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Introduction

Detergents are amphipathic molecules that possess both a hydrophobic (water-fear) and a hydrophilic (water-friend) group that allow them to act as excellent solubilization agents.

Hydropobicity

Hydropobicity from the Greek words hydro (water) and phobos (fear) refers to the physical property of a molecule (known as a hydrophobe) that is repelled from a mass of water.

Water molecules form a highly ordered structure by the intermolecular action of its hydrogen bonds. Polar, or hydrophilic, molecules can readily dissolve in water as their charged groups can interact with the hydrogen bonds maintaining a ordered structure.

Non-polar, or hydrophobic, molecules are unable to form stable structures and are repelled by the water molecules and are therefore immiscible with the water. The addition of hydrophobic molecules disrupts the energy favoured structure of water, creating “holes” devoid of water molecules. The water molecules at the edge of the holes rearrange into an ordered manner and this results in an unfavorable decrease in entropy. To combat the loss of entropy, water molecules force the hydrophobic molecules to cluster to occupy the smallest space possible. This effect is known as the hydrophobic effect.

The hydrophobic effect plays an important role in protein structure and is involved in defining the tertiary structure of proteins. The amino acids of proteins can be polar or non-polar and therefore in an aqueous environment the proteins fold to protect the hydrophobic non-polar groups from the water molecules.

How do detergents work?

The structure of detergents is key to its ability to function as a solubilization agent. Detergent molecules contain a polar head group from which extends a long hydrophobic carbon tail.

The amphipathic properties of the detergent molecules allows them to exhibit unique properties in aqueous solutions. The polar (hydrophilic) head groups interact with the hydrogen bonds of the water molecules and the hydrophobic tails aggregate resulting in highly organized spherical structures called micelles. At low concentrations, the detergents exist as single molecules or small aggregates and as the concentration increases micelles begin to form. The concentration at which micelles begin to form is known as the Critical Micelle Concentration (CMC).

How do detergents solubilize proteins?

A wide range of detergents are routinely used to release, or solubilize, proteins from lipid membranes.

Biological membranes consist of phospholipids that are similar to detergents as they have the same amphipathic properties. The phospholipids have a charged polar head normally connected to two hydrophobic groups or tails. The phospholipids assemble as bilayers, with the hydrophobic tails between two faces of polar head groups.

For biological membranes, proteins and lipids (i.e. cholesterol) are embedded in the bilayer forming the fluid mosaic model. The proteins are held in the lipid bilayer by hydrophobic interactions between the lipid tails and hydrophobic protein domains. These integral membrane proteins are not soluble in aqueous solutions as they aggregate to protect their hydrophobic domains, but are soluble in detergent solutions.

The proteins are released from lipid bilayers by detergents as the detergent micelles have similar properties as the lipid bilayer. The integral membrane proteins embed themselves in the detergent micelles protecting their hydrophobic domains from aggregation.

A schematic of how detergents solubilize membrane proteins is shown below. At low detergent concentrations, less than the detergent’s CMC, the detergent molecules insert themselves in the lipid membrane and begin partitioning the lipid bilayer. At concentrations equal to, or higher than the detergent’s CMC, the lipid bilayer becomes saturated with detergent molecules and the lipid bilayer breaks apart. The resulting products are protein-detergent complexes, where the detergent hydrophobic regions bind to the protein hydrophobic domains protecting them from aggregations. In addition to these, detergent and detergent-lipid micelles are formed.
Critical Micelle Concentration (CMC)

The solubilization of proteins from lipid bilayers is dependent on the Critical Micelle Concentration (CMC) of the detergents.

The CMC is defined as the concentration of surfactants (detergents) above which micelles are spontaneously formed. The CMC is dependent on the alkyl chain length, presence of double bonds, branched points and additives in the solubilization buffers. As the alkyl chains increase, the CMC decreases; the introduction of double bonds and branch points increases the CMC; additives, such as urea, that are chaotropic increase the CMC.

The detergent CMC is important as it allows researcher’s to use the precise amount of detergent, too little means inadequate solubilization of proteins, too much can affect downstream process and problematic detergent removal steps.

CMC can be determined by light scattering (increases with detergent concentration), surface tension (decrease) and dye solubilization (increase) (Vulliez-Le Normand and Jean-Luc Eisele (1993)). All three techniques are time consuming and are rarely performed for this reason. G-Biosciences has developed Optimizer-blueBALLS™, which is based on the dye solubilization method, but is significantly more convenient. More information on Optimizer-blueBALLS™ is provided later in this handbook.
Proteomic Grade Detergent Solutions (10%), Sterile

Ultra low carbonyl & peroxide contaminants

Many commercial grade detergents contain elevated levels of sulfhydryl oxidizing agents, peroxides, salts and carbonyl compounds. The proteins that are isolated with these detergents are highly susceptible to contaminating peroxides and carbonyls. The peroxides will oxidize proteins and the carbonyl groups will form Schiff’s bases with the proteins that will interfere with a protein’s structure.

Our Proteomic Grade Detergent Solutions contain reduced peroxides and carbonyl compounds. In addition, the detergents have less than 50µS conductivity. These detergents are offered as sterile, 10% aqueous solutions, sealed under inert gas and are suitable for protein applications. These non ionic detergents are suitable for isolating membrane-protein complexes.

FEATURES
- Low peroxide contamination
- Low carbonyl contamination
- Low conductivity
- Sterile detergent solutions
- Reduced metal ions
- 10% aqueous solutions
- Sealed under inert gas to prevent oxidation

We offer a selection of widely used Proteomic Grade Detergent Solutions. The aldehyde and peroxide levels are <100µM and <50µM respectively with a conductivity of <50µS.

Critical Micelle Concentration (CMC)

The CMC is defined as the concentration of surfactants (detergents) above which micelles are spontaneously formed. See previous section.

Kraft Point

The Kraft Point is used to describe the temperature at which an equilibrium exist between an insoluble crystalline state, monomeric detergent and detergent micelles. At low temperatures, detergents form insoluble crystalline states that shift to detergent monomers and finally detergent micelles with increasing temperatures.

The temperature at which the CMC concentration is reached is known as the critical micellar temperature (CMT). In most cases, the CMT is equal to the Kraft Point.

Cloud Point

The Cloud Point is another temperature related property that is specific for non ionic detergents. As temperatures pass the CMT, the non ionic detergents become cloudy and separate into a detergent-rich and an aqueous layer, a process known as phase separation. This temperature is known as the cloud point.

This property is used for the purification of integral membrane proteins with Triton® X-114. The cloud point of Triton® X-114 is 23°C, therefore cellular membranes can be solubilized at 0°C and then warmed to >23°C. The integral membrane proteins partition into the detergent-rich phase away from the hydrophilic proteins that remain in the aqueous phase (Bordier, C (1981)).

Aggregation Number

This is quite simply the number of detergent molecules that are associated together to form a micelle and is calculated by:

\[
\text{Aggregation No.} = \frac{\text{Micellar molecular weight}}{\text{Monomeric molecular weight}}
\]

The micellar molecular weight can be determined by gel filtration, sedimentation equilibrium, X-ray scattering or light scattering.

Hydrophile-Lipophile Balance (HLB)

A measure of the hydrophilic character of a detergent. Basically, detergents with HLB of 12-20 are preferred for non-denaturing solubilization; >20 for extrinsic protein solubilization. Detergents with a low HLB are more readily removed by hydrophobic chromatography as they are more hydrophobic.
Non ionic detergents have a hydrophilic head group that is uncharged and are preferred for their ability to break lipid-lipid and lipid-protein interactions. They have limited ability to break protein-protein interactions and are often referred to as non-denaturing detergents and are used to isolate biologically active membrane proteins.

The non ionic detergents are supplied as a general Research Grade, Proteomic Grade (PG) Solutions and 2D-Detergents™. The Proteomic Grade (PG) Solutions have ultra low aldehyde (<100µM) and peroxide (<50µM) concentrations to reduce the effects of peroxidase and carbonyl compounds that negatively interact with membrane proteins. The 2D-Detergents™ have low conductivity (<10µS) and ultra low aldehyde (<100µM) and peroxide (<50µM) concentrations.

**Triton® X-100**

**Octylphenolpoly(ethyleneglycolether)**

*Figure 8: Structure of Triton® X-100.*

**Type:** Non ionic detergent

**Form:** 10% aqueous solution (w/v) or 100% solution

**Mol. Formula:** C₉H₁₈O₄₇ for x = 10

**Mol. Weight:** 647 (for x=10)

**Absorbance (254nm):** 0.16 (0.05% w/v)

**Aldehyde content:** <100µM

**Peroxide content (as H₂O₂):** <50µM

**Critical micelle concentration (CMC):** approx. 0.2 x 10⁻³M (25°C)

**Cloud Point: 65°C**

**Average micellar weight:** 80,000

**Application:** One of the most commonly used non ionic detergents for solubilizing membrane proteins during isolation of membrane-protein complexes. Ultra low aldehyde and peroxide concentrations reduce the effects of peroxidase and carbonyl compounds that negatively interact with membrane proteins.

**CITED REFERENCES**


**Triton® X-114**

**Polyethylene glycol tert-octylphenyl ether**

*Figure 9: Structure of Triton® X-114.*

**Type:** Non ionic detergent

**Form:** 10% aqueous solution (w/v), white solid

**Mol. Formula:** C₁₈H₃₆O₇[OCH₂CH₂]ₙ for n =8

**Mol. Weight:** ~537 (for n=7-8)

**Absorbance (254nm):** 0.18 (0.05% w/v)

**Aldehyde content:** <100µM

**Peroxide content (as H₂O₂):** <50µM

**Critical micelle concentration (CMC):** approx. 0.35 x 10⁻³M (25°C)

**Cloud Point: 23°C**

**Application:** A non ionic detergent with a low cloud point (23°C) making it suitable for protein solubilization with phase-partitioning of hydrophilic proteins from amphiphilic proteins.

**CITED REFERENCES**


**Brij® 35**

**Polyoxyethylene (23) lauryl ether**

*Figure 10: Structure of Brij® 35.*

**Type:** Non ionic detergent

**Form:** 10% aqueous solution (w/v), white solid

**Mol. Formula:** C₁₈H₃₆O₇(OCH₂CH₂)₁₀

**Mol. Weight:** 627

**Absorbance (225nm):** 0.07 (1% w/v)

**Aldehyde content:** <100µM

**Peroxide content (as H₂O₂):** <50µM

**Critical micelle concentration (CMC):** 90µM

**Aggregation number:** 24-40

**Cloud Point:** >100°C

**Average micellar weight:** 48,000

**Appearance:** Clear solution with a faint yellow color

**Application:** For protein extraction, permeabilization of cells, and preparation of yeast spheroplasts.

**CITED REFERENCES**


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<th>Size</th>
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<td>Triton® X-114, 100% solution</td>
<td>1L</td>
</tr>
<tr>
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<td>Triton® X-114, 10% solution</td>
<td>10 x 10ml vials</td>
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</tr>
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<td>DG518</td>
<td>Triton® X-114, 10% solution</td>
<td>100ml bottle</td>
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<td>10 x 10ml vials</td>
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<tr>
<td>DG515</td>
<td>Brij® 35, 10% solution</td>
<td>100ml bottle</td>
</tr>
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For further details, visit GBiosciences.com
**Brij® 58**

*Polyoxyethylene (20) cetyl ether*

- **Type:** Non ionic detergent
- **Form:** 10% aqueous solution (w/v), white solid
- **Mol. Formula:** C\(_{16}\)H\(_{33}\)(OCH\(_2\)CH\(_2\))\(_{20}\)OH
- **Mol. Weight:** 1122
- **Absorbance (225nm):** 0.0788 (1% w/v)
- **Aldehyde content:** < 100µM
- **Peroxide content (as H\(_2\)O\(_2\)):** < 50µM
- **Critical micelle concentration (CMC):** 7-77µM
- **Aggregation number:** 70
- **Cloud Point:** >100°C
- **Average micellar weight:** 79,000
- **Appearance:** Clear solution with a faint yellow color
- **Application:** For protein extraction, permeabilization of cells, and preparation of yeast spheroplasts

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<th>Size</th>
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<td>786-522</td>
<td>Brij® 58</td>
<td>500g</td>
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<td>DG005</td>
<td>Brij® 58, 10% solution</td>
<td>5 x 10ml vials</td>
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<td>DG006</td>
<td>Brij® 58, 10% solution</td>
<td>10 x 10ml vials</td>
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<tr>
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<td>Brij® 58, 10% solution</td>
<td>100ml bottle</td>
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**Tween® 20**

*Polyethylene glycol sorbitan monolaurate*

- **Type:** Non ionic detergent
- **Form:** 10% aqueous solution (w/v), 100% solution
- **Mol. Formula:** C\(_{20}\)H\(_{36}\)O\(_6\)•[C\(_2\)H\(_4\)O]\(_w\)\(_x\)\(_y\)\(_z\) for w+x+y+z =20
- **Mol. Weight:** ~1227 (for w+x+y+z =20)
- **Absorbance (215nm):** 0.05 (0.05% w/v)
- **Aldehyde content:** < 100µM
- **Peroxide content (as H\(_2\)O\(_2\)):** < 50µM
- **Critical micelle concentration (CMC):** ~0.012 x 10\(^{-3}\)M (25°C)
- **Aggregation number:** 60
- **Cloud Point:** 76°C
- **Application:** For solubilizing membrane proteins during isolation of membrane-protein complexes

**CITED REFERENCES**


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<td>Tween® 80, 100% solution</td>
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<td>DG013</td>
<td>Tween® 80, 10% solution</td>
<td>5 x 10ml vials</td>
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<td>DG520</td>
<td>Tween® 80, 10% solution</td>
<td>100ml bottle</td>
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**Non Ionic Detergents**

**Figure 11: Structure of Brij® 58.**

**Figure 12: Structure of Tween® 20.**

**Figure 13: Structure of Tween® 80.**
Nonidet® P-40 Substitute

Nonylphenyl-polyethylene glycol

Figure 14: Structure of Nonidet® P-40 Substitute.

Type: Non ionic detergent
Form: 10% aqueous solution (w/v), 100% solution
Mol. Formula: $C_{15}H_{24}O[C_2H_4O]_n$
Mol. Weight: 573 (for $n=8$)
Absorbance (254nm): 0.14 (0.05% w/v)
Aldehyde content: < 100µM
Peroxide content (as $H_2O_2$): < 50µM
Critical micelle concentration (CMC): approx 0.05-0.3mM (25°C)
Application: A commonly used non ionic detergent for solubilizing membrane proteins during isolation of membrane-protein complexes

Cat. No. Description Size
786-511 Nonidet® P-40 Substitute, 100% solution 500ml
786-512 Nonidet® P-40 Substitute, 100% solution 1L
DG001 Nonidet® P-40 Substitute, 10% solution 5 x 10ml vials
DG002 Nonidet® P-40 Substitute, 10% solution 10 x 10ml vials
DG501 Nonidet® P-40 Substitute, 10% solution 50ml bottle
DG514 Nonidet® P-40 Substitute, 10% solution 100ml bottle

Octyl β Glucoside

N-Octyl-beta-D-glucopyranoside

Figure 15: Structure of Octyl-β-Glucoside.

Type: Non ionic detergent
Form: White to off white powder
Purity: >98%
Solubility: Water soluble
Critical micelle concentration (CMC): 20-25mM (25°C)
Aggregation number: 84
Cloud Point: >100°C
Average micellar weight: 25,000
Application: Widely used for membrane proteins. For solubilization of membrane-bound proteins in their native state, and for preparation of lipid vesicles. Low molecular weight permits easy removal by dialysis. Useful for solubilizing enzymes, receptors and phosphatidylcholine bilayers

Cat. No. Description Size
DG015 Octyl β Glucoside 1g
DG016 Octyl β Glucoside 5g

MEGA 8

Octanoyl-N-methylglucamide

Figure 16: Structure of MEGA 8.

Type: Non ionic detergent
Mol. Formula: $C_{15}H_{31}NO_6$
Mol. Weight: 321.4
Form: White powder
Purity: >99%
Solubility: Water soluble
Critical micelle concentration (CMC): 58mM (25°C)
Application: Non ionic detergent that is water soluble and readily removed by dialysis. Used for the solubilization of membranes

Cat. No. Description Size
DG017 MEGA 8 1g
DG018 MEGA 8 5g

MEGA 9

Nonaoyl-N-methylglucamide

Figure 17: Structure of MEGA 9.

Type: Non ionic detergent
Mol. Formula: $C_{16}H_{33}NO_6$
Mol. Weight: 335.4
Form: White powder
Purity: >99%
Solubility: Water soluble
Critical micelle concentration (CMC): 19-25mM (25°C)
Application: Non ionic detergent that is water soluble and readily removed by dialysis. Used for the solubilization of membranes

Cat. No. Description Size
DG019 MEGA 9 1g
DG020 MEGA 9 5g

For further details, visit GBiosciences.com
Non Ionic Detergents

MEGA 10

**Decanoyl-N-methylglucamide**

**Figure 18:** Structure of MEGA 10.

<table>
<thead>
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<tbody>
<tr>
<td>Mol. Formula:</td>
<td>C₁₇H₃₅NO₆</td>
</tr>
<tr>
<td>Mol. Weight:</td>
<td>349.5</td>
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<tr>
<td>Form:</td>
<td>White powder</td>
</tr>
<tr>
<td>Purity:</td>
<td>&gt;99%</td>
</tr>
<tr>
<td>Solubility:</td>
<td>Water soluble</td>
</tr>
<tr>
<td>Critical micelle concentration (CMC):</td>
<td>6-7 mM (25°C)</td>
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<td>Application:</td>
<td>Non ionic detergent that is water soluble and readily removed by dialysis. Used for the solubilization of membranes</td>
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</tr>
<tr>
<td>DG022</td>
<td>MEGA 10</td>
<td>5g</td>
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Big CHAP

**N,N-Bis[3-(D-gluconamido)propyl]cholamide**

**Figure 19:** Structure of Big CHAP.

<table>
<thead>
<tr>
<th>Type:</th>
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<tbody>
<tr>
<td>Mol. Formula:</td>
<td>C₄₂H₇₅N₃O₁₆</td>
</tr>
<tr>
<td>Mol. Weight:</td>
<td>878.1</td>
</tr>
<tr>
<td>Form:</td>
<td>Fine colorless crystals</td>
</tr>
<tr>
<td>Purity:</td>
<td>&gt;99%</td>
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<tr>
<td>Solubility:</td>
<td>Water soluble</td>
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<td>Conductivity:</td>
<td>&lt;25μS in a 10% solution</td>
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<tr>
<td>Critical micelle concentration (CMC):</td>
<td>3.4 mM (25°C)</td>
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<tr>
<td>Aggregation number:</td>
<td>10</td>
</tr>
<tr>
<td>Average micellar weight:</td>
<td>8800</td>
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<tr>
<td>Application:</td>
<td>Non ionic detergent for membrane solubilization</td>
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<td>DG023</td>
<td>Big CHAP</td>
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<tr>
<td>DG024</td>
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<td>5g</td>
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Deoxy Big CHAP

**N,N-Bis[3-(D-gluconamido)propyl]deoxycholamide**

**Figure 20:** Structure of Deoxy Big CHAP.

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<td>Mol. Formula:</td>
<td>C₄₄H₇₅N₃O₁₅</td>
</tr>
<tr>
<td>Mol. Weight:</td>
<td>862.1</td>
</tr>
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<td>Form:</td>
<td>White powder</td>
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<td>Purity:</td>
<td>&gt;95%</td>
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<td>Solubility:</td>
<td>Water soluble</td>
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<td>Critical micelle concentration (CMC):</td>
<td>1.1-1.4 mM (25°C)</td>
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<td>Aggregation number:</td>
<td>8-16</td>
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<td>Average micellar weight:</td>
<td>10,500</td>
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<td>Application:</td>
<td>Non ionic detergent that is water soluble and has increased solubility compared to CHAPS. Used for the solubilization of membranes</td>
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<td>Deoxy Big CHAP</td>
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<td>DG026</td>
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Proteomic Grade Detergent Variety Pack

The variety pack contains a selection of our non ionic Proteomic Grade Detergent Solutions, Zwitterionic and non-detergent sulfobetaines for trial and optimization.

The following proteomic grade detergents are available as a trial pack. The pack contains one 10ml vial of 10% aqueous solutions of:

- Triton® X-100
- Triton® X-114
- Tween® 20
- Tween® 80
- Nonidet® P-40 Substitute
- Brij® 35
- Brij® 58

And 1gm of:

- CHAPS
- NDSB 201

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Description</th>
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</thead>
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<tr>
<td>DG521</td>
<td>Proteomic Grade Detergent Variety Pack</td>
<td>9 vials</td>
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</table>
2D-Detergent™

Ultra low conductivity & low carbonyl & peroxide contaminants

Our 2D-Detergent™ solutions contain reduced peroxides and carbonyl compounds. In addition, the detergents have less than 15µS conductivity. These detergents are offered as 10% aqueous solutions, sealed under inert gas and are suitable for all protein applications, including 2D-electrophoresis. These non ionic detergents are suitable for isolating membrane-protein complexes.

The aldehyde levels are <50µM, the peroxide levels are <10µM and have a conductivity of <15µS.

FEATURES

- Low conductivity; <15µS
- Low peroxide contamination
- Low carbonyl contamination
- Reduced metal ions
- Ready to use 10% aqueous solutions
- Sealed under inert gas to prevent oxidation

![Graph](image)

Figure 21: Comparison of carbonyl (as a measure of aldehyde) (blue) and peroxide (red) concentration in G-Biosciences 2D-Detergent™ NP-40 Substitute (left) or 2D-Detergent™ Triton® X-100 (right) and non-proteomic grade commercially available detergents.

<table>
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<tr>
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<td>2D-Detergent™ Triton® X-100</td>
<td>5 x 10ml vials</td>
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<td>10 x 10ml vials</td>
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<td>DG901</td>
<td>2D-Detergent™ Nonidet® P-40 Substitute</td>
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<tr>
<td>DG902</td>
<td>2D-Detergent™ Nonidet® P-40 Substitute</td>
<td>10 x 10ml vials</td>
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Ionic detergents are used for complete disruption of cellular structure and denaturing of proteins for separation during gel electrophoresis. Ionic detergents bind with protein molecules masking their native charge and rendering the protein molecules the overall charge of the ionic detergent.

**SDS**

**Sodium dodecyl sulfate**

![Structure of SDS](image)

**Type:** Anionic detergent  
**Mol. Formula:** $\text{C}_{12}\text{H}_{25}\text{NaO}_4\text{S}$  
**Mol. Weight:** 288.38  
**Form:** White to off white powder, 10% or 20% solution  
**Purity:** >99%  
**Solubility:** Water  
**Critical micelle concentration (CMC):** 7-10mM (25 °C)  
**Aggregation number:** 62  
**Cloud point:** >100 °C  
**Average micellar weight:** 18,000

**Application:** Capable of almost complete disruption of cellular structures and denaturation. Used for solubilization of a wide variety of proteins, including membrane proteins, for electrophoretic separation. Detergent molecules tightly bind with the protein molecules masking their native charge and rendering the protein molecules with an overall negative charge.

<table>
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<td>DG093</td>
<td>SDS</td>
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<tr>
<td>R014</td>
<td>SDS, 10% Solution</td>
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<td>786-016</td>
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<td>786-017</td>
<td>SDS, 20% Solution</td>
<td>1L</td>
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**CTAB**

**Hexadecyltrimethylammonium bromide**

![Structure of CTAB](image)

**Type:** Cationic detergent  
**Mol. Formula:** $\text{C}_{15}\text{H}_{29}\text{N(Br)(CH}_3)_3$  
**Mol. Weight:** 364.5  
**Form:** White to off white powder  
**Purity:** >99%  
**Solubility:** Water soluble  
**Critical micelle concentration (CMC):** 1mM (25 °C)  
**Aggregation number:** 61 in water; 169 in 13mM KBr  
**Average micellar weight:** 62,000

**Application:** A cationic detergent used for solubilization of a wide variety of proteins and nucleic acids.

**CITED REFERENCES**


<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Description</th>
<th>Size</th>
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</thead>
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<td>CTAB</td>
<td>25g</td>
</tr>
<tr>
<td>DG095</td>
<td>CTAB</td>
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</table>
Zwitterionic detergents protect the native state of proteins without altering the native charge of the protein molecules. Zwitterionic detergents are used for isoelectric focusing and 2D electrophoresis. Synthetic zwitterionic detergents are known as sulfobetaines. Sulfobetaines retain their zwitterionic characteristics over a wide range of pH. The following zwitterionic detergents are the most efficient and widely used for 2D gel electrophoresis.

**CHAPS**

3-[(3-Cholamidopropyl)dimethylammonio]-1-propanesulfonate

Type: Zwitterionic detergent  
Mol. Formula: C_{32}H_{58}N_{2}O_{7}S  
Mol. Weight: 614.9  
Form: White solid  
Purity: >99%  
Solubility: Water soluble  
Conductivity: <25µS in a 10% solution  
Critical micelle concentration (CMC): 6-10mM (25°C)  
Aggregation number: 10  
Cloud point: >100°C  
Average micellar weight: 6150  
Application: Zwitterionic detergent. Non-denaturing. Electrically neutral. CHAPS has all the advantages of sulfobetaine containing detergents: hydrophobic, bile salt, and anionic detergents in a single molecule. Better at solubilizing proteins and breaking protein-protein interactions. Less protein aggregation than non ionic detergents. Capable of solubilizing opiate receptors. CHAPS can be removed from protein solutions with a detergent removing gel or by dialysis.

**CITED REFERENCES**


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<td>DG051</td>
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</tr>
<tr>
<td>DG099</td>
<td>CHAPS, 5% filtered solution</td>
<td>500ml</td>
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**CHAPSO**

3-[(3-Cholamidopropyl)dimethylammonio]-2-hydroxy-1-propanesulfonate

Type: Zwitterionic detergent  
Mol. Formula: C_{32}H_{58}N_{2}O_{8}S  
Mol. Weight: 630.9  
Form: White solid  
Purity: >99%  
Solubility: Water soluble  
Conductivity: <50µS in a 10% solution  
Critical micelle concentration (CMC): 8mM (25°C)  
Aggregation number: 11  
Cloud point: 90°C  
Average micellar weight: 7000  
**Sulfobetaine 3-10 (SB 3-10)**

*N-Decyl-N,N-dimethyl-3-ammonio-1-propanesulfonate*

![Structure of Sulfobetaine 3-10](image1)

**Type:** Zwitterionic detergent  
**Mol. Formula:** CH₃(CH₂)₉N⁺(CH₃)₂CH₂CH₂SO₃⁻  
**Mol. Weight:** 307.5  
**Form:** White solid  
**Purity:** >99%  
**Solubility:** Water soluble  
**Critical micelle concentration (CMC):** 25-40mM (25°C)  
**Aggregation number:** 41  
**Application:** Zwitterionic detergent for solubilization of membrane proteins in their native state

**CITED REFERENCES**


**Cat. No.**  
**Description**  
**Size**  
DG054  Sulfobetaine 3-10  1g  
DG055  Sulfobetaine 3-10  5g

---

**Sulfobetaine 3-12 (SB 3-12)**

*N-Dodecyl-N,N-dimethyl-3-ammonio-1-propanesulfonate*

![Structure of Sulfobetaine 3-12](image2)

**Type:** Zwitterionic detergent  
**Mol. Formula:** CH₃(CH₂)₁₁N⁺(CH₃)₂CH₂CH₂SO₃⁻  
**Mol. Weight:** 335.5  
**Form:** White solid  
**Purity:** >99%  
**Solubility:** Water soluble  
**Critical micelle concentration (CMC):** 2-4mM (25°C)  
**Aggregation number:** 55  
**Average micellar weight:** 18,500  
**Application:** Zwitterionic detergent for solubilization of membrane proteins in their native state

**Cat. No.**  
**Description**  
**Size**  
DG056  Sulfobetaine 3-12  1g  
DG057  Sulfobetaine 3-12  5g

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**Sulfobetaine 3-14 (SB 3-14)**

*N-Tetradecyl-N,N-dimethyl-3-ammonio-1-propanesulfonate*

![Structure of Sulfobetaine 3-14](image3)

**Type:** Zwitterionic detergent  
**Mol. Formula:** CH₃(CH₂)₁₃N⁺(CH₃)₂CH₂CH₂SO₃⁻  
**Mol. Weight:** 364.0  
**Form:** White solid  
**Purity:** >99%  
**Solubility:** Water soluble  
**Critical micelle concentration (CMC):** 0.1-0.4mM (25°C)  
**Aggregation number:** 83  
**Average micellar weight:** 30,200  
**Application:** Zwitterionic detergent for solubilization of membrane proteins in their native state

**Cat. No.**  
**Description**  
**Size**  
DG058  Sulfobetaine 3-14  1g  
DG059  Sulfobetaine 3-14  5g

---

**ASB-14**

**Amidosulfobetaine-14**

![Structure of ASB-14](image4)

**Type:** Zwitterionic detergent  
**Mol. Formula:** C₂₂H₄₆N₂O₄S  
**Mol. Weight:** 434.7  
**Form:** White to off white powder  
**Purity:** >99%  
**Solubility:** Water soluble  
**Conductivity:** <50µS in a 10% solution  
**Critical micelle concentration (CMC):** 8mM (25°C)  
**Application:** Zwitterionic detergent. Aminosulfobetaine with C₁₄ alkyl tail. Useful for solubilizing proteins for 2D analysis. Optimal solubility achieved in urea-thiourea mixtures and not in urea alone. Reported to show better protein solubilization properties than CHAPS. ASB-14 has been shown to solubilize membrane proteins previously undetected

**Cat. No.**  
**Description**  
**Size**  
DG060  ASB-14  1g  
DG061  ASB-14  5g

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For further details, visit GBiosciences.com
ASB-16

Amidosulfobetaine-16

![Structure of ASB-16](image)

**Type:** Zwitterionic detergent  
**Mol. Formula:** C_{24}H_{50}N_{2}O_{4}S  
**Mol. Weight:** 462.7  
**Form:** White to off white powder  
**Purity:** >99%  
**Solubility:** Water soluble  
**Conductivity:** <50µS in a 10% solution  
**Critical micelle concentration (CMC):** 8mM (25°C)  
**Application:** Zwitterionic detergent. Aminosulfobetaine with C_{16} alkyl tail. In some cases superior than ASB-14. Useful for solubilizing proteins for 2D analysis. Optimal solubility achieved in urea-thiourea mixtures and not in urea alone. Reported to show better protein solubilization properties than CHAPS. ASB-16 has been shown to solubilize membrane proteins previously undetected.

CITED REFERENCES

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ASB-C8Ø

4-n-Octylbenzoylamido-propyl-dimethylammonio sulfobetaine

![Structure of ASB-C8Ø](image)

**Type:** Zwitterionic detergent  
**Mol. Formula:** C_{23}H_{40}N_{2}O_{4}S  
**Mol. Weight:** 440.6  
**Form:** Off white powder  
**Purity:** >99%  
**Solubility:** Water soluble  
**Application:** A Zwitterionic aminosulfobetaine with an aromatic core that stabilizes and solubilizes integral membrane proteins. Useful for solubilizing proteins for 2D analysis.

CITED REFERENCES

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NON-DETERGENT SULFOBETAIEN

NDSB 201

3-(1-Pyridino)-1-propane sulfonate

![Structure of NDSB 201](image)

**Type:** Non-detergent sulfobetaine  
**Mol. Formula:** C_{8}H_{11}NO_{3}S  
**Mol. Weight:** 201.4  
**Form:** White powder  
**Purity:** >99%  
**Solubility:** Water  
**Application:** NDSB 201 is a zwitterionic compound. Unlike zwitterionic detergents, the hydrophobic group in NDSB 201 is too short to form micelles, even at 1M concentrations. NDSB 201 has been used for purification of proteins and solubilization of protein samples for 2D gel electrophoresis.

CITED REFERENCES

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### Detergent Selection Guide

#### NON IONIC DETERGENTS

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<th>Detergent</th>
<th>Type</th>
<th>Cat. No.</th>
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<th>Molecular Weight</th>
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<th>Aggregation No.</th>
<th>HLB</th>
<th>Average Micellar Weight</th>
<th>Cloud Point (°C)</th>
<th>Conductivity (μS)</th>
<th>Sterile</th>
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<td>Average Micellar Weight</td>
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<td>25gm</td>
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1) Critical Micellular Concentration (CMC) determined at 20-25°C. CMC is the concentration at which micelles begin to form.
2) Aggregation number is the average number of monomers in a micelle.
3) Hydrophilic-Lipophilic Balance (HLB) defines the hydrophilic character of a detergent.
4) Data not available

Triton is a registered trademark of Union Carbide Corp; Tween is a registered trademark of Uniqema, a business unit of ICI Americas, Inc.; Nonidet is a registered trademark of Shell Chemicals; Brij is a registered trademark of ICI Americas, Inc.

G-Biosciences offers a range of detergent removal systems that use either a rapid column based system or a precipitation system.

Our products are designed to remove a wide variety of detergents, including SDS, Tween® 20, Triton® X-100, Triton® X-114, Nonidet® P-40, CTAB, CHAPS, deoxycholate and Lubrol®.
Detergents are essential for protein solubility during protein extraction and sample preparation, especially when working with hydrophobic proteins. The presence of high concentrations of detergents in protein samples can impair ELISA, IEF, protease digestion of proteins and suppress peptide ionization when analyzed by mass spectrometry.

The resin removes free, unbound anionic, nonionic or zwitterionic detergents (e.g. SDS, Triton® X-100 or CHAPS) from aqueous protein and peptide samples with minimal sample loss for downstream analysis by mass spectrometry and other techniques.

The DetergentOUT™ GBS10 columns were shown in independent studies to be fully compatible with DI-QTOF and LC-MS/MS (see references). The use of the DetergentOUT™ GBS10 columns significantly increased the number of peptide spectra detected. In addition, the DetergentOUT™ GBS10 columns have a high binding capacity for detergents, i.e. 6mg SDS and 14mg Triton® X-100 by every ml settled resin.

Table 1: A comparison of the detergent removal rates and percentage protein recovery with DetergentOUT™ GBS10.

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<tr>
<th>Light Azide</th>
<th>Sample Size (µl)</th>
<th>Resin (µl)</th>
<th>Size</th>
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<tbody>
<tr>
<td>786-154</td>
<td>DetergentOUT GBS10-125</td>
<td>10-30</td>
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<td>786-156</td>
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<td>200-750</td>
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<td>500-1,250</td>
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<td>786-998</td>
<td>DetergentOUT GBS10 Spin. Plates</td>
<td>30-200</td>
<td>800</td>
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<td>786-159</td>
<td>DetergentOUT GBS10 Resin</td>
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</table>

CITED REFERENCES

Figure 36: DetergentOUT™ GBS10 retains ≤6mg SDS per ml settled resin. SDS solution was continuously applied to DetergentOUT™ GBS10 column. The graph depicts the amount of SDS detected in the flow-through. SDS was not detected until fraction 7, so after 12mg SDS had been retained by the 2ml of DetergentOUT™ GBS10 resin, resulting in a 6mg/ml settled resin binding capacity.
DETERGENT OPTIMIZATION

Optimizer blueBALLS™

Establish optimal detergent conditions

The “Critical Micelle Concentration” (CMC) of a detergent varies with temperature, pH, ionic strength, detergent concentration, purity and presence of organic agents in the detergent. Using a large excess of detergent may pose problems during purification or other downstream applications.

A simple hydrophobic dye solubilization method for the determination of CMC has been described (1) and involves the solubilization of a dye in a detergent solution only in the presence of micelles. The amount of dye solubilized is directly proportional to the micelle concentration. The CMC is determined by plotting optical density of the solubilized dye against detergent concentration. The points of inflection on the plot of observed data versus detergent concentration correspond to the CMC of a typical detergent.

This method is simple and comparable to CMC determined by expensive light scattering or surface tension methods. Furthermore, this method is applicable to all detergents.

Figure 38: Graphical representation of critical micelle concentration determination. Blue colored Optimizer blueBALLS™ imitate membrane proteins and solubilize when the critical micellar concentration is reached, releasing a non-reactive blue color into the extraction buffer.

FEATURES

- Hydrophobic blue dye coated glass balls that behaves as membrane proteins
- Add to extraction or perform parallel extractions
- Ensures optimal detergent concentration is used for extraction
- Improve downstream processing results
- Compatible with all detergent types

APPLICATIONS

- Tool for establishing an optimal protein extraction protocol

CITED REFERENCES


DetergentOUT™ Tween®

Removal of Tween® (polysorbate) detergents

A spin column format detergent removal resin for polysorbate or Tween® detergents or surfactants. DetergentOUT™ Tween® removes polysorbate detergents without significant loss of proteins, dilution of the protein solution, or change to the buffer composition of the protein solution.

CITED REFERENCES


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<td>DetergentOUT®_Tween®, Medi</td>
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<td>Optimizer blueBALLS®</td>
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For further details, visit GBiosciences.com
**SDS Detection & Estimation**

A reagent kit for detection and estimation of SDS in a sample. Mix the test sample in the extraction buffer reagents provided with the kit. If SDS is present in the sample, a blue color is extracted that can be quantitatively measured.

**CITED REFERENCES**


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**CMC-535™ Detergent Assay**

The CMC-535™ Detergent Assay is a simple, fluorescent assay designed for the detection of various detergents in aqueous solutions and is an ideal compliment for the DetergentOUT™ detergent removal columns.

The basic principle of the assay is the interaction of detergents with the CMC-535™ Fluorescent Dye, resulting in an enhancement of the fluorescent signal that is proportional to the detergent concentration.

The assay can be used to quantitate detergent levels with the use of a standard curves or can be used to compare detergent removal rates to a diluted starting material sample.

The assay is designed to detect detergents at concentrations below their CMC values for most detergents. The assay is compatible with most aqueous buffers, with the exception of buffers that contain phosphates, including molecules that release phosphates (i.e. ADP and ATP). As the assay is sensitive to molecules with strong hydrophobic segments, we recommend <1mg/ml protein and <0.1mg/ml nucleic acids. Suitable for 200 microwell assays.

![Detergent Assays](Image)

**Figure 39: A selection of detergent standard curves produced with CMC-535™ Detergent Assay.**