOISTURE.			
REQUIRES SPECIAL SHIPPING: ICE PACK			

Name	Activity	Catalog Number	Package	Code
Trypsin (Continued)				
Trypsin, Purified, Sequencing Grade II				TRSEQII
Bovine trypsin that has been treated with L-(tosylamido-2-phenyl) ethyl chloromethyl ketone (TPCK) to inhibit contaminating chymotryptic activity and extensively purified to remove autolysis products. Supplied as a lyophilized powder. Store at -20°C. PROTECT FROM MOISTURE. REQUIRES SPECIAL SHIPPING: ICE PACK	≥ 150 Units	LS02115	4 x 25 µg	
	per mg protein	LS02117	4 x 100 µg	
	(≥ 8,625	LS02119	1 mg	
	BAEE/2875	LS02118	Bulk	
	USP/NF units			
	per mg protein)			
Trypsin, TPCK Treated				TRTPCK
A chromatographically purified, diafiltered, lyophilized powder that has been treated with L-(tosylamido-2-phenyl) ethyl chloromethyl ketone (TPCK) to inhibit contaminating chymotryptic activity (Kostka and Carpenter, <i>J. Biol. Chem.</i> 239, 1799, 1964. Store at 2-8°C. PROTECT FROM MOISTURE.	≥ 180 Units	LS003740	100 mg	
	per mg protein	LS003741	500 mg	
	(≥ 10,350	LS003744	1 gm	
	BAEE/3,450	LS003742	Bulk	
	USP/NF u/mg			
	protein)			
Trypsin 3X				TRL3
Supplied as a chromatographically purified, diafiltered and lyophilized powder. Store at 2-8°C. PROTECT FROM MOISTURE.	≥ 180 Units	LS003708	100 mg	
	per mg	LS003707	1 gm	
	protein	LS003709	Bulk	
	(≥ 10,350			
	BAEE/3,450			
	USP/NF u/mg			
	protein)			
Trypsin 2X				TRL
Supplied as a dialyzed and lyophilized powder. Store at 2-8°C. PROTECT FROM MOISTURE.	≥ 180 Units	LS003702	100 mg	
	per mg	LS003703	1 gm	
	protein	LS003704	10 gm	
	(≥ 10,350	LS003706	Bulk	
	BAEE/3,450			
	USP/NF u/mg			
	protein)			

Name	Activity	Catalog Number	Package	Code
Trypsin (Continued)				
Trypsin, 0.22µ Filtered				TRLS
Trypsin chromatographically purified, diafiltered, (Code TRL3) filtered through a 0.22 micron pore size membrane and lyophilized in sterile vials. This product is not tested for pyrogenicity. Store at 2-8°C. PROTECT FROM MOISTURE.	≥ 180 Units per mg protein (≥ 10,350 BAEE/3,450 USP/NF u/mg protein)	LS003736 LS003734 LS003738	50 mg 5 x 50 mg Bulk	
Trypsin Vial, NCIS				TRLSNK
A component of the NCIS kit. This material is 0.22 micron membrane filtered and lyophilized in autoclaved vials. A vial reconstituted with 2 ml of HBSS yields a solution of 500 µg/ml of trypsin, Code: TRLS. Suitable for cell isolation and culture applications. Store at 2-8°C.	≥ 180 Units per vial	LK003220 LK003225	1 vi 5 vi	
Trypsin, Sterile, Irradiated				TRLVMF
Chromatographically purified (Code: TRL), lyophilized, irradiated and tested for the absence of mycoplasma and extraneous virus according to 9 CFR113.53c. Each vial is filled to contain ≥ 100 mg. Store at 2-8°C.	≥ 180 Units per mg protein (≥ 10,350 BAEE/3,450 USP/NF u/mg protein)	LS004454 LS004452	100 mg 5 x 100 mg	
Trypsin, TPCK-Treated, Irradiated				TRTVMF
Chromatographically purified trypsin treated with L-(tosylamido-2-phenyl) ethyl chloromethyl ketone (TPCK) to inhibit contaminating chymotryptic activity according to (Kostka and Carpenter, <i>J. Biol. Chem.</i> 239, 1799, 1964), Code: TRTPCK, lyophilized, irradiated and tested for the absence of mycoplasma and extraneous virus according to 9 CFR 113.53c. Each vial is filled to contain ≥ 100 mg. Store at 2-8°C. PROTECT FROM MOISTURE.	≥ 180 Units per mg protein (≥ 10,350 BAEE/3,450 USP/NF u/mg protein)	LS003750 LS003752	100 mg 5 x 100 mg	

Name	Activity	Catalog Number	Package	Code
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Trypsin Inhibitors

CAS Number: 9035-81-8

Lima Bean Inhibitor: Lima bean trypsin inhibitor, which inhibits bovine as well as human trypsin and plasmin, acts upon both trypsin and chymotrypsin by forming equimolar complexes. Lima bean inhibitors may be chromatographically separated into as many as six variants. Jones *et al.*, *Biochem.*, 2, 66, (1963) characterized four of them. All have similar but not identical amino acid composition, contain six or seven disulfide bonds and lack methionine and tryptophan. Molecular weights vary between 8 kDa and 10 kDa.

Stability/Storage: The lima bean inhibitor is stable 1-2 years at 2-8°C.

Ovomucoid: Ovomucoids are the glycoprotein protease inhibitors of avian egg white. There are several protease inhibitors in egg white. The Worthington product is that described by Lineweaver and Murray, *J. Biol. Chem.*, 171, 565 (1947). It has a molecular weight of approximately 28 kDa.

Stability/Storage: Ovomucoid is stable 1- 2 years when stored at 2-8°C.

Soybean Inhibitor: The soybean trypsin inhibitor was first crystallized by Kunitz in 1945 and is one of several such inhibitors found in soybeans. Its molecular weight is 21.5 ± 0.8 kDa and the optimum pH is 7.0. Soybean inhibitor inhibits trypsin mole-for-mole and to a lesser extent chymotrypsin.

Stability/Storage: The soybean inhibitor is stable for 1-2 years at 2-8°C.

Unit Definition: The activity of the inhibitors is expressed as the amount of twice crystallized trypsin (Worthington Code: TRL) inhibited per milligram of inhibitor. 1 mg TRL ≥ 180 TAME units, 10,350 BAEE units, 3,450 USP/NF units.

Trypsin Inhibitor, Lima Bean

Animal Free

Fraction III of the preparation described by Fraenkel-Conrat *et al.*, *Arch. Biochem. Biophys.*, 37, 393 (1952). Supplied as a dialyzed, lyophilized powder. Store at 2-8°C.

1 mg inhibits
≥ 2.2 mg
trypsin,
Code: TRL

LS002829
LS002830
LS002831

100 mg
1 gm
Bulk

LBI



Trypsin Inhibitor, Ovomucoid

Mucoprotein and antitryptic factor of egg white described by Lineweaver and Murray, *J. Biol. Chem.*, 171, 565 (1947). A dialyzed, dried powder. Store at 2-8°C.

1 mg inhibits
≥ 1.2 mg
trypsin,
Code: TRL

LS003085
LS003087
LS003086
LS003089

500 mg
1 gm
2 gm
Bulk

OI

Trypsin Inhibitor, Soybean, Purified

Animal Free

Chromatographically purified. A dialyzed, lyophilized powder. Purity checked using SDS PAGE. Store at 2-8°C.

1 mg inhibits
≥ 1.2 mg
trypsin,
Code: TRL

LS003570
LS003571
LS003573

100 mg
1 gm
Bulk

SI



Trypsin Inhibitor, Soybean

Animal Free

Partially purified by methods developed at Worthington. A diafiltered, lyophilized powder. Store at 2-8°C.

1 mg inhibits
≥ 0.75 mg
trypsin,
Code: TRL

LS003587
LS003589
LS003590

1 gm
10 gm
Bulk

SIC



Ordering Information

Worthington provides various options to make ordering fast and convenient:

- **Call:** 1.800.445.9603 (8am – 5:30pm EST Mon. – Fri.)
1.732.942.1660
- **Fax:** 1.800.368.3108
1.732.942.9270 (24hr/day, 7 days/week)
- **E-mail:** custservice@Worthington-Biochem.com
techservice@Worthington-Biochem.com
- **Online/Website:** Worthington-Biochem.com
TissueDissociation.com
- **Write:** Worthington Biochemical Corporation
730 Vassar Avenue
Lakewood, New Jersey 08701 U.S.A

Terms of Sale

Prices effective January, 2019 and are subject to change without notice. Additional charges added for shipping, which will be prepaid and added to the invoice unless other arrangements are made at the time of ordering. Insurance will be charged for higher-value shipments at our discretion.

Payment terms are Net 30 Days, F.O.B. Origin, Lakewood, New Jersey USA, payable in US dollars. All checks must be drawn on a US bank or payment made by wire transfer. Past due accounts may be charged a 1.5% per month late payment fee.

Complete Standard Terms and Conditions of Sale available on our website.

VISA, MasterCard & American Express are also accepted.



Discounts

Quantity Discounts

<i>Quantity</i>	<i>Price</i>
1 to 4	List Price
5 to 9	5% off list
10 to 19	10% off list
20 or more	15% off list
Bulk	Inquire

Standing Orders & Additional Discounts

For orders of greater than 25 packages, or orders of material packed in bulk, contact your representative or the Bulk Sales Office for special pricing consideration. Standing orders may also qualify for discounts. We welcome long-term use projections for which we can consider special rates. Large institutional buyers should contact their representative regarding special purchasing agreements.

Bulk, Contract/Custom & OEM Enzyme Purchasing

As a primary manufacturer, Worthington can supply products in a wide range of purity and activity specifications and in large-scale bulk quantities at substantial discounts. In addition, we welcome inquiries for contract and custom manufacturing, custom analysis, and special packaging for OEM applications. Several products are listed as Bulk Only in this catalog due to limited availability. For more information on our services, see page 102. Please contact Customer Service or our Bulk Sales Office to discuss your specific requirements.

Complete Standard Terms and Conditions of Sale available on our website.

Technical Service

***Available 8:00 AM to 5:00 PM Eastern Time Monday through Friday.
We can be contacted 24 hours a day by fax, e-mail or through
our website.***

Worthington makes the products we sell and welcome your questions and suggestions. Because we are a primary manufacturer we have ready access to all production and quality control records of our products by lot number.

Our years of experience in enzyme purification put us in a position to assist individual researchers with special needs. We frequently do customized preparations of entirely new products. We can make modifications of a regular production procedure on a custom basis. Furthermore, our quality control department can do special testing if needed.



*Need help with protocols?
Ask a representative how we can
help update you with our latest
technical tools.*

Online Sampling Program

Our position as the principal manufacturer of research grade collagenase makes possible our Collagenase Sampling Program. Under the program, we provide 100 mg samples of up to three different lots of collagenase for evaluation in your own cell isolation systems. A period of 60 days is allowed for your evaluation of these samples. A minimum of 3 grams of each lot of collagenase will be placed on HOLD, reserved in your name. When you determine which lot performs best for you, specify the lot desired when ordering. The only requirement, once a suitable lot of collagenase is found, is that you purchase a minimum of 3 grams of the material.

There is no charge for participating in the Collagenase Sampling Program.

**Contact your representative or our Technical Service group for more information:
techservice@Worthington-Biochem.com.**

Collagenase Lot Selection Tool

Worthington's Collagenase Lot Selection Tool is available online at our website. This feature was designed to help researchers select and evaluate current collagenase lots that match previous lots or desired activity profiles. Users may enter target values for collagenase, caseinase, clostripain, and tryptic activities or specify previous lot numbers. Each value can be weighted based on the relative level of importance to the application. After the search for matches is completed, a ranked list of collagenase lots currently available is generated. The selected lots can then be sampled simply by using the built-in link to the Free Collagenase Sampling Program. As always, Worthington Customer and Technical Service personnel are available via phone and e-mail to assist with collagenase or any other products.

ISO 9001 Certified Quality Management System

Worthington Biochemical Corporation is company-wide ISO9001 certified and operates according to GMP guidelines. Our initial ISO assessment audit was performed by ANAB-accredited SGS US Testing Company, Systems & Services Certification in 2005 with continuous successful re-certifications.

Product Use

All Worthington products are sold for manufacturing, research, and laboratory use only by properly trained and authorized personnel. Researchers and clinical laboratory personnel intending to use any of these products for medical investigation on humans are solely responsible for such use, and for compliance with the pertinent regulations of the United States Food & Drug Administration (USFDA) and other regulations. We do not assume liability for damages resulting from the use of these products or from their use in violation of patent or other rights.

U.S.D.A. Certified Raw Materials

All products from animal sources are produced from starting materials of United States Department of Agriculture (USDA) or equivalent approved origin, collected in USDA or equivalent approved facilities, inspected to be free of disease and suitable for exportation. Certificates of Origin are available upon request.

Animal Free Products

Several Animal Free (AF) nucleases, proteases and other products are also available to eliminate BSE/TSE and mammalian viral risks. Please inquire. All animal free products are designated with this symbol for ease of use.



Product Returns

Authorization for any product return must be obtained from Worthington Biochemical Corporation (Customer Service Department), or its authorized representative, prior to the return of product. This authorization is required to insure the proper return of material and, if applicable, the correct issuance of credit. There is no provision for credit of misused, improperly stored or outdated material. Product(s) must be returned in the same condition as received within 30 days of the original shipment by Worthington Biochemical Corporation. A restocking fee may be charged.

Complete Standard Terms and Conditions of Sale available on our website.

Online Resources

Hundreds of pages of technical, product and reference information are available online at: Worthington-Biochem.com

Worthington Enzyme Manual
Tissue Dissociation Guide
Catalog and Price List
Online Collagenase Lot Selection Tool

Additional Features

Complete Searchability
Current Collagenase Lot Availability and Activities
Online Ordering and Technical Service
Updated Announcements and Exhibit Schedules
International Distributor Listing
Useful Links

Visit us at: [**facebook**](#) [**Linked in**](#)



Addressing your individual needs, we value every customer interaction. Let us know how we are doing.

Australia:

ScimaR

Email: scimar@bigpond.net.au

Austria:

Eubio

Email: eubio@eubio.at

Website: www.eubio.at

Belgium:

GESTIMED s.p.r.l./b.v.b.a.

Email: info@gestimed.be

Website: www.gestimed.be

Brazil:

Sellex

Email: vendas@sellex.com

Website: www.sellex.com

Sinapse Biotecnologia Ltda

Website: www.sinapsebiotecnologia.com.br

Canada:

Canadian Customers may contact us directly:

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Website: www.fermelo.cl

China:

4A Biotech Company, Ltd.

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Website: www.4aBio.com

EQUL Ltd.

Email: info@equl.com

Website: www.equl.com

Gene Company Ltd.

Email: info@genehk.com

Website: www.genehk.com

Genetimes Excell Technology, Inc.

Email: order@genetimes.com.cn

Website: www.genetimes.com.cn

MACGENE (Beijing) Biotechnology Ltd.

Email: order@macgene.com

Website: www.macgene.com

Shanghai 78 Biosciences Co., Ltd.

Website: www.qfbio.com

Shanghai Universal BioTech Co., Ltd.

Email: purchasing@univ-bio.com

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Website: www.serlabo.fr

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Website: www.genehk.com

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Website: www.ptgenetika.com

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Website: www.enco.co.il

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Website: www.bionordika.se

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Website: www.bioconcept.ch

Taiwan:

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Website: www.integrated-bio.com

Johnson & Annie Company, Ltd.

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Website: www.johnsonandannie.com

Protech Technology Enterprise Co. Ltd.

Email: service@bio-protech.com.tw

Website: www.bio-protech.com.tw

Thailand:

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Email: pacscien@ksc.th.com

Website: www.pacificscience.co.th

Please visit: Worthington-Biochem.com

For territories not listed or contact International Sales,

Email: international@Worthington-Biochem.com

Our Driving Force is Quality

The energy that drives all Worthington employees is the deep commitment to consistently produce superior quality products while providing personal service.

Our ISO9001 certified enzyme manufacturing facility and proprietary processes are designed specifically for the life science community, bioprocessing and OEM/private label business partners. We are proud to be a primary producer with over 90% of our products manufactured at our core facility located in Lakewood, New Jersey, USA.

Value Verified



ISO9001 Certified Quality Management System
All Processes Fully Documented and Traceable from Raw Materials through Final Shipment



Primary Producer For Biotech, Life Science Research, Diagnostic, Biopharmaceutical and Bioprocessing
Respected Manufacturer of High Quality, Lot-to-Lot Consistent Enzymes for Over 70 Years



Multi-Scale Extraction, Fermentation, Protein Purification, Lyophilization and Packaging Capabilities Produced Under GMP Guidelines
Internal Testing Capabilities include Enzyme, Protein, and Related Biochemical Analysis and Characterization



Animal-Free Certified and USDA Approved Animal-Sourced Products
Suitable for Worldwide Exportation



Flexible and Responsive Production Scheduling
Sample Lots and Bulk Inventories Available for Immediate Shipment



Superior Customer Services and Technical Support — Before, During and After Sale
Volume Purchases, Bulk Packaging, Standing Orders, OEM/Supply Agreements, and Special Arrangements



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