Life may be water-based but the components of life science research are not always water-soluble. Sigma detergents can solve your solubility challenges.

Detergents and Solubilization Reagents

Proteomics Kits and Reagents
Detergent Properties and Applications
BioUltra Detergents
Cyclodextrins
Antifoams
Your gateway to Biochemicals and Reagents for Life Science Research from Sigma

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Introduction

Vicki Caligur
Product Manager, Specialty Biochemistry
vicki.caligur@sial.com

Detergents have been staples in the research laboratory for over 60 years. A paper from 1946 regarding the isolation of *Escherichia coli* phage using cationic detergents cites earlier work on the lysis of bacteria and viruses with detergents.\(^1\) The ongoing challenge continues for analysis and preparation of proteins, nucleic acids, lipids, and small biomolecules in aqueous media. Life may be water-based but its components are not always water-soluble. Given the vast number of past publications, older reviews of detergent properties and applications are still informative. Recent articles on analysis, isolation, and crystallization of membrane proteins demonstrate detergents are not obsolete, but continue as important reagents in life science research.\(^2\)\(^-\)\(^4\)

For proteomics applications, the use of detergents focuses on the balance of attributes a detergent provides:

1. The detergent should solubilize the protein.
2. The detergent should stabilize the folded protein to maintain functionality.
3. The detergent must not interfere with downstream techniques. This may be accomplished by either selection of a non-interfering detergent or by removal of the detergent after isolation of the detergent-protein complex.

Since detergents are common, well-established reagents, it is useful to review their suitability for biomolecular solubilization and understand how to use physical parameters for detergent selection in a specific application. Even then, experimentation and evaluation are often required. As stated by Privé, “Despite the large number of detergents that are commercially available, no single “universal detergent” is ideally suited to all biochemical applications.”\(^5\)

In this issue of BioFiles, you will find

- **ProteoPrep**\(^\text{®}\) extraction kits, designed for native protein extraction from a variety of sources, including *Escherichia coli*, cell paste, and plant or animal tissue.
- **CelLytic**\(^\text{™}\), Sigma’s suite of reagents used for bacterial cell lysis and extraction of solubilized recombinant proteins, as well as mammalian and plant cell lysis.
- An extensive table of the physical properties and recommended biological applications for key detergents.
- **BioUltra** detergents for demanding applications, where minimizing impurities is a critical factor.
- Cyclodextrins for an alternative method to solubilize biochemicals
- **Porozorb**\(^\text{™}\) and **Rezorian**\(^\text{™}\) cartridges and **MiniTips**\(^\text{™}\) columns for detergent removal/depletion

References

## Proteomics Kits and Reagents

<table>
<thead>
<tr>
<th>Kit Components</th>
<th>ProteoPrep Membrane Extraction Kit</th>
<th>ProteoPrep Universal Extraction Kit</th>
<th>ProteoPrep Total Extraction Sample Kit</th>
<th>ProteoPrep Detergent Sample Pack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soluble Cytoplasmic and Loosely-bound Membrane Protein Extraction Reagent, 3 × 125 mL (S2813)</td>
<td>Soluble Cytoplasmic Extraction Reagent, 2 × 125 mL (S2688)</td>
<td>Protein Extraction Reagent Type 1 (C0481)</td>
<td>C7BzO, 1 g (C0856)</td>
<td></td>
</tr>
<tr>
<td>Protein Extraction Reagent Type 4, 23 mL (C0356)</td>
<td>Soluble Protein Resuspension Reagent, 23 mL (S3688)</td>
<td>Protein Extraction Reagent Type 2 (C0606)</td>
<td>CHAPS, 1 g (C9426)</td>
<td></td>
</tr>
<tr>
<td>Tributylphosphine Stock Solution, 5 × 0.5 mL (T7567)</td>
<td>Protein Extraction Reagent Type 4 (C0356)</td>
<td>Protein Extraction Reagent Type 3 (C0731)</td>
<td>ASB-14, 1 g (A1346)</td>
<td></td>
</tr>
<tr>
<td>Alkylation Reagent, Iodoacetamide, 5 × 56 mg (A3221)</td>
<td>Tributylphosphine Stock Solution, 5 × 0.5 mL (T7567)</td>
<td>Protein Extraction Reagent Type 4 (C0356)</td>
<td>SB3-10, 1 g (D4266)</td>
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</tr>
<tr>
<td></td>
<td>Alkylation Reagent, Iodoacetamide, 5 × 56 mg (A3221)</td>
<td>ProteoPrep Detergent Sample Pack</td>
<td>n-Dodecyl β-D-maltoside, 1 g (O6004)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Octyl β-D-glucopyranoside, 1 g (D4641)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Polyoxyethylene 10 tridecyl ether (C&lt;sub&gt;13&lt;/sub&gt;EO&lt;sub&gt;10&lt;/sub&gt;), 1 g (P2393)</td>
<td></td>
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<td></td>
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<td></td>
<td>BRJ&lt;sup&gt;®&lt;/sup&gt; 56, 1 g (P5759)</td>
<td></td>
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<td></td>
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<td></td>
<td>TRITON® X-100, 1 mL (T8532)</td>
<td></td>
</tr>
</tbody>
</table>

### Table 1: Sample Sizes and Applications

<table>
<thead>
<tr>
<th>Sample Sizes</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum 10 2-mL samples</td>
<td>For preparing a highly enriched membrane protein solution from many types of cells. Yields protein solution that is ideal for expression profiling by 2D gel electrophoresis and subsequent MS following detergent removal.</td>
</tr>
<tr>
<td>Minimum 6 2-mL samples</td>
<td>For the sequential isolation of separate soluble cytoplasmic and membrane proteins. Final protein solutions are uniquely ready for expression profiling by 2D gel electrophoresis and subsequent MS following detergent removal.</td>
</tr>
<tr>
<td>Minimum 10 2-mL samples</td>
<td>For testing or optimizing extraction conditions to produce total protein extracts and provides four fractions. Provides four proteins extracts for profiling by 2D electrophoresis and subsequent MS following detergent removal.</td>
</tr>
<tr>
<td>Minimum 10 2-mL samples</td>
<td>Varies with application. Innovative detergents for customizing and optimizing protein extraction protocols, which may vary with the protein of interest and cell type. Protein extracts are suitable for profiling by 2D electrophoresis and subsequent MS following detergent removal.</td>
</tr>
</tbody>
</table>

### Table 2: Sample Scale

<table>
<thead>
<tr>
<th>Sample Scale</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum 10 2-mL samples</td>
<td>This kit utilizes a powerful detergent for higher loading and high resolution of proteins in 2D gel electrophoresis, providing excellent visualization of low abundance/low copy proteins. This kit also includes reagents for reduction and alkylation of disulfide bonds.</td>
</tr>
<tr>
<td>Minimum 6 2-mL samples</td>
<td>This kit features innovative detergents, and uses specially formulated reagents to generate two subcellular protein fractions. The special reducing and alkylation reagents produce samples that exhibit improved focusing and decreased streaking in 2D gels.</td>
</tr>
<tr>
<td>Minimum 10 2-mL samples</td>
<td>This kit provides four extraction reagents of increasing solubilizing power. Along with conventional reagents, the kit also includes the newer generation of detergents. This allows comparison of the protein extractions obtained with each of the four reagents.</td>
</tr>
<tr>
<td>Minimum 10 2-mL samples</td>
<td>This sample pack contains 10 non-ionic and zwitterionic detergents for protein solubilization. Zwitterionic detergents uniquely offer some intermediate class properties that are superior to other detergent types. Each detergent is supplied in a convenient package.</td>
</tr>
</tbody>
</table>
ProteoPrep® Protein Extraction Kits

ProteoPrep Universal Extraction Kit
For the sequential isolation of separate soluble cytoplasmic & membrane protein fractions

This kit features new and innovative detergents, and uses specially formulated reagents and an optimized protocol designed to generate two prepared subcellular fractions that are uniquely ready for two-dimensional (2D) electrophoresis.

- Fraction 1: Soluble/Cytoplasmic Proteins
- Fraction 2: Membrane Proteins

The special reducing and alkylating reagents produce samples that exhibit improved focusing and decreased streaking in 2D gels. This kit provides reagents sufficient to process a minimum of ten samples, yielding two fractions each. This kit is appropriate for use with various model organism sample sources used in proteomics research. Improved solubility allows for higher protein loading capacities, resulting in improved visualization of low abundance proteins in 2D gels.

- Innovative detergent preparations - Highly improved solubility allows for higher protein loads and greater visibility of low abundance proteins on 2D gels.
- Two pre-mixed solubilization solutions - Generates two distinct populations for easy 2D analysis.
- Pre-measured reducing and alkylating reagents - Easy-to-use reagents provide improved IEF resolution.
- Pre-weighed dry blends - Stable and easy to reconstitute.
- Conveniently packaged - No waste; use only the amount needed.

ProteoPrep Membrane Extraction Kit
For total extraction of membrane proteins

This kit features new and innovative detergents, and uses specially formulated reagents and an optimized protocol to generate one fraction containing membrane proteins that is uniquely ready for two-dimensional (2D) electrophoresis. The special reducing and alkylating reagents produce samples that exhibit improved focusing and decreased streaking in 2D gels. This kit is appropriate for use with various model organism sample sources used in proteomics research. Higher protein loading capacities and improved solubility, especially for difficult membrane bound proteins, provide excellent visualization of low abundance/low copy proteins.

- Innovative detergent preparations - Improved solubility allows for higher protein loads and greater visibility of low abundance proteins in 2D gels.
- Two pre-mixed solubilization solutions - Removes interfering non-membrane proteins prior to extraction, resulting in uncluttered 2D arrays.
- Pre-measured reducing and alkylating reagents - Easy-to-use reagents provide improved IEF resolution.
ProteoPrep® Total Extraction Sample Kit

Components
Protein Extraction Reagent Type 1 (Sigma C0481)
Protein Extraction Reagent Type 2 (Sigma C0606)
Protein Extraction Reagent Type 3 (Sigma C0731)
Protein Extraction Reagent Type 4 (Sigma C0356)
Iodoacetamide (Sigma A3221) 5 x 56 mg
Tributylphosphine solution (Sigma T7567) 5 x 0.5 mL

store at: 2-8°C

PROTTOT-1KT 1 kit

ProteoPrep® Detergent Sample Kit

Components
ASB-14 (Sigma A1346) 1 g
Brij® 56 (Sigma P5759) 1 g
C7BzO (Sigma C0856) 1 g
Polyoxyethylene 10 tridecyl ether (Sigma P2393) 1 g
CHAPS (Sigma C9426) 1 g
n-Dodecyl β-D-maltoside (Sigma D4641) 1 g
Octyl β-D-glucopyranoside (Sal D08001) 1 g
Octyl β-D-1-thioglucopyranoside (Sigma O6004) 1 g
3-(Decyldimethylammonio)propanesulfonate inner salt (Sigma D4266) 1 g
Triton® X-100 (Sigma T8532) 1 ml

PROTDT-1KT 1 kit

ProteoPrep Total Extraction Sample Kit

For testing or optimizing extraction conditions to produce total protein extracts

This kit provides four extraction reagents of increasing solubilizing power, each of which can generate total protein extracts from cellular samples. Along with conventional reagents, the kit also includes the newest generation of detergent reagents. This allows comparison of the protein extractions obtained with each of the four reagents and optimization to meet your individual needs. The reducing and alkylating reagents produce protein samples that exhibit improved focusing and decreased streaking in 2D gels. Enough of each component is provided to process a minimum of ten samples by each extraction reagent. For researchers who have optimized an extraction protocol using one chaotropic extraction reagent, each reagent is available as an individual product as well.

- Four pre-mixed solubilization reagents - Enables rapid solubilization.
- Pre-measured reducing and alkylating reagents - Easy-to-use reagents provide improved IEF resolution.
- Innovative detergent preparations - Highly improved solubility allows higher protein loads and greater visibility of low abundance proteins in 2D gels.

ProteoPrep Detergent Sample Kit

Customize & optimize your protein extraction using the most innovative detergents available.

Protein extraction is considered by many to be the most critical step of proteomic analysis; proteins to be studied must first be solubilized. The ProteoPrep Detergent Sample pack contains 10 detergents, non-ionic and zwitterionic, for solubilization of membrane proteins. The variety of detergents enables testing and optimizing of extraction formulas, which vary with the protein of interest and cell type.
CelLytic reagents have been specifically developed for the lysis of cells from natural sources and bacterial expression systems and to extract cellular proteins, including inclusion bodies, using a non-denaturing environment. Overall protein extraction efficiencies using CelLytic reagents are consistently higher than for other common protocols, such as freeze-thawing or sonication. These proprietary formulations do not interfere with downstream applications such as Western blotting, gel-shift assays, affinity purification, and reporter detection techniques. The CelLytic products are compatible with a wide variety of protease inhibitors, chelating agents, and chaotropes and are available as ready-to-use solutions, concentrated reagents for large-scale processes, and convenient powders and tablets for the lysis of bacterial cultures.

**Bacterial Lysis**

**CelLytic™ B, CelLytic B 2x, and CelLytic B 10x**

CelLytic B is a highly efficient, yet gentle reagent for the extraction of proteins from bacteria (*E. coli*). This reagent is a proprietary formulation of two zwitterionic detergents in 40 mM Trizma®-HCl (pH 8.0). Treatment of bacterial cells with CelLytic B results in the rapid extraction of proteins that are suitable for affinity purification and analysis. CelLytic B is the method of choice for recombinant protein extraction and purification from *E. coli*.

CelLytic B 2x has double the strength of CelLytic B for small volume extractions. Only 5 ml of the CelLytic B 2x reagent is required to lyse and extract protein from 1 gram of wet cell paste. This allows CelLytic B 2x to be used when a higher protein concentration or lower volume is required. The original formula, CelLytic B, requires 10-20 ml of the reagent for 1 gram of wet cell paste.

CelLytic 10x is provided as a concentrated mixture of the proprietary detergents found in CelLytic B, without the presence of a buffering component. This allows the user to customize the extraction reagent by choosing the detergent concentration and buffering components ideal for the extraction and purification of their protein(s) of interest. CelLytic 10x is also suitable for the lysis of yeast and mammalian cells.

**Features and Benefits**
- Gentle, non-denaturing bacterial cell lysis
- Highly efficient protein extraction
- Compatible with affinity purification

One gram of *E. coli* cell paste was extracted using CelLytic B, lysozyme, sonication, or a commercially available bacterial extraction reagent. CelLytic B, Competitor N, and Competitor P were all used at a ratio of 10 mL per gram of cell paste. The lysozyme treatment was performed using 1 mg/mL lysozyme (Cat. No. L6878) and 10 mM EDTA on ice for 15 minutes. Sonication time was 2 minutes on ice. Total protein extracted was determined by BCA assay.

**CelLytic™ B Cell Lysis Reagent**

Covered by US Patent No 7,282,475 B2 and are sold for research use only. Commercial use requires additional licenses.

<table>
<thead>
<tr>
<th></th>
<th>Standard Strength</th>
<th>Concentrate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>standard strength</strong></td>
<td></td>
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</tr>
<tr>
<td>B7435-50ML</td>
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<td></td>
</tr>
<tr>
<td>B7435-500ML</td>
<td>500 mL</td>
<td></td>
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<tr>
<td><strong>2x concentrate</strong></td>
<td></td>
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</tr>
<tr>
<td>B7310-50ML</td>
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<tr>
<td>B7310-250ML</td>
<td>250 mL</td>
<td></td>
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<tr>
<td><strong>10x concentrate</strong></td>
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<tr>
<td>C8740-10ML</td>
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<tr>
<td>C8740-50ML</td>
<td>50 mL</td>
<td></td>
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<tr>
<td>C8740-100ML</td>
<td>100 mL</td>
<td></td>
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</tbody>
</table>
CellLytic™ B Plus
For efficient protein extraction of Gram-positive and Gram-negative Bacteria

The CellLytic B Plus Kit is designed to efficiently lyse cells and extract proteins from both Gram-negative, and difficult to lyse Gram-positive bacteria. This is accomplished using the standard CellLytic B, a proprietary non-ionic detergent in concert with lysozyme, Benzonase®, and protease inhibitors. This complete kit takes the guesswork out of protein extraction from a variety of bacterial species.

Features and Benefits
- Lyse Gram-positive and Gram-negative bacteria
- More efficient than sonication
- Compatible with affinity purification
- Isolate inclusion bodies for subsequent solubilization
- Non-denaturing cell lysis preserves protein function

Lysis with CellLytic B Plus preserves protein function and is compatible with affinity chromatography. The gentle non-denaturing conditions preserve protein function so that assays can often be performed without removal of lysis reagents. Lysates containing CellLytic B Plus can be applied directly to ANTI-FLAG® M2 and HIS-Select® Nickel Affinity Gels for direct isolation of tagged recombinant proteins. In addition, insoluble inclusion bodies can be isolated for subsequent solubilization using Cellytic IB and refolding using your method of choice.

B. subtilis extraction, 0.5 gram of cell paste.

Cellytic B Plus Kit vs. leading competitors. 0.5 gram of Bacillus subtilis were lysed using standard procedures. The lysates were then spun to remove cellular debris and the supernatant was analyzed using Bradford Reagent (Cat. No. B6916) and 5 μl of lysate was loaded onto a 4-20% Tris-Glycine Polyacrylamide Gel to visualize the proteins. The gel was then stained with EZBlue™ Gel Staining Reagent (Cat. No. G1041).

Lysis with CellLytic B Plus preserves protein function and is compatible with affinity chromatography. The gentle non-denaturing conditions preserve protein function so that assays can often be performed without removal of lysis reagents. Lysates containing CellLytic B Plus can be applied directly to ANTI-FLAG® M2 and HIS-Select® Nickel Affinity Gels for direct isolation of tagged recombinant proteins. In addition, insoluble inclusion bodies can be isolated for subsequent solubilization using Cellytic IB and refolding using your method of choice.

A Perfect Fit!

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**CelLytic IB**

CelLytic IB was designed to solubilize protein aggregates called inclusion bodies. In bacteria, inclusion bodies are sometimes formed when recombinant proteins are overexpressed. CelLytic IB was formulated to solubilize the protein of interest for immediate analysis of protein content or refolding procedures.

<table>
<thead>
<tr>
<th>Solubilization Reagent</th>
<th>Water</th>
<th>Home Brew</th>
<th>Competitor A</th>
<th>CelLytic IB</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Protein Recovery</td>
<td>6</td>
<td>63</td>
<td>93</td>
<td>100</td>
</tr>
</tbody>
</table>

Solubilization of Streptavidin Inclusion Bodies

Samples of solubilized inclusion body protein were assayed using BCA Reagent (Cat. No. BCA-1). 50 μl of each sample were incubated with BCA reagent at 60 °C for 15 min. The samples were then cooled to room temperature and assayed at 562 nm. The data above has been standardized to the protein recovery of CelLytic IB.

**CelLytic™ IB Inclusion Body Solubilization Reagent**

store at: Room temp

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>CS236-25ML</td>
<td>25 mL</td>
</tr>
<tr>
<td>CS236-100ML</td>
<td>100 mL</td>
</tr>
</tbody>
</table>

**CelLytic™ Express**

Sigma-Aldrich introduces CelLytic™ Express, a non-denaturing and highly efficient protein extraction formulation for in-culture bacterial cell lysis. This proprietary, powder formulation extracts 2-3 times more protein than conventional methods such as sonication. CelLytic Express saves time by eliminating centrifugation steps required for cell harvest and clarification of lysate. In addition, the method is fast and requires less sample manipulations, reducing proteolytic degradation and preserving recombinant protein activity.

Unlike other in-culture lysis products, CelLytic Express is a complete formulation including lysozyme and DNase I. The resulting lysate is completely clear of cellular debris, is immediately ready for affinity purification, and is compatible with products such as the HIS-Select® Affinity Gels and FLAG® Affinity Gel. It also makes possible “one-tube” purifications with magnetic bead formats, such as glutathione magnetic beads. CelLytic Express is unique in that this powder formulation adds minimal volume to the final lysate. It also makes large-scale extraction faster, more convenient and it provides a method that is easier to validate for production protocols.

Convenient package sizes that are pre-weighed powder are suitable for indicated culture volumes.

All the advantages of CelLytic™ Express now in a tablet format. Efficient and non-denaturing in-culture protein extraction.

- Save time by eliminating centrifugation steps
- Preserve biological activity with less sample manipulations
- Includes enzymes for complete lysate clarification
- Compatible with affinity resins and magnetic beads
- Ideal for Production Scale Extraction protocols

For lysis of bacterial cultures and direct affinity purification—Eliminating the need for centrifugation!
Mammalian Lysis

**CellLytic™ M**

CellLytic M is a proprietary detergent solution designed for efficient whole-cell protein extraction from cultured mammalian cells. It enables efficient and rapid cell lysis and solubilization of proteins for both suspension and adherent cells. Treatment of adherent cells does not require scraping from culture dishes. Lysates can be used in many downstream applications without removing the CellLytic M such as reporter gene assays, Western blots/immunoprecipitation, electrophoretic mobility shift assays, phosphatase assays, and kinase assays. Use 125 μl of CellLytic M for 10^6-10^7 of suspended cells. For adherent cells, use 500-1,000 μl for a 100 mm plate; 200-400 μl for a 35 mm plate.

- **Efficient** - Up to 50% more efficient than freeze thaw, sonication and other products
- **Non-denaturing** - Does not interfere in downstream applications such immunoprecipitation, kinase and phosphatase assays, reporter gene assays and gel shift assays
- **Convenient** - Ready-to-use reagent requires no scraping from culture plates
- **Fast** - Rapid cell lysis at room temperature.

**Comparison of Extraction Efficiency.**

2 x 10^7 COS cells were washed and divided into equal aliquots, then lysed by one of the methods indicated. Protein amounts were determined by a BCA assay.

**CellLytic™ MT**

For mammalian tissues, CellLytic MT is an efficient reagent for the extraction of proteins. The lysis buffer consists of a dialyzable mild detergent, bicine, and 150 mM NaCl, resulting in minimal interference with protein interactions and biological activity. CellLytic MT is also used for extraction of cell-line proteins. A volume of 20 ml of CellLytic MT is sufficient for 1 gram of tissue. It has been tested on the following tissues: rat brain, kidney, muscle, heart, liver, and spleen; mouse brain, kidney, and muscle.

- **Gentle** - Non-denaturing and does not interfere with downstream applications
- **Convenient** - Provided ready to use

**Gel Shift Assay of Oct-1.**

Double stranded ^32^P-labeled Oct-1 binding motif oligonucleotide was incubated with CellLytic MT extracts (4 μg total protein). Arrows indicate the Oct-1-DNA complex and free probe.

**CellLytic™ MT Cell Lysis Reagent**

<table>
<thead>
<tr>
<th></th>
<th>50 mL</th>
<th>250 mL</th>
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<tbody>
<tr>
<td>C3228-50ML</td>
<td></td>
<td></td>
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<tr>
<td>C3228-500ML</td>
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</tbody>
</table>
**Cellytic™ NuCLEAR Extraction Kit**

Within this kit is a complete system for preparing nuclear and cytoplasmic protein extracts from mammalian tissue or cultured cells. A number of different procedures in the detailed technical bulletin enable the selection that best fits a particular application. For example, choose between detergent and nondetergent extraction of nuclear protein or between the standard hypotonic lysis buffer for most cell types and isotonic lysis buffer for fragile cells. In addition, the kit provides a procedure for salt reduction from the nuclear extract with dilution buffer. Cellytic NuCLEAR offers the flexibility you need for optimal protein extraction. Extracts can be prepared in less than 2 hours and are highly pure since there is little or no cross-contamination between nuclear and cytoplasmic extracts.

**Cellytic™ MEM Protein Extraction Kit**

The kit offers a fast and convenient method to isolate hydrophobic and raft microdomain associated proteins from cells. The method is based on phase separation and does not require cell membrane isolation. The separated proteins can be used for further experiments such as SDS-PAGE, Western blotting, dot blotting, and immunoprecipitation. The kit has been tested on HeLa, HEK-293, NIH 3T3, COS, and CHO cell lines.

**RIPA Buffer**

RIPA (Radio-Immunoprecipitation Assay) Buffer enables efficient cell lysis and protein solubilization while avoiding protein degradation and interference with protein immunoreactivity and biological activity. RIPA Buffer also results in low background in immunoprecipitation and molecular pull-down assays. Sigma’s RIPA Buffer is a ready-to-use 1x solution and is formulated as follows: 150 mM NaCl, 1.0% IGEPAL CA-630, 0.5% sodium deoxycholate, 0.1% SDS, and 50 mM Tris, pH 8.0. It is also compatible with EZview™ Red Affinity Gels.
Plant Lysis

**CelLytic™ P**

CelLytic P is a non-ionic detergent-based reagent that offers a convenient method for efficient plant cell lysis and protein solubilization. It is a non-denaturing reagent and maintains protein immunoreactivity and biological activity. CelLytic P is efficient, rapid, and ready to use. It contains bicine buffer, which is preferable for many biological activities. Use of CelLytic P enables extraction of proteins from less than one gram to hundreds of grams of fresh or frozen leaves, employing the same short procedure. It has been tested on leaves from four plant models: tobacco, tomato, spinach, and *arabidopsis*.

**CelLytic™ PN Isolation and Extraction Kit**

This kit is for the rapid isolation of nuclei and extraction of functional nuclear proteins from plant leaves. Nuclei or nuclear proteins can be extracted from a few grams to hundreds of grams of fresh or frozen leaves. The nuclear protein extract is suitable for the detection of DNA-protein interactions using gel-shift assay, DNase-I footprinting analysis, as well as Western blot assay and similar techniques. The isolated nuclei can also be used as a source for chromatin, genomic DNA, RNA, etc. The kit provides a detailed protocol for nuclei isolation and protein extraction from four plant models: tobacco, tomato, spinach, and *arabidopsis*. 

**CelLytic™ PN Isolation/Extraction Kit**

1 kit sufficient for 30 extractions (20 g of fresh or frozen leaves)

**Components**

- Nuclei Isolation Buffer 4x (NIB)
- Percoll®
- Sucrose 2.3 M
- TRITON® X-100 10% solution
- Extraction Buffer
- Nuclei PURE Storage Buffer
- Filter Mesh 100

store at: 2-8°C

**CEL4TPN1-1KT**

1 kit
Clean up with everything you need including potent new detergents

research essentials made simple

At Sigma-Aldrich we bring you the broadest range of basic essentials for all your everyday research needs. Our buffers, solvents, biological reagents and chemicals of every kind are manufactured to exacting standards so you can complete your study - create your innovation - deliver your results - and focus on your success. So when you need products like biological detergents, think Sigma-Aldrich. We’re all you need to know when it comes to freshening up your research.

sigma-aldrich.com/researchessentials
Detergent Properties and Applications

The key to detergent function is an amphipathic structure. All detergents are characterized as containing a hydrophilic “head” region and a hydrophobic “tail” region (see Figure 1).

These structural characteristics allow detergents to aggregate in aqueous media. At a sufficiently high concentration, the polar hydrophilic region of each molecule is oriented toward the polar solute (water) while the hydrophobic regions are grouped together to form thermodynamically stable micelles with hydrophobic cores. The hydrophobic core region of the detergent micelle associates with the hydrophobic surfaces of proteins and results in soluble protein-detergent complexes. Figure 2 is a simple illustration of a micelle to demonstrate the orientation concept. Actual micelle structures are more complex and dynamic, and can change due to detergent concentration and solution composition.¹

Detergent Physical Characteristics

The concentration at which micelles begin to form is the critical micelle concentration (CMC). The CMC is the maximum monomer concentration and constitutes a measure of the free energy of micelle formation. The lower the CMC, the more stable the micelle and the more slowly molecules are incorporated into or removed from the micelle. The structure of the hydrophobic region of the detergent can affect the micelle structure. An increase in the length of the hydrophobic hydrocarbon chain of ionic detergents results in an increased micelle size and a lower CMC, as fewer molecules are needed to construct a micelle.

The average number of monomers in a micelle is the aggregation number. The CMC and aggregation number values are highly dependent on factors such as temperature, pH, ionic strength, and detergent homogeneity and purity. Slight discrepancies in reported values for CMC and aggregation number may be the result of variations in the analytical methods used to determine the values. Aggregation number values are also shifted by concentration, since the number of detergent molecules per micelle may increase if the concentration is above the CMC.

Ease of removal or exchange is an important factor in the selection of a detergent. Some of the more common detergent removal methods include:

- Dialysis
- Gel filtration chromatography
- Hydrophobic adsorption chromatography
- Protein precipitation

The CMC value associated with the detergent is a useful guide to hydrophobic binding strength. Detergents with higher CMC values have weaker binding and are subsequently easier to remove by dialysis or displacement methods. Detergents with low CMC values require less detergent in order to form micelles and solubilize proteins or lipids.

Another useful parameter when evaluating detergents for downstream removal is the micelle molecular weight, which indicates relative micelle size. Smaller micelles are more easily removed and are usually desirable when protein-detergent complexes are to be separated based on the molecular size of the protein. The micelle molecular weight may be calculated by multiplying the micelle molecular weight by the monomer molecular weight.

The cloud point is the temperature at which the detergent solution near or above its CMC separates into two phases. The micelles aggregate, typically forming a cloudy phase with high detergent concentration, while the balance of the solution becomes detergent-depleted. The resulting two-phase solution can be separated, with the extracted protein being located in the detergent-rich phase. Detergents with low cloud point temperatures, such as TRITON® X-114 (cloud point ~23 °C) are recommended for use with proteins since high cloud point temperatures may denature solubilized proteins. The cloud point can be affected by changes in detergent concentration, temperature, and the addition of salt or polymers such as dextran and polyethylene glycol. Note that the detergent-rich phase is also contingent on the specific detergent(s) and salt concentration; under some conditions the phase may be clear rather than cloudy and be located as either the upper or lower phase of the solution. In non-ionic detergents, this behavior has been applied in the phase separation and purification of membrane proteins.²

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¹ Figure 1. Structure of the anionic detergent sodium dodecyl sulfate (SDS), showing the hydrophilic and hydrophobic regions.

² Figure 2. Simple illustration of a sodium dodecyl sulfate micelle.

Biological detergents are commonly used to disrupt the bipolar lipid membrane of cells in order to release and solubilize membrane-bound proteins. Some detergents can be used to solubilize recombinant proteins, while others are recommended for the stabilization, crystallization, or denaturation of proteins. Detergents can align at aqueous/non-aqueous interfaces, resulting in reduced surface tension, increased miscibility, and stabilization of emulsions. Additional detergent applications include:

- Extraction of DNA and RNA
- Solubilization of specimens for diagnostic applications
- Cell lysis
- Liposome preparation
- Prevention of reagent and analyte precipitation from solution
- Prevention of non-specific binding in immunoassays

---

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Detergent Types and Selection

When selecting a detergent, the first consideration is usually the form of the hydrophilic group:

- Anionic
- Cationic
- Non-ionic
- Zwitterionic (ampholytic)

Anionic and cationic detergents are considered biologically “harsh” detergents because they typically modify protein structure to a greater extent than neutrally charged detergents. The degree of denaturation varies with the individual protein and the particular detergent and concentration. Ionic detergents are more sensitive to pH, ionic strength, and the nature of the counter ion, and can interfere with downstream charge-based analytical methods.

Non-ionic detergents are considered to be “mild” detergents because they are less likely than ionic detergents to denature proteins. By not separating protein-protein bonds, non-ionic detergents allow the protein to retain its native structure and functionality, although detergents with shorter hydrophobic chain lengths are more likely to cause protein deactivation. Many non-ionic detergents can be classified into three structure types:

- Poly(oxyethylene) ethers and related polymers
- Bile salts
- Glycosidic detergents

Poly(oxyethylene) ethers and related detergents have a neutral, polar head and hydrophobic tails that are oxyethylene polymers (e.g. Brij® and TWEEN®) or ethyleneglycoether polymers (e.g. TRITON®). The tert-octylphenol poly(ethyleneglycoether) series of detergents, which includes TRITON X-100 and IGEPAL® CA-630, have an aromatic head that interferes with downstream UV analysis techniques.

Bile salts have a steroid core structure with a polar and apolar orientation, rather than the more obvious nonpolar tail structure of other detergents. Bile salts may be less denaturing than linear chain detergents with the same polar head group.

Glycosidic detergents have a carbohydrate, typically glucose or maltose, as the polar head and an alkyl chain length of 7-14 carbons as the polar tail.

Zwitterionic detergents have characteristics of both ionic and non-ionic detergent types. Zwitterionic detergents are less denaturing than ionic detergents and have a net neutral charge, similar to non-ionic detergents. They are more efficient than non-ionic detergents at disrupting protein-protein bonds and reducing aggregation. These properties have been used for chromatography, mass spectrometry, and electrophoresis methods, and solubilization of organelles and inclusion bodies.

Non-detergent sulfobetaines (NDSB), although not detergents, possess hydrophilic groups similar to those of zwitterionic detergents but with shorter hydrophobic chains. Sulfobetaines do not form micelles. They have been reported to improve the yield of membrane proteins when used with detergents and prevent aggregation of denatured proteins.

Additional References

The following references are recommended for further review of the properties and applications of detergents.


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Detergent Selection Table

Detergent Categories

Detergents are grouped into four categories, based on the nature of the hydrophilic head group:

- **Non-ionic**: Gentle detergents used for solubilizing proteins while maintaining native subunit structure, enzymatic activity, or other structural functions.
- **Anionic**: Strong detergents that often completely disrupt cell membranes and fully denature proteins. They are sensitive to pH, ionic strength, and the nature of the counter-ion. Ionic detergents can interfere with charge-based analytical methods.
- **Cationic**: Strong detergents with properties similar to those for anionic detergents. These are used in DNA purification, as surfactants in drug/vaccine delivery systems, and in cleaning and disinfecting applications.
- **Zwitterionic**: Electrically neutral detergents that protect the native state of proteins and prevent non-specific aggregation. They are often useful alternatives to non-ionic detergents in ion-exchange chromatography, electrophoresis, and isoelectric focusing.

Non-ionic

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<th>Antigen/Vaccine Preparation</th>
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<th>Membrane Protein Preparation</th>
<th>Electrophoresis/ Chromatography</th>
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Cationic

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*CMC in water at 20–25°C unless otherwise specified
**Unspecified temperature
**Physical properties:**

**CMC (Critical Micelle Concentration)** is the concentration at which micelles begin to form (i.e., the maximum monomer concentration). It should be noted that micelles cannot form, even above this concentration, if the solution temperature is too low.

**Aggregation Number** is the average number of monomers in a micelle. A low aggregation number and high CMC value favor removal by dialysis.

**HLB (Hydrophilic-Lipophilic Balance)** is a calculated value that is an indicator of the hydrophilic character of the detergent. Detergents with high HLB values are more hydrophilic than detergents with low HLB values (more lipophilic). A low HLB favors removal of the detergent by reverse-phase chromatography.

**Cloud Point** is the temperature at which the micelles in a detergent solution begin to aggregate into larger structures that scatter light and the solution separates into detergent-rich and detergent-deficient phases. A cloud point typically develops in the detergent-rich phase, however the phase may remain clear. The cloud point phenomenon interferes with applications that require optical clarity, but can be used to remove detergent molecules from aqueous solutions.

This characteristic has been applied in phase separation for the isolation of membrane proteins.

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**Detergent Properties and Applications**

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BioUltra Detergents

The BioUltra label has been assigned to a group of basic reagents with a well-defined high purity. BioUltra reagents are designed for use in biochemical, biological, and life science applications where large amounts of reagent are required in comparison to the amount of analyte under investigation. The BioUltra reagents have been analyzed for low levels of contaminating impurities and are provided with documentation that reports consistent quality control testing. For demanding applications that require the highest quality products, we offer a range of BioUltra detergents.

The BioUltra Reagent Certification guarantees:
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- Homogeneous and clear appearance in solution (solubility test)
- Zero residue in the filter test
- Limited UV absorbance at key biochemical wavelengths
- pH value of an aqueous solution within a defined range

BioUltra reagents are carefully handled to ensure a very high quality product at the time of packaging. Cross-contamination is avoided by packing BioUltra products in a controlled environment, void of both dust and moisture. BioUltra Reagents are subject to strict analysis in our laboratories to meet the indicated guarantee requirements.

For a comprehensive list of our BioUltra reagents, please visit sigma.com/highpurity.

### N,N-Dimethylidodecylamine N-oxide solution

DDAO; LDAO; Lauryldimethylamine N-oxide

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<table>
<thead>
<tr>
<th>Volume</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mL</td>
<td></td>
</tr>
<tr>
<td>250 mL</td>
<td></td>
</tr>
</tbody>
</table>

### Docusate sodium salt

Sulfobutaneidic acid bis(2-ethylhexyl) ester sodium salt; Sulfosuccinic acid bis(2-ethylhexyl) ester sodium salt; Bis(2-ethylhexyl) sulfosuccinate sodium salt; AOT; Diocetyl sulfosuccinate sodium salt; Sodium bis(2-ethylhexyl) sulfosuccinate

<table>
<thead>
<tr>
<th>Reagent</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BioUltra, ≥99.0% (TLC)</td>
<td></td>
</tr>
<tr>
<td>solubility</td>
<td></td>
</tr>
<tr>
<td>methanol</td>
<td>0.1 M at 20 °C, clear, colorless</td>
</tr>
<tr>
<td>passes filter test</td>
<td></td>
</tr>
<tr>
<td>chloride (Cl⁻)</td>
<td>≤100 mg/kg</td>
</tr>
<tr>
<td>Al</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>As</td>
<td>≤1 mg/kg</td>
</tr>
<tr>
<td>Ba</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Bi</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Ca</td>
<td>≤10 mg/kg</td>
</tr>
<tr>
<td>Cd</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Co</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Cr</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Cu</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Fe</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>K</td>
<td>≤50 mg/kg</td>
</tr>
<tr>
<td>Cu</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Fe</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>K</td>
<td>≤50 mg/kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>10 g</td>
<td></td>
</tr>
<tr>
<td>50 g</td>
<td></td>
</tr>
<tr>
<td>250 g</td>
<td></td>
</tr>
</tbody>
</table>

### Hexadecyltrimethylammonium bromide

Cetrimonium bromide; Palmitoyltrimethylammonium bromide; CTAB; Cetyltrimethylammonium bromide

<table>
<thead>
<tr>
<th>Reagent</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BioUltra, for molecular biology, ≥99.0% (AT)</td>
<td></td>
</tr>
<tr>
<td>solubility</td>
<td></td>
</tr>
<tr>
<td>H₂O</td>
<td>0.1 M at 40 °C, clear, colorless</td>
</tr>
<tr>
<td>proteases</td>
<td>none detected</td>
</tr>
<tr>
<td>phosphatases</td>
<td>none detected</td>
</tr>
<tr>
<td>insoluble matter</td>
<td>passes filter test</td>
</tr>
<tr>
<td>NaNes</td>
<td>none detected</td>
</tr>
<tr>
<td>DNases</td>
<td>none detected</td>
</tr>
<tr>
<td>pH</td>
<td>5.0-7.0, 0.1 M H₂O at 25°C</td>
</tr>
<tr>
<td>Al</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Ba</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Bi</td>
<td>≤5 mg/kg</td>
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<tr>
<td>Ca</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Cd</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Co</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Cr</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Cu</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>Fe</td>
<td>≤5 mg/kg</td>
</tr>
<tr>
<td>K</td>
<td>≤50 mg/kg</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 g</td>
<td></td>
</tr>
<tr>
<td>250 g</td>
<td></td>
</tr>
</tbody>
</table>

### Sigma Aldrich

sigma.com/orde  |  Technical service: sigma.com/techinf
Hyamine® 1622
Phenerid chloride; (Diisobutylphenoxyethoxyethyl)dimethylbenzylammonium chloride solution; Benzethonium chloride
[121-54-0] C24H40ClNO2 FW 448.08

- **BioUltra**, ≥99.0% (AT)
solubility
H2O ................................................... 0.1 M at 20 °C, clear, colorless
insoluble matter .............................................................................. ≤1%

- **BioUltra**, ≥99.0% (AT)
solubility
H2O ................................................... 0.1 M at 20 °C, clear, colorless
insoluble matter .............................................................................. ≤1%

N-Lauroylsarcosine sodium salt
N-Dodecanoyl-N-methylglycine sodium salt; Sarkosyl NL
[137-16-6] CH12H25CON(CH3)2CH2C00Na FW 293.38
micellar avg wt. 600
aggregation number ................................................................. 2
CMC ............................................................................... 14.6 mM (20-25°C)

- **BioUltra**, for molecular biology, ≥99.0% (HPLC)
solubility
H2O ................................................... 1 M at 20 °C, clear, colorless
insoluble matter .............................................................................. none detected
DNases ...................................................................................... none detected
proteases ...................................................................................... none detected
phosphatases .............................................................................. none detected
RNases ...................................................................................... none detected

Sodium deoxycholate monohydrate
7-Deoxycholic acid sodium salt; Deoxycholic acid sodium salt; 3α,12α-Dihydroxy-5β-cholic acid sodium salt
[145224-92-6] C27H44NaO6·H2O FW 432.57

- **BioUltra**, ≥99.0% (NT)
solubility
H2O ................................................... 1 M at 20 °C, clear, colorless
insoluble matter .............................................................................. ≤0.5% (TLC)

Sodium deoxycholate monohydrate
7-Deoxycholic acid sodium salt; Deoxycholic acid sodium salt; 3α,12α-Dihydroxy-5β-cholic acid sodium salt
[145224-92-6] C27H44NaO6·H2O FW 432.57

- **BioUltra**, ≥99.0% (NT)
solubility
H2O ................................................... 1 M at 20 °C, clear, colorless
insoluble matter .............................................................................. ≤0.5% (TLC)

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solubility
H2O ................................................... 1 M at 20 °C, clear, colorless
insoluble matter .............................................................................. ≤0.5% (TLC)

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N-Dodecanoyl-N-methylglycine sodium salt; Sarkosyl NL
[137-16-6] CH12H25CON(CH3)2CH2C00Na FW 293.38
micellar avg wt. 600
aggregation number ................................................................. 2
CMC ............................................................................... 14.6 mM (20-25°C)

- **BioUltra**, for molecular biology, ≥99.0% (HPLC)
solubility
H2O ................................................... 1 M at 20 °C, clear, colorless
insoluble matter .............................................................................. none detected
DNases ...................................................................................... none detected
proteases ...................................................................................... none detected
phosphatases .............................................................................. none detected
RNases ...................................................................................... none detected

Sodium deoxycholate monohydrate
7-Deoxycholic acid sodium salt; Deoxycholic acid sodium salt; 3α,12α-Dihydroxy-5β-cholic acid sodium salt
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solubility
H2O ................................................... 1 M at 20 °C, clear, colorless
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solubility
H2O ................................................... 1 M at 20 °C, clear, colorless
insoluble matter .............................................................................. ≤0.5% (TLC)
**Detergents**

### Non-ionic Detergents

**Bile Acids and Sapogenins**

N,N-Bis(3-D-gluconamido)propyl]deoxycholamide
decoxy-Big Chap: Deoxy-Big Chap

- FW: 862.06
- micellar average mol wt 10,500

**Digitonin**

Digitonin

- FW: 1229.31
- micellar avg wt. 70,000

**Saponin**

Saponin

- FW: 1229.31

### Sodium dodecyl sulfate

- CH₃(CH₂)₄OSO₃Na
- FW: 288.38

- Solubility: neat
- Micellar avg mol wt 10,500

**Sodium dodecyl sulfate solution**

<table>
<thead>
<tr>
<th>pH</th>
<th>5.0-6.5</th>
<th>280 nm</th>
<th>0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>71736-100ML</td>
<td>100 mL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>71736-500ML</td>
<td>500 mL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sodium dodecyl sulfate solution**

- 4-(1,1,3,3-tetramethylbutyl)phenyl-polyethylene glycol solution

- [9002-93-1]

**BioUltra, for molecular biology, 10% in H₂O**

- pH: 5.0-6.5
- 280 nm: 0.2

- 71736-100ML: 100 mL
- 71736-500ML: 500 mL

**BioUltra, for molecular biology, 20% in H₂O**

- 280 nm: 0.5
- 290 nm: 0.3

- 05020-500ML-F: 500 mL
- 05030-1L-F: 1 L
- 05030-2.5L-F: 2.5 L

### Triton X-100 solution

- 4-(1,1,3,3-tetramethylbutyl)phenyl-polyethylene glycol solution

- [9002-93-1]

**BioUltra, for molecular biology, ~10% in H₂O**

- pH: 6.5-8.5 at 25°C
- 280 nm: 0.1

**Saponin from quillaja bark**

- Potent hemolytic when injected i.v.; surfactant that enhances penetration of proteins and other macromolecules through cell membranes; it also has been used as an adjuvant for vaccines.

- Purified to remove low molecular weight contaminants

**Saponin**

- FW: 1229.31
- Micellar average mol wt 10,500

**Detergents**

**Non-ionic Detergents**

**Bile Acids and Sapogenins**

N,N-Bis(3-D-gluconamido)propyl]deoxycholamide
decoxy-Big Chap: Deoxy-Big Chap

- FW: 862.06
- Micellar average mol wt 10,500

**Digitonin**

- FW: 1229.31
- Micellar avg wt. 70,000

**Saponin**

- FW: 1229.31

**Sodium dodecyl sulfate solution**

- CH₃(CH₂)₄OSO₃Na
- FW: 288.38

- Solubility: neat
- Micellar avg mol wt 10,500

**Sodium dodecyl sulfate solution**

- 4-(1,1,3,3-tetramethylbutyl)phenyl-polyethylene glycol solution

- [9002-93-1]

**BioUltra, for molecular biology, 10% in H₂O**

- pH: 5.0-6.5
- 280 nm: 0.2

- 71736-100ML: 100 mL
- 71736-500ML: 500 mL

**BioUltra, for molecular biology, 20% in H₂O**

- 280 nm: 0.5
- 290 nm: 0.3

- 05020-500ML-F: 500 mL
- 05030-1L-F: 1 L
- 05030-2.5L-F: 2.5 L

**Triton X-100 solution**

- 4-(1,1,3,3-tetramethylbutyl)phenyl-polyethylene glycol solution

- [9002-93-1]

**BioUltra, for molecular biology, ~10% in H₂O**

- pH: 6.5-8.5 at 25°C
- 280 nm: 0.1

**Saponin from quillaja bark**

- Potent hemolytic when injected i.v.; surfactant that enhances penetration of proteins and other macromolecules through cell membranes; it also has been used as an adjuvant for vaccines.

- Purified to remove low molecular weight contaminants

**Saponin**

- FW: 1229.31
- Micellar average mol wt 10,500
Glycosidic Detergents

2-Cyclohexylethyl β-D-maltoside

Cymal-2
{[260804-65-7] C_{13}H_{14}O_{11} FW 452.49
CMC ................................................................................. 120 mM (20-25°C)

≥99.0% (TLC)

Detergent for the purification and crystallization of membrane-bound proteins in native structure. It has a higher CMC (critical micelle concentration) and is more hydrophobic than the corresponding linear chain analog (C_{12}).


Decyl-β-D-maltoside

Cymal-6
{[228579-27-9] C_{19}H_{22}O_{11} FW 508.60
micellar average mol wt 32,000
aggregation number ............................................................. 63
CMC ................................................................................. 0.56 mM

≥99.0% (TLC)

Detergent for the purification and crystallization of membrane-bound proteins in native structure. It has a higher CMC (critical micelle concentration) and is more hydrophobic than the corresponding linear chain analog (C_{12}).


5-Cyclohexylpentyl β-D-maltoside

Cymal-5
{[250692-65-0] C_{15}H_{20}O_{11} FW 494.57
micellar average mol wt 32,600
aggregation number ............................................................. 66
CMC ................................................................................. 2.4-5 mM (20-25°C)

≥99.0% (TLC)

Detergent for the purification and crystallization of membrane-bound proteins in native structure. It has a higher CMC (critical micelle concentration) and is more hydrophobic than the corresponding linear chain analog (C_{12}).


Decyl β-D-maltopyranoside

Detergent for the purification and crystallization of membrane-bound proteins in native structure. It has a higher CMC (critical micelle concentration) and is more hydrophobic than the corresponding linear chain analog (C_{12}).


≥99.0% (TLC)

Detergent for the purification, extraction and solubilization of membrane-bound proteins in the native structure. It increases solubilization by dissociating aggregates and is easily removed by dialysis.

store at: −20°C

Decyl-β-D-thiomaltopyranoside

Oligo-β-D-glucopyranoside

OGP; n-Octyl glucoside
{[29836-26-8] C_{11}H_{22}O_{11} FW 292.37
Non-ionic, dialyzable detergent for the solubilization and isolation of membrane proteins. Has been shown to increase the resolution of proteins in 2D gels.

micellar average mol wt. 25,000
aggregation number ........................................................................ 84
CMC ................................................................................. 0.15 mM (20-25°C)

≥99.0% (TLC)

Detergent for the purification, extraction and solubilization of membrane-bound proteins in the native structure. It increases solubilization by dissociating aggregates and is easily removed by dialysis.

store at: −20°C

≤0.01%

Insoluble matter ........................................................................ 0.01% Zn
≤0.001%

≤0.0005%

SigmaUltra, ≥98% (GC)

store at: −20°C

D5172-250MG 250 mg
D5172-1G 1 g

Octyl β-D-glucopyranoside

DDM; Lauryl-β-D-maltoside
{[92227-93-6] C_{15}H_{22}O_{11} FW 510.62
Non-ionic detergent for the stabilization and activation of enzymes and for membrane research.1,2,3,4

micellar avg wt. 50,000
aggregation number ........................................................................ 98
CMC ................................................................................. 0.15 mM (20-25°C)

≥99.0% (TLC)

Detergent for the purification, extraction and solubilization of membrane-bound proteins in the native structure. It increases solubilization by dissociating aggregates and is easily removed by dialysis.

store at: −20°C

D4641-500MG 500 mg
D4641-1G 1 g
D4641-5G 5 g
D4641-25G 25 g

≥99.0% (TLC)

Detergent for the purification, extraction and solubilization of membrane-bound proteins in the native structure. It increases solubilization by dissociating aggregates and is easily removed by dialysis.

store at: −20°C

D5172-250MG 250 mg
D5172-1G 1 g

n-Octyl β-D-maltoside

Chem. Phys. Lipids

SigmaUltra, >98% (GC)

Insoluble matter ................................................................................................. <0.1%
Phosphorus (P) ....................................................................................................... <0.005%
chloride (Cl) ......................................................................................................... <0.05%
sulfate (SO₄)²⁻ ................................................................................................. <0.05%
Al ........................................................................................................................ <0.005%
Mg ........................................................................................................................ <0.005%
Ca ........................................................................................................................ <0.003%
NH₄⁺ ................................................................................................................... <0.1%
Fe ........................................................................................................................ <0.001%
store at: ~20°C
O9882-100MG 100 mg
O9882-250MG 250 mg
O9882-500MG 500 mg
O9882-1G 1 g
O9882-5G 5 g

Octyl β-D-thioglucopyranoside

Octyl thiogluicoside
[85618-21-9] C₅H₁₂O₆S  FW 308.43
CMC ................................................................. 9 mM (20-25°C)

>98% (GC)
A non-ionic detergent for solubilization and reconstitution of membrane proteins.
store at: ~20°C
O6004-500MG 500 mg
O6004-1G 1 g
O6004-5G 5 g
O6004-10G 10 g

Undecyl-β-D-maltoside

[170552-39-3] C₁₁H₂₂O₁₁  FW 496.59
CMC .............................................................................................................0.59 mM (20-25°C)

>99.0% (TLC)
Detergent for the purification, extraction and solubilization of membrane-bound proteins. It increases
solubilization by dissociating aggregates and is easily removed by dialysis.¹
store at: ~20°C
94206-250MG 250 mg
94206-1G 1 g

Poly(oxyethylene) Detergents

Brij® 35
C₅H₁₀E₅; Polyoxyethylene 23 lauryl ether
[9002-92-0]

Brij® 58
Polyoxyethylene 20 cetyl ether; Polyethylene glycol hexadecyl ether
[9004-95-9] HO(CH₂)₁₉CH₃  HLB 6.0

> suitable for Stein-Moore chromatography
Non-ionic detergent. Useful for the extraction of membrane proteins. Typically used in the range of 0.1-1%.
micellar avg wt. 48,000
estimated mol wt 1198
cloud point ........................................................................................................ >100 °C
aggregation number .......................................................................................... 20-40
CMC ............................................................................................................. 91 μM
HLB ................................................................................................................ 16.9
P1254-500G 500 g
P1254-5KG 5 kg

Brij® 35 solution

> 30 % (w/v)
B4184-10ML 10 mL
B4184-100ML 100 mL
B4184-1L 1 L
B4184-1GAL 1 gal

Brij® 58
Polyoxyethylene 20 cetyl ether; Polyethylene glycol hexadecyl ether
[9004-95-9] HO(CH₂)₁₉CH₃  HLB 6.0

> average M₉ ~ 1124
Non-ionic detergent for protein extraction, permeabilization of cells; may be used in the preparation of yeast spheroplasts.
micellar avg wt. 79,000
cloud point.................................................................................................... >100 °C
aggregation number ..................................................................................... 70
CMC ............................................................................................................. 0.08 mM (20-25°C)
HLB ................................................................................................................ 13

Decaethylene glycol monododecyl ether
Polyoxyethylene 10 lauryl ether; C₁₂E₁₀
[9016-45-9] C₁₂H₂₅O₁₀  FW 626.86
P9769-500G 500 g
P9769-1KG 1 kg

IGEPLAN® CA-630
(Octylphenoxypolyethoxyethanol; Octylphenyl-polyethylene glycol
[9036-19-5] C₁₈H₃₇O₄H₂O Nonidet™ P 40 Substitute
Nonidet™ P 40 Substitute
Nonylphenyl-polyethylene glycol
(C₁₈H₃₇O₄H₂O) which is chemically indistinguishable, is offered as a
commercially available.
CMC ............................................................................................................. 0.08 mM (20-25°C)
HLB ................................................................................................................ 13.1

Viscous liquid
mol wt ~603
I3021-50ML 50 mL
I3021-100ML 100 mL
I3021-500ML 500 mL

Nonidet™ P-40
Nonidet™ P-40 is no longer commercially available. IGEPLAN®-CA630
(Cat. No. I3021) which is chemically indistinguishable, is offered as a
replacement for Nonidet P-40.

Nonidet™ P 40 Substitute
Nonylphenyl-polyethylene glycol
[9016-45-9] C₁₈H₃₇O₄H₂O average mol wt 680
cloud point .................................................................................................... 45 - 50 °C
CMC ............................................................................................................. 0.059 mM (20-25°C)

Mixture of 15 homologues
pH .................................................................................................................. 5.4-7.0
H₂O K+ ........................................................................................................... ≤1000 mg/kg
chloride (Cl⁻) ................................................................................................. ≤500 mg/kg
sulfate (SO₄)²⁻ ................................................................................................. ≤10 mg/kg
Ca ................................................................................................................... ≤100 mg/kg
Mg ................................................................................................................... ≤5 mg/kg
Cd ................................................................................................................... ≤5 mg/kg
Nor ................................................................................................................... ≤5 mg/kg
Cr ................................................................................................................... ≤5 mg/kg
Cu ................................................................................................................... ≤5 mg/kg
Fe ................................................................................................................... ≤5 mg/kg
Zn ................................................................................................................... ≤5 mg/kg
Pb ................................................................................................................... ≤5 mg/kg
Ni ................................................................................................................... ≤5 mg/kg
Cr ................................................................................................................... ≤5 mg/kg
Cu ................................................................................................................... ≤5 mg/kg
Fe ................................................................................................................... ≤5 mg/kg
Zn ................................................................................................................... ≤5 mg/kg
74385-1L 1 L
74385-5L 5 L
### Pluronic® F-68
Polyoxyethylene-polyoxypropylene block copolymer [9003-11-6] \(\left(C_6H_{11}O\right)_{n}\) 
Contains 100 ppm BHT

average mol wt 8350

<table>
<thead>
<tr>
<th>CMC</th>
<th>0.4 mmol/L (20-25°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLB</td>
<td>29</td>
</tr>
</tbody>
</table>

- **cell culture tested**
- **insect cell culture tested**

Non-ionic detergent, protects cells from hydrodynamic damage.

P1300-500G 500 g

### Triton® X-100 reduced
Polyoxyethylene(10) nonylphenol ether [92046-34-9] \(4-(C_{6}H_{4})(C_{6}H_{5}(OCH_{2}CH_{2})_{n}\) OH, \(n=10\)

Hydrogenated to reduce UV absorbance.

A \(\%\), \(H_2O\) ................................................................. \(0.250\)

X100RS-5G 5 g
X100RS-25G 25 g

- **Triton® X-100 solution, BioUltra**, for molecular biology, see Page 20

### Triton® X-114
(1,1,3,3-Tetramethylbutyl)phenyl-polyethylene glycol; Polyethylene glycol tert-octylphenyl ether [9036-19-5] \(\gamma\)-Oct-C\(_6\)H\(_4\)(OCH\(_2\)CH\(_2\))\(_n\)OH, \(x\approx 7-8\) 

FW 426.59

average mol wt 537

cloud point ................................................................. 23 °C

CMC ............................................................................... 0.2 mmol/L (20-25°C)

HLB .................................................................................. 12.4

- **laboratory grade**

A non-ionic detergent with a low cloud point (23 °C) enabling protein solubilization with phase-partitioning of hydrophilic from amphiphilic proteins.

X114-100ML 100 mL
X114-500ML 500 mL
X114-L 1 L
X114-1GA 1 gal
X114-5GA 5 gal

### TWEEN® 20
Polyoxyethylenesorbitan monolaurate; Polyethylene glycol sorbitan monolaurate [9005-64-5] 
mol wt \(\sim 1200\)

cloud point ................................................................. 76 °C

CMC ............................................................................... 0.06 mmol/L (20-25°C)

HLB .................................................................................. 16.7

P1379-25ML 25 mL
P1379-100ML 100 mL
X1379-500ML 500 mL
X1379-6500ML 6 \times 500 mL
P1379-1L 1 L
P1379-1GA 1 gal

- **SigmaUltra**

Useful for removal of peripheral membrane proteins.

Phosphorus (P) ........................................................................ <0.05%

chloride (Cl) ........................................................................ <0.05%

sulfate (SO\(_4\)\(^{2-}\)) .......................................................... <0.05%

Al ................................................................. <0.0005%

Na ................................................................. <0.05%

Ca ................................................................. <0.005%

\(NH_4\) ................................................................. <0.005%

Fe ................................................................. <0.001%

Zn ................................................................. <0.0005%

P7949-100ML 100 mL
P7949-500ML 500 mL

### TWEEN® 40
Polyoxyethylenesorbitan monopalmitate [9005-66-7] 
estimated mol wt 1277

CMC ............................................................................... 0.027 mmol/L (20-25°C)

HLB .................................................................................. 15.6

Non-ionic detergent used for cell lysis, nuclei isolation and cell fractionation.

X1379-100ML 100 mL
X1379-500ML 500 mL
X1379-1GA 1 gal
**TWEEN® 60**
Polyoxypolyether sorbitan monostearate; Polyethylene glycol sorbitan monostearate
[9005-67-8]
estimated mol wt 1309
CMC .................................................. 27 mg/L
HLB .......................................................... 14.9
P1629-100ML 100 mL
P1629-500ML 500 mL
P1629-1GA 1 gal

**TWEEN® 80**
Polyoxypolyether sorbitan monoleate; Polyoxyethylene sorbitan monoleate; Polysorbate 80
[9005-65-6]
Non-ionic detergent used for selective protein extraction and isolation of nuclei from mammalian cell lines.
micellar avg wt. 79,000
average mol wt 1310
cloud point .................................. 65 °C
aggregation number .............................................. 60
CMC .................................................. 0.012 mM (20-25°C)
HLB .......................................................... 15
>viscous liquid
P1754-25ML 25 mL
P1754-500ML 500 mL
P1754-1GA 1 gal

**SigmaUltra**
Phosphorus (P) .................................................. <0.05%
chloride (Cl) .................................................. <0.05% K
sulfate (SO₄²⁻) .................................................. <0.05% Mg
Al .................................................. <0.0005% Na
Ca .................................................. <0.0005% NH₄⁺
Cu .................................................. <0.0005% Pb
Fe .................................................. <0.0005% Zn
PB074-100ML 100 mL
PB074-500ML 500 mL

**Additional Non-ionic Detergents**

**N-Decanoyl-N-methylglucamine**
N-Decanoyl-N-methyl-ß-glucamine; N-(ß-Glucityl)-N-methyldecanamide;
MEGA-10
[85261-20-7] C₁₆H₃₁NO₃ FW 349.46
CMC .................................................. 6.7 mM (20-25°C)
>v=98% (GC)
Non-ionic, dialyzable detergent used for the solubilization of membrane proteins
store at: 2-8°C
D6277-500MG 500 mg
D6277-1G 1 g
D6277-5G 5 g

**Dimethyldicylphosphine oxide**
APO-10; Decylmethyldicylphosphine oxide
[2190-95-6] CH₃(CH₂)₉P(O)(CH₂)₉ FW 218.32
micellar avg wt. 28,597
aggregation number .............................................. 131
CMC .................................................. 4.6 mM (20-25°C)
>v=98.0% (GC)
Non-ionic detergent useful for plasmid DNA isolation¹
λ .................................................. 1 % in H₂O 280 nm .................. 0.05
260 nm ................................. 0.05
40108-1G 1 g

**Dodecyldimethylphosphine oxide**
APO-12; Dimethyldodecyldicylphosphine oxide
[871-95-4] CH₃(CH₂)₁₁P(O)(CH₂)₁₁ FW 246.37
micellar avg wt. 549.965
aggregation number .............................................. 2232
CMC .................................................. 0.568 mM (20-25°C)
>v=96% (GC)
Non-ionic detergent for the purification, extraction and solubilization of membrane-bound proteins in the native structure. It is stable in water and easily removable by dialysis. Useful for plasmid DNA isolation.¹
λ .................................................. 1 % in H₂O 280 nm .................. 0.2
260 nm ................................. 0.2
40223-1G 1 g

**N-Nonanoyl-N-methylglucamine**
N-Methyl-N-nonanoyl-ß-glucamine; MEGA-9; N-(ß-Glucityl)-N-methylnonanamide
[85261-19-4] C₁₀H₂₁NO₃ FW 335.44
Non-ionic, dialyzable detergent
CMC .................................................. 19-25 mM (20-25°C)
>v=98%
N1138-500MG 500 mg
N1138-1G 1 g
N1138-5G 5 g
N1138-25G 25 g

**N-Octanoyl-N-methylglucamine**
N-Methyl-N-octanoyl-ß-glucamine; MEGA-8; N-(ß-Glucityl)-N-methyloctanamide
[85316-98-9] C₁₀H₂₁NO₃ FW 321.41
CMC .................................................. 58 mM (20-25°C)
>v=98%
Non-ionic detergent used for the solubilization of proteins
O3129-5G 5 g
O3129-25G 25 g

**Span® 80**
Sorbitane monooleate
[1338-43-8]
Fatty acid composition: Oleic acid (C18:1) minimum 60%; balance primarily linoleic (C18:2), linolenic (C18:3) and palmitic (C16:0) acids.
S6760-250ML 250 mL
S6760-1L 1 L

**Span® 85**
Sorbitane trioleate
[26266-58-0]
Fatty acid composition: Oleic acid (C18:1) approx. 74%; linoleic acid (C18:2) approx. 7%; linolenic acid (C18:3) approx. 2%; palmitoleic acid (C16:1) approx. 7%; balance primarily palmitic acid (C16:0).
S7135-250ML 250 mL
S7135-1L 1 L
Tyloxapol 
4-(1,1,3,3-Tetramethylbutyl)phenol polymer with formaldehyde and o xoamine [25301-02-4] 
A nonionic liquid polymer of the alkyl aryl polyether alcohol type. Used as a surfactant. 
cloud point ............................................................................................................. 94.3 °C 
CMC .................................................................................................................... 0.018 mM 

Reagent Grade 

| T8761-50G | 50 g |
| T8761-250G | 250 g |

Sigma Ultra 
Phosphorus (P) ........................................................................................................ <0.0005% 
chloride (Cl) ........................................................................................................ <0.0005% 
sulfate (SO₄²⁻) .................................................................................................... <0.0005% 
Al .......................................................................................................................... <0.0005% 
Ca .......................................................................................................................... <0.0005% 
Cu .......................................................................................................................... <0.0005% 
Na .......................................................................................................................... <0.0005% 
Fe .......................................................................................................................... <0.001% 

T3037-5G | 5 g |
| T3037-10G | 10 g |
| T3037-50G | 50 g |

Anionic Detergents 

Alkyl Sulfates 

Lithium dodecyl sulfate 
Dodecyl lithium sulfate; Dodecyl sulfate lithium salt; Lauryl sulfate lithium salt; Lithium lauryl sulfate 
[2484-56-6] CH₃(CH₂)₁₁OSO₃Li FW 272.33 
Anionic detergent that may be used in place of SDS for electrophoresis in cold conditions. 

CMC .................................................................................................................... 7-10 mM (20-25°C) 

Sigma Ultra, ≥99.0% (GC) 
micellar avg wt. 18,000 
solubility 
H₂O ..................................................................................................................... 0.1 M at 20 °C, clear, colorless 
A ......................................................................................................................... <0.08 
A ......................................................................................................................... <0.05 

Insoluble matter .................................................................................................. passes filter test 
chloride (Cl) ........................................................................................................ <0.05% 
phosphate (PO₄)³⁻ ............................................................................................ <0.005% 
Al .......................................................................................................................... <0.0005% 
Ca .......................................................................................................................... <0.0005% 
Cu .......................................................................................................................... <0.0005% 

L6026-50G | 50 g |
| L6026-250G | 250 g |
| L6026-1KG | 1 kg |

for electrophoresis, ≥98.5% (GC) 
micellar mol wt 18,000 

- tested for use in denatured polyacrylamide gel electrophoresis. 

Alkyl Sulfonates 

1-Octanesulfonic acid sodium salt 

Octyl sulfate sodium salt 

OCTYL SULFOSUCCHNATE 

Sodium octyl sulfate 

Octyl sulfate sodium salt 

FW 232.27 

≤0.1 
≤0.5 
≤0.02% 
≤0.001% 
≤0.02% 
≤0.001% 
≤0.005% 
≤0.005% 
≤0.005% 
≤0.005% 
≤0.005% 
≤0.005% 
≤0.005% 
≤0.005% 
≤0.001% 
≤0.001% 
≤0.0005% 
≤0.0005% 
≤0.0005% 
≤0.0005% 
≤0.0005% 
≤0.0005% 
≤0.0005% 

L3771-25G | 25 g |
| L3771-100G | 100 g |
| L3771-500G | 500 g |
| L3771-1KG | 1 kg |

O8380-5G | 5 g |
| O8380-25G | 25 g |
| O8380-100G | 100 g |

Sigma Ultra, ≥99.0% (GC) 

solubility 
H₂O ..................................................................................................................... 1 M at 20 °C, clear, colorless 

Insoluble matter .................................................................................................. ≤0.1% 

Phosphorus (P) .................................................................................................... ≤0.005% 
chloride (Cl) ........................................................................................................ ≤0.005% 
Ca .......................................................................................................................... ≤0.0005% 
Cu .......................................................................................................................... ≤0.0005% 

O0133-5G | 5 g |
| O0133-25G | 25 g |
| O0133-100G | 100 g |

Our Innovation, Your Research — Shaping the Future of Life Science
### Detergents

| **Sodium 1-decanesulfonate** | 1-Decanesulfonic acid sodium salt  
| [13419-61-9] C_{11}H_{23}O_{3}Na | FW 244.33  
| Ion-associating reagent for HPLC, including analyses of peptides and proteins. |  
| ![Image](image1.png) |  
| >98% |  
| D3412-5G | 5 g |  
| D3412-25G | 25 g |  
| D3412-100G | 100 g |  

| **Sodium 1-heptanesulfonate** | 1-Heptanesulfonic acid sodium salt  
| [22767-50-6] C_{7}H_{15}O_{3}Na | FW 202.25  
| Ion-pairing reagent for HPLC, including analyses of peptides and proteins. |  
| ![Image](image2.png) |  
| >98% |  
| H2766-5G | 5 g |  
| H2766-25G | 25 g |  
| H2766-100G | 100 g |  

| **Sodium hexanesulfonate** | 1-Hexanesulfonic acid sodium salt  
| [2832-45-3] C_{6}H_{13}O_{3}Na | FW 188.22  
| ![Image](image3.png) |  
| >98% |  
| H5269-5G | 5 g |  
| H5269-25G | 25 g |  

| **SigmaUltra** | solubility  
| ![Image](image4.png) |  
| H_{2}O | 0.5 M at 20 °C, clear, colorless |  
| Insoluble matter | <0.1% |  
| Phosphorus (P) | <0.001% |  
| chloride (Cl) | <0.05% |  
| Al | <0.0005% |  
| Ca | <0.0005% |  
| Cu | <0.0005% |  
| Fe | <0.0005% |  
| H8901-5G | 5 g |  
| H8901-25G | 25 g |  

| **Sodium pentanesulfonate** | 1-Pentanesulfonic acid sodium salt  
| [22767-49-3] C_{5}H_{11}O_{3}Na | FW 174.19  
| Ion-associating reagent for HPLC, including analyses of peptides and proteins. |  
| ![Image](image5.png) |  
| ≥95% (elemental analysis) |  
| P0299-5G | 5 g |  
| P0299-25G | 25 g |  
| P0299-100G | 100 g |  

| **Sigmatech** | solubility  
| ![Image](image6.png) |  
| H_{2}O | 0.5 M at 20 °C, clear, colorless |  
| Insoluble matter | <0.1% |  
| Phosphorus (P) | <0.001% |  
| chloride (Cl) | <0.05% |  
| K | ≤0.0005% |  
| Al | ≤0.0005% |  
| Ca | ≤0.005% |  
| Cu | ≤0.0005% |  
| Fe | ≤0.0005% |  
| Pb | ≤0.0005% |  
| Zn | ≤0.0005% |  
| H9026-5G | 5 g |  
| H9026-25G | 25 g |  

### Bile Salts

| **Chenodeoxycholic acid** |  
| ![Image](image7.png) |  
| Chenodiol; 3α,7α-Dihydroxy-5β-cholanic acid; 5β-Cholanic acid-3α,7α-diol  
| [474-25-9] C_{24}H_{40}O_{4} | FW 392.57  
| Non-denaturing ionic detergent used for extraction of membrane proteins. |  
| ![Image](image8.png) |  
| >98% |  
| C9377-100MG | 100 mg |  
| C9377-5G | 5 g |  
| C9377-25G | 25 g |  

| **Cholic acid** |  
| ![Image](image9.png) |  
| 3α,7α,12α-Trihydroxy-5β-cholanic acid; Cholic acid  
| [81-25-4] C_{24}H_{40}O_{4} | FW 408.57  
| Non-denaturing ionic detergent used for extraction of membrane proteins. |  
| ![Image](image10.png) |  
| >98% |  
| C1129-25G | 25 g |  
| C1129-100G | 100 g |  
| C1129-500G | 500 g |  
| C1129-1KG | 1 kg |  

| **Deoxycholic acid** |  
| ![Image](image11.png) |  
| 3α,12α-Dihydroxy-5β-cholanic acid; 7-Deoxycholic acid; Deoxycholic acid  
| [83-44-3] C_{24}H_{38}O_{4} | FW 392.57  
| Non-denaturing ionic detergent used for extraction of membrane proteins. |  
| ![Image](image12.png) |  
| >99% (TLC and titration) |  
| D2510-10G | 10 g |  
| D2510-100G | 100 g |  
| D2510-500G | 500 g |  

| **SigmaUltra, >99% (TLC and titration)** | solubility  
| ![Image](image13.png) |  
| H_{2}O | 0.5 M at 20 °C, clear, colorless |  
| Insoluble matter | <0.1% |  
| Phosphorus (P) | <0.001% |  
| chloride (Cl) | <0.05% |  
| K | ≤0.0005% |  
| Al | ≤0.0005% |  
| Ca | ≤0.005% |  
| Cu | ≤0.0005% |  
| Fe | ≤0.0005% |  
| Pb | ≤0.0005% |  
| Zn | ≤0.0005% |  
| D4297-5G | 5 g |  
| D4297-25G | 25 g |  

| **Glycocholic acid hydrate** |  
| ![Image](image14.png) |  
| 3α,7α,12α-Trihydroxy-5β-cholanic acid-N-(carboxymethyl)amide; Cholylglycine; N-3α,7α,12α-Trihydroxy-24-oxocholan-24-yl-glycine  
| [475-31-0] C_{25}H_{42}N_{2}O_{10}·xH_{2}O | FW 465.62 (Anh)  
| Non-denaturing ionic detergent used for extraction of membrane proteins. |  
| ![Image](image15.png) |  
| >99% (TLC and titration) |  
| G2878-100MG | 100 mg |  
| G2878-500MG | 500 mg |  
| G2878-1G | 1 g |  
| G2878-5G | 5 g |  
| G2878-25G | 25 g |
Lithocholic acid
3α-Hydroxy-5β-cholanic acid; 3α-Hydroxy-5β-chol-24-oic acid; 5β-Chol-24-oic acid-3α-ol
[434-13-9] C₂₄H₄₂O₅ FW 376.57

- ≥97% (titration)

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<th>G</th>
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<th>100 mg</th>
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Sodium cholate hydrate
Cholalic acid sodium salt; 3α,7α,12α-Trihydroxy-5β-chol-24-oic acid sodium salt
[206986-87-0] C₂₅H₄₀NaO₅·xH₂O FW 430.55 (Anh)
Non-denaturing detergent used for extraction of membrane receptors and other plasma membrane proteins.

- ≥97% (titration)

<table>
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<th>10 g</th>
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- SigmaUltra, ≥99% (titration)

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Sodium deoxycholate monohydrate
[145224-92-6] C₂₄H₂₆NaO₅·H₂O FW 432.57

- SigmaUltra, ≥99% (titration)

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Sodium glycodeoxycholate hydrate
N-(3α,7α,12α-Trihydroxy-24-oxocholan-24-y1)glycine sodium salt; Glycocholic acid sodium salt hydrate; N-Cholylglycine sodium salt; 3α,7α,12α-Trihydroxy-5β-chol-24-oic acid N-(carboxymethyl)amide sodium salt
[863-57-0] C₂₄H₄₀NO₅·xH₂O FW 487.60 (Anh)
Non-denaturing detergent used for extraction of membrane receptors and other plasma membrane proteins.

- ≥97% (TLC)

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Sodium glycocholate
N-(3α,7α,12α-Trihydroxy-24-oxocholan-24-y1)glycine sodium salt; Glycocholic acid sodium salt hydrate; N-Cholylglycine sodium salt;

Sodium glycodeoxycholacte
3α,12α-Dihydroxy-5β-chol-24-oic acid N-(carboxymethyl)amide; Glycodeoxycholic acid sodium salt; N-(3α,12α-Dihydroxy-24-oxocholan-24-y1)glycine; Glycodeoxycholic acid
[16409-34-0] C₂₄H₂₀NaO₅ FW 471.61

- SigmaUltra, ≥97% (TLC)

<table>
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<td>G9910-5G</td>
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</tbody>
</table>
Sodium taurodeoxycholate hydrate
2-[(3α, 7α, 12α-Dihydroxy-24-oxo-5β-cholan-24-yl)amino]ethanesulfonic acid; Taurodeoxycholic acid sodium salt hydrate
[20773-97-1] C_{32}H_{40}NO_{12}S Na FW 521.69 (Anh)
Bile salt-related, anionic detergent used for isolation of membrane proteins including inner mitochondrial membrane proteins.
micellar avg wt. 3100
aggregation number ...................................................... 6
CMC .............................................................................. 1-4 mM (20-25°C)
≥95% (TLC)
T0875-1G 1 g  T0875-5G 5 g  T0875-25G 25 g  T0875-50G 50 g  T0875-100G 100 g
≥95% (TLC)
SigmaUltra, ≥97% (TLC)
solubility
H_{2}O ........................................................ 0.5 M at 20 °C, clear, colorless to faintly yellow
Insoluble matter ................................................................................ ≤0.1%
Phosphorus (P) .................................................................. ≤0.002%
sulfate (SO_{4}) .................................................................. ≤0.05%
Al .............................................................................. ≤0.0005%
Ca ........................................................................... ≤0.0005%
Cu ........................................................................... ≤0.0005%
Fe ........................................................................... ≤0.0005%
T0557-500MG 500 mg  T0557-1G 1 g  T0557-5G 5 g
Sodium taouroursodeoxycholate
3α, 7β-Dihydroxy-5β-cholan-24-0ic acid N-(2-sulfoethyl)amide; Taouroursodeoxycholic acid sodium salt
[14605-22-2] C_{32}H_{38}NO_{12}S Na FW 521.69
≤90%
T0266-500MG 500 mg  T0266-1G 1 g
Taurocholic acid sodium salt hydrate
Sodium taurocholate hydrate; 2-[(3α, 7α, 12α-Trihydroxy-24-oxo-5β-cholan-24-yl)amino]ethanesulfonic acid; 3α, 7α, 12α-Trihydroxy-5β-cholan-24-0ic acid N-(2-sulfoethyl)amide
[345909-26-4] C_{32}H_{38}NO_{12}S Na FW 537.68 (Anh)
Anionic detergent used for protein solubilization.
micellar avg wt. 2100
aggregation number ...................................................... 4
CMC .............................................................................. 3-11 mM (20-25°C)
≥95% (TLC)
SigmaUltra, ≥95% (TLC)
solubility
H_{2}O ........................................................ 0.5 M at 20 °C, clear, colorless to faintly yellow
Insoluble matter ................................................................................ ≤0.1%
Phosphorus (P) .................................................................. ≤0.0005%
sulfate (SO_{4}) .................................................................. ≤0.05%
Al .............................................................................. ≤0.0005%
Ca ........................................................................... ≤0.0005%
Cu ........................................................................... ≤0.0005%
Fe ........................................................................... ≤0.0005%
T9034-1G 1 g  T9034-5G 5 g  T9034-25G 25 g
Additional Anionic Detergents
Docusate sodium salt
Sulfobutandioic acid bis(2-ethylhexyl ester) sodium salt; Sulfo\n succinic acid bis(2-ethylhexyl) ester sodium salt; Bis(2-ethylhexyl) \nsulfosuccinate sodium salt; AOT; ‘Diocyl’ sulfosuccinate sodium salt; Sodium bis(2-ethylhexyl) sulfosuccinate
[577-11-7] C_{32}H_{34}NO_{12}S Na FW 444.56
≥96.0% (TLC)
water ................................................................................ ≤2%
86140-100G 100 g  86140-500G 500 g
≥99%
SigmaUltra, ≥99%
solubility
Insoluble matter ................................................................................ ≤0.1%
Phosphorus (P) .................................................................. ≤0.0005%
sulfate (SO_{4}) .................................................................. ≤0.05%
Al .............................................................................. ≤0.0005%
Ca ........................................................................... ≤0.0005%
Cu ........................................................................... ≤0.0005%
Fe ........................................................................... ≤0.0005%
D4422-50G 50 g  D4422-100G 100 g  D4422-500G 500 g
Docusate sodium salt, SigmaUltra, see Page 18
W-Laurylsarcosine sodium salt
N-Dodecanoyl-N-methylglycine sodium salt; Sarkosyl NL [137-16-6] CH_{13}CH_{2}CONCH_{2}CH_{2}COONa FW 293.38
micellar avg wt. 600
aggregation number ...................................................... 2
CMC .............................................................................. 14.6 mM (20-25°C)
≥94%
LS125-50G 50 g  LS125-100G 100 g  LS125-500G 500 g  LS125-1KG 1 kg
SIGMAULTRA, ≥97% (TLC)
solubility
H_{2}O ........................................................ 0.1 M at 20 °C, clear, colorless to faintly yellow
Insoluble matter ................................................................................ ≤0.1%
Phosphorus (P) .................................................................. ≤0.0005%
sulfate (SO_{4}) .................................................................. ≤0.05%
Al .............................................................................. ≤0.0005%
Ca ........................................................................... ≤0.0005%
Cu ........................................................................... ≤0.0005%
Fe ........................................................................... ≤0.0005%
K ........................................................................... ≤0.01%
L5777-50G 50 g  L5777-100G 100 g  L5777-500G 500 g
W-Laurylsarcosine sodium salt, SigmaUltra, for molecular biology, see Page 19
### Cationic Detergents

#### Alkytrimethylammonium bromide

Cetrimide (per BP)

- ≥95% (TLC)
- Predominantly C₁₄H₂₉N(CH₃)₃Br but also contains C₁₂ and C₁₅ homologs.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>M7635-100G</td>
<td>100 g</td>
<td></td>
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<tr>
<td>M7635-250G</td>
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<tr>
<td>M7635-500G</td>
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</tr>
<tr>
<td>M7635-1K</td>
<td>1 kg</td>
<td></td>
</tr>
</tbody>
</table>

#### Benzalkonium chloride

Alkyldimethylbenzylammonium chloride; Alkylbenzyldimethylammonium chloride

(predominantly C₁₄H₂₉N(CH₃)₂Cl, to C₁₈H₃₃Cl)

- Also contains C₁₄ and C₁₅ homologs.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>234427-5G</td>
<td>5 g</td>
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<tr>
<td>234427-100G</td>
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</tr>
<tr>
<td>234427-1K</td>
<td>1 kg</td>
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</table>

- SigmaUltra

<p>| | | |</p>
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<thead>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Insoluble matter</td>
<td>≤0.1%</td>
<td></td>
</tr>
<tr>
<td>Phosphate (P)</td>
<td>≤0.001%</td>
<td></td>
</tr>
<tr>
<td>sulfate (SO₄²⁻)</td>
<td>≤0.005%</td>
<td></td>
</tr>
<tr>
<td>Al</td>
<td>≤0.0005%</td>
<td></td>
</tr>
<tr>
<td>Ca</td>
<td>≤0.0005%</td>
<td></td>
</tr>
<tr>
<td>Cu</td>
<td>≤0.0005%</td>
<td></td>
</tr>
<tr>
<td>Fe</td>
<td>≤0.0005%</td>
<td></td>
</tr>
<tr>
<td>Zn</td>
<td>≤0.0005%</td>
<td></td>
</tr>
</tbody>
</table>

|                |                  |      |
| B6295-100G     | 100 g            |      |
| B6295-500G     | 500 g            |      |

- Benzoethonium chloride, BioUltra, see Hyamine® 1622, Page 19

#### Benzethonium chloride

Phmeral chloride; (Disobutylphenoxyethoxyethyl)dimethylbenzylammonium chloride solution

- [121-54-0] C₁₄H₂₉ClNO₃ FW 448.08
- ≥97% (titration), ≥99% (TLC)

|                |                  |      |
| B8879-100G     | 100 g            |      |
| B8879-250G     | 250 g            |      |
| B8879-500G     | 500 g            |      |

#### Benzethonium hydroxide solution

- [498-77-1] C₁₄H₂₉NO₃ FW 429.64
- ~1.0 M in methanol (by HCl titration)

|                |                  |      |
| B2156-25ML     | 25 mL            |      |
| B2156-100ML    | 100 mL           |      |
| B2156-500ML    | 500 mL           |      |
| B2156-1L       | 1 L              |      |

#### Dihexadecyldimethylammonium bromide

Distearyldimethylammonium bromide

- ≥98% (TLC)

|                |                  |      |
| D2779-10G      | 10 g             |      |
| D2779-50G      | 50 g             |      |

#### Hyamine 1622

Phmeral chloride; (Disobutylphenoxyethoxyethyl)dimethylbenzylammonium chloride

|                |                  |      |
| H9151-25G      | 25 g             |      |
| H9151-100G     | 100 g            |      |
| H9151-250G     | 250 g            |      |

- Hyamine® 1622, BioUltra, see Page 19

#### Hexadecyldimethylammonium chloride monohydrate

Cetyltrimethylammonium chloride monohydrate

- [6004-24-6] C₁₄H₂₉ClNO₂·H₂O FW 358.00
- ≥99.0-102.0%

|                |                  |      |
| C9002-25G      | 25 g             |      |
| C9002-100G     | 100 g            |      |
| C9002-500G     | 500 g            |      |
| C9002-1K       | 1 kg             |      |

- Hexadecytrimethylammonium bromide, BioUltra, for molecular biology, see Page 18

#### Hexadecytrimethylammonium bromide

Cetrimonium bromide; Palmityltrimethylammonium bromide; CTAB; Cetyltrimethylammonium bromide

- [57-09-0] CH₃(CH₂)₃NBr(CH₂)₃ FW 364.45
- micellar avg wt. 62,000
- aggregation number....................... 170
- CMC.......................................................... 1 mM (20-25°C)
- ≥98%

|                |                  |      |
| H5882-100G     | 100 g            |      |
| H5882-500G     | 500 g            |      |
| H5882-1K       | 1 kg             |      |

- SigmaUltra, ≥99%

|                |                  |      |
| Phosphorus (P) | ≤0.001%           |      |
| sulfate (SO₄²⁻) | ≤0.005%           |      |
| Al             | ≤0.0005%          |      |
| Ca             | ≤0.0005%          |      |
| Cu             | ≤0.0005%          |      |
| Fe             | ≤0.0005%          |      |
| Zn             | ≤0.0005%          |      |

|                |                  |      |
| B6295-100G     | 100 g            |      |
| B6295-500G     | 500 g            |      |

#### Methylbenzethonium chloride

N,N-Dimethyl-N-(2-[2-(methyl-4-[1,1,3,3-tetramethylbutyl]phenoxy)ethoxy]ethyl)benzylammonium chloride

(25155-18-4) C₁₉H₂₈NClO₂ FW 462.11

|                |                  |      |
| M7379-10G      | 10 g             |      |

#### Myristytrimethylammonium bromide

Tetradecytrimethylammonium bromide; Trimethyl(tetradecyl)ammonium bromide

- [1119-97-7] CH₃(CH₂)₃NBr(CH₂)₃ FW 336.39
- micellar avg wt. 27,000
- aggregation number....................... 80
- CMC.......................................................... 4-5 mM (20-25°C)
- ≥99%

|                |                  |      |
| T4762-5G       | 5 g              |      |
| T4762-100G     | 100 g            |      |
| T4762-250G     | 250 g            |      |
| T4762-500G     | 500 g            |      |
| T4762-1K       | 1 kg             |      |
Zwitterionic Detergents

ASB-14
Amidosulfobetaine-14; 3-{(N,N-Dimethyl)3-myristoylammonio}propanesulfonate
[216667-08-2] C₇₇H₅₀N₅O₇S FW 434.68
Zwitterionic detergent. Useful for solubilization of proteins, including membrane proteins, for 2D electrophoresis.
store at: 2-8°C
A1346-1G 1 g

C7BzO
3-(4-Heptylphenyl-3-hydroxypropyl)dimethylammoniopropanesulfonate
Zwitterionic detergent; especially well-suited to protein extraction for proteomics applications.
estimated mol wt 400 Da (anhydrous)
C0856-1G 1 g

CHAPS
3-{[3-Cholamidopropyl]dimethylammonio}-1-propanesulfonate
[7562103-3] C₁₈H₃₅N₃O₄S FW 614.88
CHAPS is a nondenaturing zwitterionic detergent for membrane biochemistry.
Useful for solubilizing membrane proteins and breaking protein-protein interactions. CHAPS’ small micellar molecular weight (6,150) and high critical micelle concentration (6-10 mM) allow it to be removed from samples by dialysis. It is also suitable for protein solubilization for isoelectric focusing and two-dimensional electrophoresis. CHAPS is commonly used for non-denaturing (without urea) IEF and has been shown to give excellent resolution of some subcellular preparations and plant proteins. Concentrations between 2-4% (w/v) are typically used in an IEF gel.
micellar avg wt. 6150
cloud point ................................................................. >100 °C
aggregation number .................................................. 10
CMC ......................................................................... 6 mM (20-25°C)
▶ ≥98% (TLC)
C3023-1G 1 g
C3023-5G 5 g
C3023-25G 25 g
C3023-100G 100 g

▶ SigmaUltra, ≥98% (TLC)
solubility
H₂O ................................................................. 0.1 M at 20 °C, clear, colorless
Insoluble matter ................................................................ ≤0.1%
Phosphorus (P) .......................................................... ≤0.005%
chloride (Cl⁻) .................................................. ≤0.05% Mg^{2+} ≤0.005%
Al .......................... ≤0.005% NH₄⁺ ≤0.05%
Ca .................................. ≤0.005% Na^{+} ≤0.005%
Cu .................................. ≤0.005% Pb^{2+} ≤0.001%
Fe .................................. ≤0.005% Zn^{2+} ≤0.005%
K ........................................ ≤0.005%
C5070-1G 1 g
C5070-5G 5 g

CHAPSO
3-{[3-Cholamidopropyl]dimethylammonio}-2-hydroxy-1-propanesulfonate
[82473-24-3] C₁₈H₃₅N₃O₇S FW 630.88
A nondenaturing zwitterionic detergent with characteristics similar to CHAPS, although it is more soluble due to a more polar head group. Useful for the solubilization of integral membrane proteins.
micellar avg wt. 7000
cloud point ................................................................. 90 °C
aggregation number .................................................. 11
CMC ......................................................................... 8 mM (20-25°C)
▶ ≥99%
C3649-500MG 500 mg
C3649-1G 1 g
C3649-5G 5 g
C3649-25G 25 g

▶ SigmaUltra
solubility
H₂O ................................................................. 0.1 M at 20 °C, clear, colorless
Insoluble matter ................................................................ ≤0.1%
Phosphorus (P) .......................................................... ≤0.005%
CMC ......................................................................... 6 mM (micellar weight =9960) K
chloride (Cl⁻) .................................................. ≤0.005% Mg^{2+} ≤0.005%
sulfate (SO₄^{2-}) .................................................. ≤0.05% NH₄⁺ ≤0.05%
Al .................................. ≤0.0005% Na^{+} ≤0.01%
Ca .................................. ≤0.0005% Pb^{2+} ≤0.001%
Cu .................................. ≤0.0005% Zn^{2+} ≤0.005%
Fe .................................. ≤0.0005%
C4695-500MG 500 mg
C4695-1G 1 g
C4695-5G 5 g

3-(Decyl(dimethylammonio))propanesulfonate inner salt
Capryl sulfobetaine; SB3-10
[15163-36-7] CH₃(CH₂)₇N⁺[(CH₃)₂N(CH₂)₆CH₃]⁻ CH₃CH₂CH₂CH₂SO₃⁻ FW 307.49
micellar avg wt. 12,600
aggregation number .................................................. 41
CMC ......................................................................... 25-40 mM (20-25°C)
Zwitterionic detergent used for protein solubilization.
D4266-5G 5 g
D4266-25G 25 g

N,N-Dimethyldecylamine N-oxide
DDAO; LDAD; Lauridylmethylamine N-oxide
[1643-20-5] CH₃(CH₂)₁₂N⁺O(CH₂)₂⁻ FW 229.40
DDAO is a non-denaturing zwitterionic surfactant with a critical micelle concentration (CMC) of approximately 1 mM. It is used to solubilize proteins and to study the conformation and molecular interactions of macromolecules.
▶ ≥99% (titration)
store at: 2-8°C
D9775-5G 5 g
D9775-25G 25 g

N,N-Dimethyldodecylamine N-oxide solution, BioUltra, see Page 18

3-(N,N-Dimethylmyristylammonio)propanesulfonate
Myristyl sulfobetaine; SB3-14; 3-(N,N-Dimethyloctadecylammonio)propanesulfonate; N-Tetradecyl-N,N-dimethyl-3-ammonio-1-propanesulfonate; 3-(Myristyldimethylammonio)propanesulfonate
[14933-09-6] CH₃(CH₂)₁₄N⁺[(CH₃)₂N(CH₂)₆CH₃]⁻ CH₃CH₂CH₂CH₂SO₃⁻ FW 363.60
micellar avg wt. 30,200
aggregation number .................................................. 83
CMC ......................................................................... 0.1-0.4 mM (20-25°C)
▶ ≥99%
T7763-5G 5 g
T7763-25G 25 g
### 3-(N,N-Dimethyloctadecylammonio)propanesulfonate

Stearyl sulfobetaine; SB3-18; 3-(Stearyl-dimethylammonio)propanesulfonate; N-Octadecyl-N,N-dimethyl-3-ammonio-1-propanesulfonate

- Aggregation number: \( \geq 99.0\% \) (TLC)
- Zwitterionic surfactant useful in membrane solubilization studies. Does not absorb UV light and hence does not interfere with spectrophotometric analysis of proteins.\(^1\)


41570-250G 250 g

### 3-(N,N-Dimethyloctylammonio)propanesulfonate inner salt

SB3-8; Octyl sulfobetaine

- Aggregation number: \( \geq 99.0\% \) (TLC)
- Zwitterionic detergent; mild solubilizer of plasma membranes.


94508-1G-F 1 g
94508-5G-F 5 g

### 3-[N,N-Dimethyl(3-palmitoylaminopropyl)ammonio]-propanesulfonate

Amidosulfobetain-16; 3-(N,N-Dimethyl-(3-palmitamidopro- pyl)ammonio)propane-1-sulfonate

- CMC: 330 mM (20-25°C)


45165-50ML 50 mL
45165-250ML 250 mL

### Non-detergent Sulfobetaines

**Non-detergent sulfobetaines (NDSB)** are reagents similar to zwitterionic detergents but with shorter hydrophobic chains. They have been reported to improve the yield of membrane proteins when used with detergents and prevent aggregation of denatured proteins. Sulfobetaines do not form micelles.

### 3-(Benzylidimethylammonio)propanesulfonate

3-(N-Phenylmethyl-N,N-dimethylammonio)propanesulfonate; PDA; NDSB 256

- CMC: 1.6-2.1 mM (20-25°C)


17236-5G 5 g
17236-25G 25 g

### 3-(1-Pyridinio)-1-propanesulfonate

PPS; 1-(3-Sulfoethyl)pyridinium betain; NDSB 201

- CMC: 1.6-2.1 mM (20-25°C)


82804-50G 50 g
82804-250G 250 g
Cyclodextrins

Many metabolically important compounds, such as lipid-soluble vitamins and hormones, have very low solubilities in aqueous solutions. Various techniques have been used to solubilize these compounds in tissue culture, cell culture, or other water-based applications. A frequently used approach is to use cyclodextrin as a “carrier” molecule to facilitate the dissolution of these compounds.

Structural representations of β-cyclodextrin, α-cyclodextrin, and γ-cyclodextrin. The cyclodextrins are cyclic oligosaccharides consisting of 7, 6, or 8 (respectively) glucopyranose units.

The solubility of natural cyclodextrins is very poor and initially this prevented cyclodextrins from becoming effective complexing agents. In the late 1960’s, it was discovered that chemical substitutions at the 2-, 3-, and 6-hydroxyl sites would greatly increase solubility. The degree of chemical substitution and the nature of the groups used for substitution determine the final maximum concentration of cyclodextrin in an aqueous medium. Most chemically modified cyclodextrins are able to achieve a 50% (w/v) concentration in water.

Cavity size is the major determinant as to which cyclodextrin is used in complexation. “Fit” is critical to achieving good incorporation of cyclodextrins. α-Cyclodextrins have small cavities that are not capable of accepting many molecules. γ-Cyclodextrins have much larger cavities than many molecules to be incorporated, and cyclodextrin hydrophobic charges cannot effectively interact to facilitate complexation. The cavity diameter of β-cyclodextrins has been found to be the most appropriate size for hormones, vitamins, and other compounds frequently used in tissue and cell culture applications. For this reason, β-cyclodextrin is most commonly used as a complexing agent.

Hydrophobic molecules are incorporated into the cavity of cyclodextrins by displacing water. This reaction is favored by the repulsion of the molecule by water. This effectively encapsulates the molecule of interest within the cyclodextrin, rendering the molecule water-soluble. When the water-soluble complex is diluted in a much larger volume of aqueous solvent, the process is reversed, thereby releasing the molecule of interest into the solution.

Sigma’s product line of water-soluble complexes includes cyclodextrins and soluble cyclodextrin-complexes of biochemicals commonly used in tissue and cell culture applications.

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Formula</th>
<th>Mol Wt.</th>
<th>Assay (%)</th>
<th>Application</th>
<th>Solubility</th>
<th>Cat. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>α-Cyclodextrin</td>
<td>C₆H₁₀O₆</td>
<td>972.84</td>
<td>≥98</td>
<td>-</td>
<td>H₂O 50 mg/mL</td>
<td>C4642-1G</td>
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<tr>
<td>α-Cyclodextrin</td>
<td>C₆H₁₀O₆</td>
<td>972.84</td>
<td>≥98</td>
<td>cell culture tested</td>
<td>H₂O 50 mg/mL</td>
<td>C4680-1G</td>
</tr>
<tr>
<td>β-Cyclodextrin</td>
<td>C₇H₁₂O₈</td>
<td>1134.98</td>
<td>≥98</td>
<td>-</td>
<td>1 M NaOH 50 mg/mL</td>
<td>C4767-25G</td>
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<tr>
<td>β-Cyclodextrin</td>
<td>C₇H₁₂O₈</td>
<td>1134.98</td>
<td>≥98</td>
<td>cell culture tested</td>
<td>1 M NaOH 50 mg/mL</td>
<td>C4805-5G</td>
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<tr>
<td>γ-Cyclodextrin</td>
<td>C₈H₁₄O₉</td>
<td>1297.12</td>
<td>≥99</td>
<td>-</td>
<td>1 M NaOH 50 mg/mL</td>
<td>C4892-1G</td>
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<tr>
<td>γ-Cyclodextrin</td>
<td>C₈H₁₄O₉</td>
<td>1297.12</td>
<td>≥98</td>
<td>cell culture tested</td>
<td>1 M NaOH 25 mg/mL, may be clear to slightly hazy</td>
<td>C4930-100MG</td>
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<tr>
<td>(2-Hydroxypropyl)-β-cyclodextrin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>H₂O 45 % (w/w)</td>
<td>H107-5G</td>
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<td>(2-Hydroxypropyl)-β-cyclodextrin</td>
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<td>cell culture tested</td>
<td>H₂O 100 mg/mL</td>
<td>C0926-5G</td>
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<tr>
<td>extent of labeling 4 - 10 (determined by NMR)</td>
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<tr>
<td>(2-Hydroxypropyl)-γ-cyclodextrin</td>
<td>(C₆H₁₀O₃)₅</td>
<td>1393.82</td>
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<tr>
<td>Methyl-β-cyclodextrin</td>
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<td>H₂O 450 mg/mL</td>
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<tr>
<td>extent of labeling 1.5 - 2.1 methyl per 1 mol</td>
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<td>C4555-1G</td>
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Solubilized Complexes

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<th>Application</th>
<th>Solubility</th>
<th>Cat. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chloramphenicol-Water Soluble</td>
<td>cell culture tested</td>
<td>H₂O 50-500 mg/mL, stock solution</td>
<td>C1175-100MG</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PBS 50-500 mg/mL, stock solution</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>other salt solutions, not recommended</td>
<td></td>
</tr>
<tr>
<td>Cholesterol-Water Soluble</td>
<td>cell culture tested</td>
<td>H₂O 200 mg/mL</td>
<td>C4951-100MG</td>
</tr>
<tr>
<td>Dexamethasone-Water Soluble</td>
<td>cell culture tested</td>
<td>H₂O 25 mg/mL, may be clear to slightly hazy</td>
<td>D2581-100MG</td>
</tr>
<tr>
<td>β-Estradiol-Water Soluble</td>
<td>cell culture tested</td>
<td>H₂O 25 mg/mL, may be clear to slightly hazy</td>
<td>E4389-100MG</td>
</tr>
<tr>
<td>Hydrocortisone-Water Soluble</td>
<td>cell culture tested</td>
<td>H₂O 100 mg/mL</td>
<td>H0396-100MG</td>
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<tr>
<td>Linoleic Acid-Water Soluble</td>
<td>cell culture tested</td>
<td>H₂O 50 mg/mL</td>
<td>L5900-100MG</td>
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<tr>
<td>Oleic Acid-Water Soluble</td>
<td>cell culture tested</td>
<td>H₂O 50 mg/mL, may be clear to slightly hazy</td>
<td>O1257-100MG</td>
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<tr>
<td>Progesterone-Water Soluble</td>
<td>cell culture tested</td>
<td>H₂O 25 mg/mL, may be clear to slightly hazy</td>
<td>P7556-100MG</td>
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<tr>
<td>Retinyl Acetate-Water Soluble</td>
<td>cell culture tested</td>
<td>H₂O 400 mg/mL</td>
<td>R0635-100MG</td>
</tr>
</tbody>
</table>

Antifoams

Antifoaming reagents have high surface activities at the interface between the air and liquid phases. Antifoams modify the surface tension in the air-liquid interface of a fermentation solution and interfere with stabilizing substances such as protein-based foam.

Antifoams are supplied as two basic types of composition or mixtures of the two. Organic antifoams are of synthetic origin. Silicone-based antifoams are generally considered to be siloxane polymers and are also synthetic.

Since one cannot predict the effectiveness of an antifoam for a particular application, antifoams should be tested to ensure adequate defoaming effectiveness under representative culture conditions for each microorganism. The variables of medium composition, temperature, pH, mixing, and aeration anticipated for the final experimental or fermentation conditions should be used. If the antifoam is not effective under these test conditions either a higher amount of antifoam can be added or a different type of antifoam can be tested.

Note that silicon-based antifoams are known to cause membrane fouling (contamination) due to gel layer formation and/or adherence to membrane surfaces. In addition, the presence of antifoam in a culture medium may inhibit organism growth.

Organic Antifoams

A recommended starting concentration for use in microbiological media is between 0.005% and 0.01%. The optimal amount of antifoam required for various applications will need to be determined.

Antifoam 204

Contains 100% active components and is a mixture of non-silicone organic defoamers in a polyol dispersion. Can be sterilized repeatedly.

A6426-100G 100 g
A6426-500G 500 g
A6426-1KG 1 kg

Autoclaved

A8311-50ML 50 mL

Antifoam O-30

A long-lasting fatty acid ester antifoam, 100% active.

A8082-100G 100 g
A8082-500G 500 g

Silicone Antifoams

The active ingredient of these antifoams is a silicone-based polymer that has a molecular weight range of 3,200 to 16,500 Da. These products consist of particles ranging in size from 10 to 40 microns, and can be removed by filtration.

The silicone-type antifoams are suspensions and must be agitated before a sample is taken from the container to ensure representative sampling. In order to remove traces of these types of antifoam from glassware, wash the glassware in hot soapy water followed by an alcohol (isopropanol) wash or bleach. Autoclaving may result in phase separation and may require remixing the emulsion. A different emulsifier is present in each of the Antifoam emulsions.

Antifoam B, C, and Y-30 contain preservatives to guard against microbial growth. Long-term storage of diluted material may diminish this antimicrobial effect and additional preservative may be required.

Antifoam emulsions are typically effective within a 1-100 ppm concentration range.

Antifoam A Concentrate

An extremely effective foam suppresser for use in aqueous and non-aqueous systems. Contains no emulsifier.

A5633-25G 25 g
A5633-100G 100 g

Antifoam B Emulsion

A 10% aqueous emulsion of Antifoam A concentrate. Contains emulsifier (different from those present in Antifoam A emulsion).

A5757-250ML 250 mL
A5757-500ML 500 mL

Antifoam C Emulsion

A 30% aqueous emulsion of Antifoam A concentrate. Contains emulsifier.

A8011-250ML 250 mL
A8011-500ML 500 mL

Antifoam Y-30 Emulsion

A 30% aqueous emulsion of Antifoam A concentrate. Contains emulsifier.

A5758-100ML 100 mL
A5758-250ML 250 mL
A5758-500ML 500 mL
Antifoam Selection Kits

The Antifoam Test Kits are sets of 20 different antifoams, detergents, and surfactants, designed to help biotechnologists and microbiologists identify the optimum antifoam for use in specific fermentation processes.

Antifoam Test Kit 1

- for biotechnological purposes

Components

1-Methoxy-2-propanol (Fluka 65280) 10 mL
2-Decanol (Fluka 30620) 10 mL
Imbittert-AGS/Sys (Fluka 56742) 10 mL
1-Oleyl-rac-glycerol (Fluka 49960) 10 mL
TWEEN® 20 (Fluka 93773) 10 mL
TWEEN® 80 (Fluka 93780) 10 mL
Ucon® HTF 14 (Fluka 93970) 10 mL
Antifoam A (Fluka 10794) 10 mL
Mineral oil type A (Fluka 91975) 10 mL
Mineral oil type B (Fluka 78473) 10 mL
Mineral oil (Fluka 69794) 10 mL
Paraffin oil (Fluka 76235) 10 mL
Polyethylene glycol solution 10,000, ~50% in H₂O (Fluka 90421) 10 mL
Polyethylene glycol solution 1,000, ~50% in H₂O (Fluka 87293) 10 mL
Nonylphenyl-polyethylene glycol acetate (Fluka 74432) 10 mL
O-(2-Aminopropyl)-O-(2-methoxyethyl)polypropylene glycol 500 (Fluka 09303) 10 mL
Polyethylene glycol solution 1,000, ~50% in H₂O (Fluka 76293) 10 mL
Polyethylene glycol solution 10,000, ~50% in H₂O (Fluka 84184) 10 mL

04686-1KT-F 1 kit

Antifoam Test Kit 2

- for biotechnological purposes

Components

Polyethylene glycol 1500 solution (Fluka 73034) 10 mL
Polyethylene glycol 2000 solution (Fluka 87006) 10 mL
Polyethylene glycol 3,350 solution (Fluka 83272) 10 mL
Polyethylene glycol 500 dimethyl ether (Fluka 81313) 10 mL
Polyethylene glycol 600 (Fluka 87333) 10 mL
Polyethylene glycol 6,000 solution (Fluka 81304) 10 mL
Polyethylene glycol 8,000 solution (Fluka 83271) 10 mL
Polyethylene glycol 2,000 monomethyl ether solution (Fluka 83918) 10 mL
Polyethylene glycol 5,000 monomethyl ether solution (Fluka 90364) 10 mL
Polyethylene glycol 550 monomethyl ether solution (Fluka 71578) 10 mL
Polypropylene glycol P 1,200 (Fluka 81380) 10 mL
Polypropylene glycol P 2,000 (Fluka 81389) 10 mL
Polypropylene glycol P 400 (Fluka 81350) 10 mL
Silicone antifoam, emulsion, 30% in water (Fluka 85390) 10 mL
Silicone oil DC 200 (Fluka 85412) 10 mL
Silicone oil DC 710 (Fluka 85427) 10 mL
Triethylene glycol monobutyl ether (Fluka 90440) 10 mL
Triethylene glycol dimethyl ether (Fluka 90420) 10 mL
Brij® 96 V (Fluka 16011) 10 mL

28401-1KT-F 1 kit

Trademarks

The following trademarks and registered trademarks are accurate to the best of our knowledge at the time of printing. Please consult individual manufacturers and other sources for specific information.

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BASF AG — Fluorescein®
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Desitin Arzneimittel GmbH — Thext®
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Detergent Removal

MiniTips™ C18

Expertly designed by chromatographers and mass spectrometrists, the MiniTip C18 pipette tip provides superior sample recovery, increased bed integrity, and enhanced binding capacity for purifying and concentrating mass spectrometry samples. MiniTips’ unique, proprietary adhesive chemistry greatly increases available silica particle surface area, leading to exceptional binding capacity and unsurpassed analytic recovery. The unique solid phase support binds peptides, proteins, and other analytes retained by reversed phase techniques while withstanding the rigors of repeated draw and dispense cycles without structural degradation. For optimal purification and concentration of important samples, trust MiniTips!

Features and Benefits

Discover the Advantages for Yourself!

• Superior recovery of peptides and proteins
• Exceptional binding capacity and enhanced affinity
• Greater sorbent bed stability for cleaner samples

TPSC18-96EA 96 ea
TPSC18-960EA 960 ea

Solvent–Detergent Removal Resin

SDR HyperD® Resin

> saline suspension with ethanol

HyperD media are highly porous, rigid ceramic beads filled with a derivatized hydrogel.

Useful for the removal of detergents from protein samples.

Features and Benefits

Characteristics are tolerant of very high flow rates without bed compression, and high exchange capacity. The bead has an exclusion limit of 10,000 Da MW, and is highly efficient at removing biological detergents from samples. Stable to most common solvents, and pHs from 2-12.

Suspension in 1 M NaCl with 20% ethanol.

Binding capacity: 4-10 column volumes of sample can be treated, with up to 99.9% removal.

store at: 2-8°C

S5054-25ML 25 mL
S5054-100ML 100 mL
S5054-500ML 500 mL

Porozorb™ Cartridge

Analysts processing protein or other biological preparations, sterile pharmaceuticals, foods, or beverages must separate wanted products from unwanted process components.

Porozorb™ cartridges are produced using validated processes, providing sterile, endotoxin-free, ready-to-use adsorbent cartridges that effectively remove detergents (Triton® X-100, sodium dodecyl sulfate, TWEEN®, etc.) or other nonpolar, hydrophobic materials from such preparations. They are appropriate for analytical scale to process scale purification schemes.

A certificate of analysis accompanies each Porozorb cartridge.

Cartridges are tested for sterility and endotoxin by an accredited test lab following modified USP guidelines. The cartridges can be rinsed with cleaning agents (e.g., most weak acids and bases) or autoclaved at 121 °C. The polycarbonate cartridge can accept 50% organic solutions during analysis, but must be stored in aqueous solutions.

Characteristics of Porozorb Cartridges

Packing: Amberlite XAD4, specially cleaned
Mean Particle Size: 500 μm

Cartridge dimensions:
250 mL - 6.55 × 8 cm
1000 mL - 26.2 × 8 cm

Nipple Connection: ½ in. I.D., ¼ in. O.D.

Shell: clear polycarbonate

Gaskets: medical grade

Max. Pressure: 30 psi (2.1 kg/cm²)

Shipped sterile and endotoxin free.

Porozorb cartridges are not for clinical or diagnostic use.

Due to shelf life limitations, Porozorb cartridges are made on receipt of an order. Expect 2-4 week delay in shipping times.

> Porozorb 254, 250 mL
57500 1 ea

> Porozorb 1004, 1000 mL
57502 1 ea

DOWEX® Retardion 11A8

Chromatographic resin for ion separation. Useful for removal of ionic detergents (e.g., SDS) from protein samples. It is used for the removal of electrolytes from water solutions, and separation of cations from anions. Desalting occurs by SEC-type mechanism, so column use is recommended for best success.

The Retardion 11A8 is not a true mixed bed resin, but a resin with mixed functionality. It contains paired anion and cation exchange sites (each exists as the other’s counter-ion) that adsorb mobile ions from a bulk stream. anamphoteric form

moisture .................................................. 43-48%

This ion-exchange resin has not been specially processed nor cleaned. We suggest that it be treated to a suitable preliminary elution and wash.

428698-100G 100 g
428698-500G 500 g

Detergent Removal