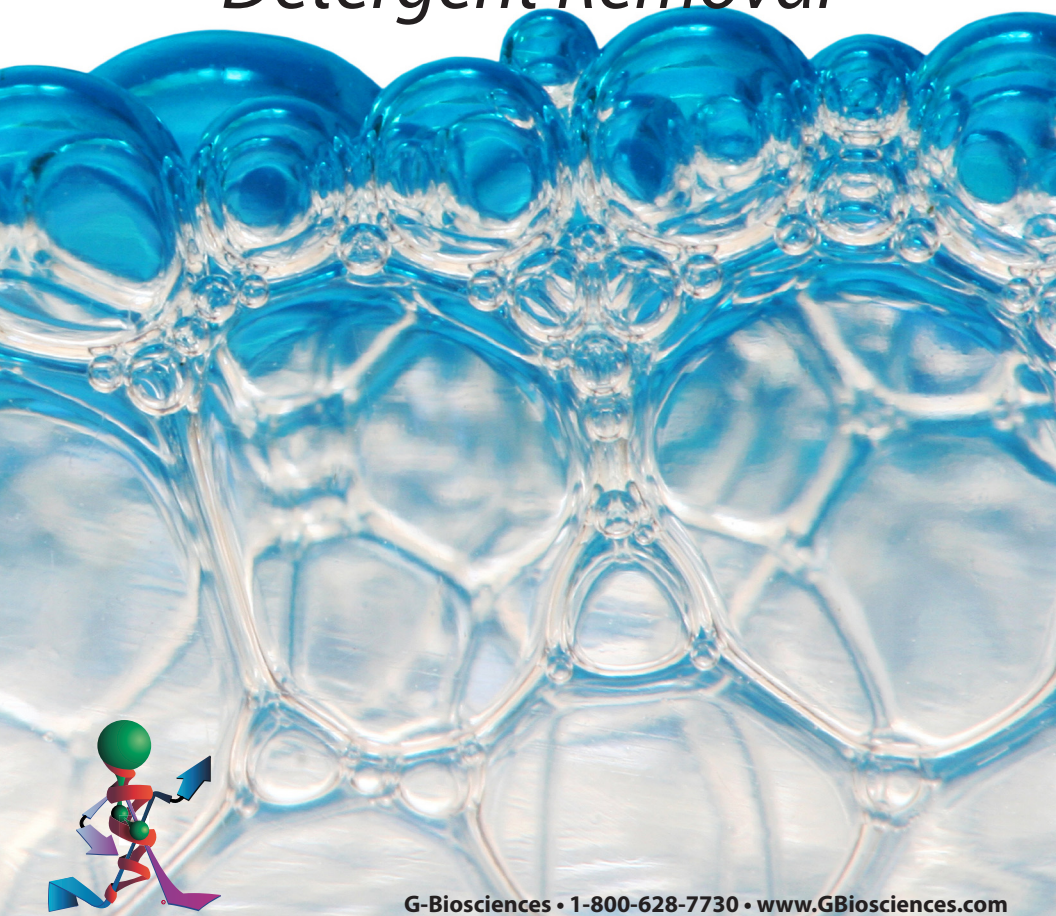
G-Biosciences

Detergents

A Handbook & Selection Guide to Detergents & Detergent Removal



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.

Hydrophobicity

Hydrophobicity 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 ordred 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 (Figure 1).

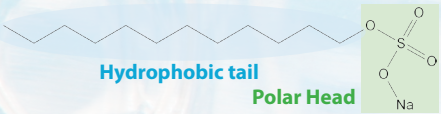


Figure 1: The structure of the detergent SDS (Sodium Dodecyl Sulfate).

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 (Figure 2). 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)***.

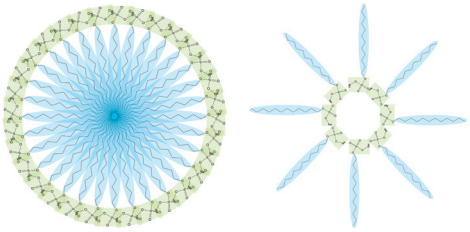


Figure 2: A detergent micelle formed with SDS molecules in an aqueous solution (left) or a non-aqueous solution (right).

Interestingly, detergents form reverse micelles in the presence of hydrocarbon solvents (non-aqueous solutions) (Figure 2).

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.

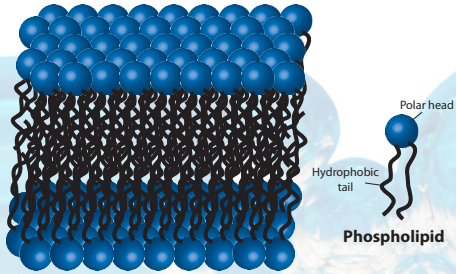


Figure 3: The structure of a lipid bilyar and a phospholipid.

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 interations 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.

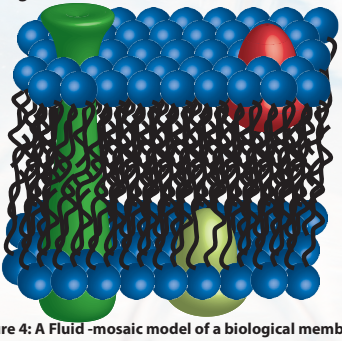


Figure 4: A Fluid -mosaic model of a biological membrane

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.

Figure 5 shows a schematic of how detergents solubilize membrane proteins. At low detergent concentrations, less than the detergent's CMC, the detergent molecules insert themselves in the lipid membrane and begin partioning 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.

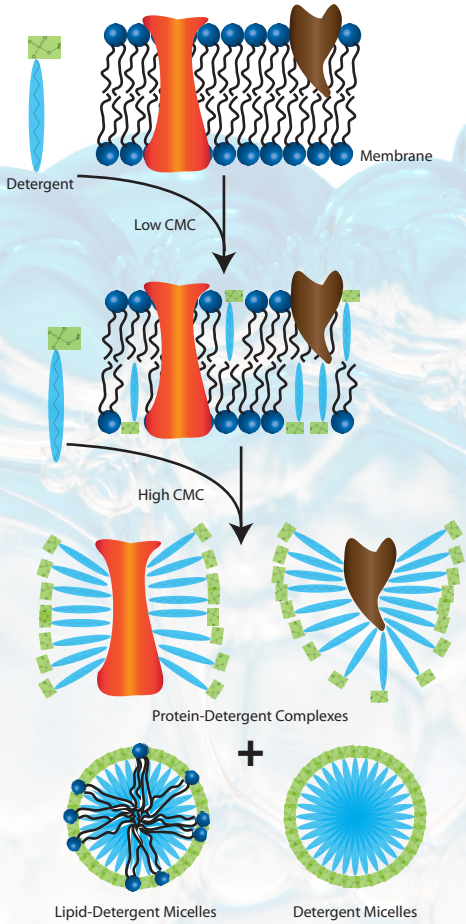


Figure 5: Schematic showing the stages of protein solubilization with detergent.

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 (Figure 5), 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-*blue*BALLS™, which is based on the dye solubilization method, but is significantly more convenient.

Optimizer-*blue*BALLS™ are simple and comparable to CMC determined by expensive light scattering or surface tension methods. Furthermore, this method is applicable to all detergents, including steroid based detergents such as CHAPS and deoxycholate, as well as non-steroid detergents like β-octylglucoside.

Optimizer-*blue*BALLS™ are hydrophobic blue dye coated glass balls that behave as membrane proteins. Simply add to your extraction, or perform parallel extractions to ensure complete solubilization. They ensure that only the minimal amount of detergent is used for maximum extraction, resulting in improved downstream processing results.

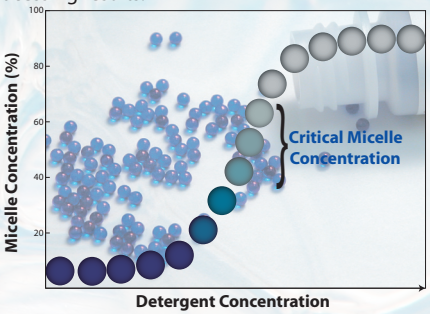


Figure 6: Graphical representation of critical micelle concentration determination. Blue colored Optimizer *blue*BALLS™ imitate membrane proteins and solubilize when the critical micellar concentration is reached, releasing a non-reactive blue color into the extraction buffer.

Cat. #	Description	Size
DGA01	Optimizer *blue*BALLS™	500

CLASSIFICATION & CHARACTERIZATION

There are a vast number of detergents available for protein solubilization. They can be classified based on the nature of their hydrophilic head group. The three classifications are:

• Non-ionic • Ionic • Zwitterionic •

In addition to the above classification, there are important properties or characteristics of detergents that can be used to aid researchers in their choice of detergent.

Critical Micelle Concentration (CMC)

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

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.

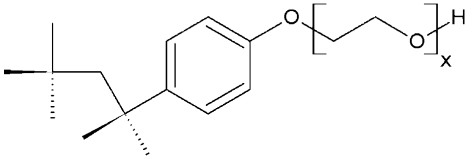
• NON-IONIC DETERGENTS •

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 deteregents 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)$_x$

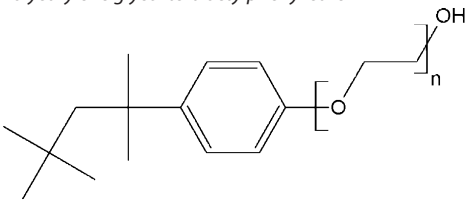


Type: Non-ionic detergent
Molecular Formula: $C_{34}H_{62}O_{11}$ for x =10
Molecular Weight: 647 (for x=10)
Absorbance (254nm): 0.16 (0.05% w/v)
Critical Micelle Conc. (CMC): ~0.2 x 10^{-3}M (25°C)
Aggregation number: 100-155
Cloud Point: 65°C
Average micellar weight: 80,000
Application: One of the most commonly used non-ionic detergents for solubilizing membrane proteins during isolation of membrane-protein complexes.
Available as Proteomic Grade (PG) Solutions, 2D-Detergent™ and Research Grade. Ultra low aldehyde and peroxide concentrations in the Proteomic Grade (PG) Solutions and 2D-Detergent™ reduce the effects of peroxidase and carbonyl compounds that negatively interact with membrane proteins.

Cat.#	Description	Size
DG007	Triton® X-100, 10% PG solution	5 x 10ml vials
DG008	Triton® X-100, 10% PG solution	10 x 10ml vials
DG507	Triton® X-100, 10% PG solution	50ml bottle
DG517	Triton® X-100, 10% PG solution	100ml bottle
DG907	2D-Detergent™ Triton® X-100	5 x 10ml vials
DG908	2D-Detergent™ Triton® X-100	10 x 10ml vials
786-513	Triton® X-100, Research Grade	500ml
786-514	Triton® X-100, Research Grade	1L

Triton® X-114

Polyethylene glycol tert-octylphenyl ether

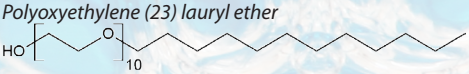


Type: Non-ionic detergent
Molecular Formula: $C_{14}H_{22}O\bullet[C_2H_4O]_{7\text{-}8}$ for n=8
Molecular Weight: ~537 (for n=7-8)
Absorbance (254nm): 0.18 (0.05% w/v)
Critical Micelle Conc. (CMC): ~0.35 x 10^{-3}M (25°C)
Cloud Point: 23°C
Application: A non-ionic detergent with a low cloud point (23°C) making it suitable for protein solubilization with phase-partitioning of hydrophilic proteins from amphiphilic proteins.
Available as Proteomic Grade Solutions and Research Grade.

Cat.#	Description	Size
DG009	Triton® X-114, 10% PG solution	5 x 10ml vials
DG010	Triton® X-114, 10% PG solution	10 x 10ml vials
DG509	Triton® X-114, 10% PG solution	50ml bottle
DG518	Triton® X-114, 10% PG solution	100ml bottle
786-515	Triton® X-114, Research Grade	500ml
786-516	Triton® X-114, Research Grade	1L

Brij® 35

Polyoxyethylene (23) lauryl ether

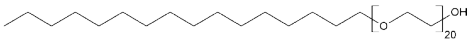


Type: Non-ionic detergent
Molecular Formula: $C_{12}H_{26}O(OCH_2CH_2)_{10}$
Molecular Weight: 627
Absorbance (225nm): 0.07 (1% w/v)
Critical Micelle Conc. (CMC): 90µM
Aggregation number: 24-40
Cloud Point: >100°C
Average micellar weight: 48,000
Appearance: Clear solution with a faint yellow color
Application: For protein extraction, permeabilization of cells, and preparation of yeast spheroplasts.
Available as Proteomic Grade Solutions and Research Grade.

Cat.#	Description	Size
DG003	Brij® 35, 10% PG solution	5 x 10ml vials
DG004	Brij® 35, 10% PG solution	10 x 10ml vials
DG503	Brij® 35, 10% PG solution	50ml bottle
DG515	Brij® 35, 10% PG solution	100ml bottle
786-351	Brij® 35, Research Grade	250gm
786-521	Brij® 35, Research Grade	500gm

Brij® 58

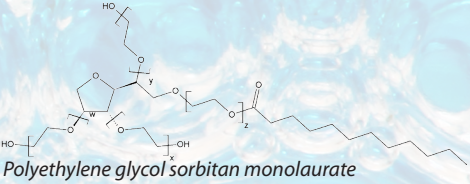
Polyoxyethylene (20) cetyl ether



Type: Non-ionic detergent
Molecular Formula: $C_{16}H_{33}(OCH_2CH_2)_{20}$-OH
Molecular Weight: 1122
Absorbance (225nm): 0.0788 (1% w/v)
Critical Micelle Conc. (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.
Available as Proteomic Grade Solutions and Research Grade.

Cat.#	Description	Size
DG005	Brij® 58, 10% PG solution	5 x 10ml vials
DG006	Brij® 58, 10% PG solution	10 x 10ml vials
DG505	Brij® 58, 10% PG solution	50ml bottle
DG516	Brij® 58, 10% PG solution	100ml bottle
786-352	Brij® 58, Research Grade	250gm
786-522	Brij® 58, Research Grade	500gm

Tween® 20

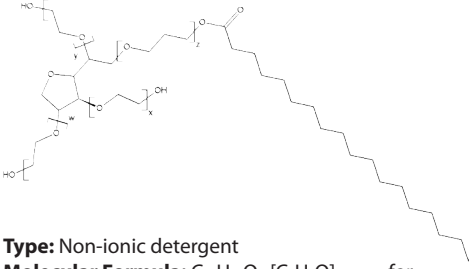


Polyethylene glycol sorbitan monolaurate
Type: Non-ionic detergent
Molecular Formula: $C_{18}H_{34}O_6\bullet[C_2H_4O]_{w+x+y+z}$ for w+x+y+z =20
Molecular Weight: ~1227 (for w+x+y+z =20)
Absorbance (215nm): 0.05 (0.05% w/v)
Critical Micelle Conc. (CMC): ~0.06 x 10^{-3}M
Cloud Point: 76°C
Application: A commonly used non-ionic detergent for solubilizing membrane proteins during isolation of membrane-protein complexes.
Available as Proteomic Grade Solutions and Research Grade.

Cat.#	Description	Size
DG011	Tween® 20, 10% PG solution	5 x 10ml vials
DG012	Tween® 20, 10% PG solution	10 x 10ml vials
DG511	Tween® 20, 10% PG solution	50ml bottle
DG519	Tween® 20, 10% PG solution	100ml bottle
786-517	Tween® 20, Research Grade	500ml
786-518	Tween® 20, Research Grade	1L

Tween® 80

Polyethylene glycol sorbitan monooleate

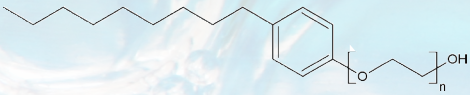


Type: Non-ionic detergent
Molecular Formula: $C_{24}H_{46}O_6 \cdot [C_2H_4O]_{w+x+y+z}$ for w+x+y+z =20
Molecular Weight: ~1325 (for w+x+y+z =20)
Absorbance (250nm): 0.14 (0.05% w/v)
Critical Micelle Conc. (CMC): ~0.012 x 10^{-3}M (25°C)
Aggregation number: 60
Cloud Point: 65°C
Average micellar weight: 79,000
Application: For solubilizing membrane proteins during isolation of membrane-protein complexes. Available as Proteomic Grade Solutions and Research Grade.

Cat.#	Description	Size
DG013	Tween® 80, 10% PG solution	5 x 10ml vials
DG014	Tween® 80, 10% PG solution	10 x 10ml vials
DG513	Tween® 80, 10% PG solution	50ml bottle
DG520	Tween® 80, 10% PG solution	100ml bottle
786-519	Tween® 80, Research Grade	500ml
786-520	Tween® 80, Research Grade	1L

Nonidet® P-40 Substitute

Nonylphenyl-polyethylene glycol

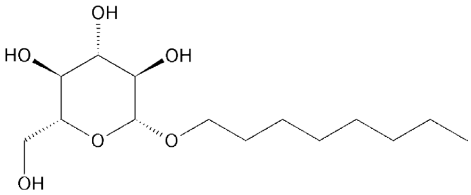


Type: Non-ionic detergent
Molecular Formula: $C_{15}H_{24}O[C_2H_4O]_n$
Molecular Weight: 573 (for n=8)
Absorbance (254nm): 0.14 (0.05% w/v)
Critical Micelle Conc. (CMC): ~0.05-0.3mM (25°C)
Application: A commonly used non-ionic detergent for solubilizing membrane proteins during isolation of membrane-protein complexes. Available as Proteomic Grade Solutions, 2D-Detergent™ and Research Grade.

Cat.#	Description	Size
DG001	Nonidet® P-40 Substitute, 10% PG solution	5 x 10ml vials
DG002	Nonidet® P-40 Substitute, 10% PG solution	10 x 10ml vials
DG501	Nonidet® P-40 Substitute, 10% PG solution	50ml bottle
DG514	Nonidet® P-40 Substitute, 10% PG solution	100ml bottle
DG901	2D-Detergent™ Nonidet® P-40 Substitute	5 x 10ml vials
DG902	2D-Detergent™ Nonidet® P-40 Substitute	10 x 10ml vials
786-511	Nonidet® P-40 Substitute, Research Grade	500ml
786-512	Nonidet® P-40 Substitute, Research Grade	1L

Octyl β Glucoside

N-Octyl-beta-D-glucopyranoside

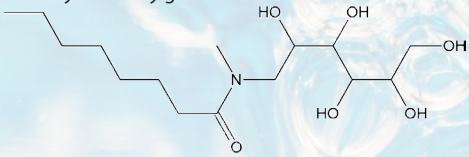


Type: Non-ionic detergent
Molecular Formula: $C_{14}H_{28}O_6$
Molecular Weight: 292.4
Form: White to off white powder
Purity: >98%
Solubility: Water soluble
Critical Micelle Conc. (CMC): 20-25mM (25°C)
Aggregation number: 84
Cloud Point: >100°C
Average micellar weight: 25,000
Application: Widely used 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.
Available as Research Grade detergents.

Cat.#	Description	Size
DG015	Octyl β Glucoside	1gm
DG016	Octyl β Glucoside	5gm

MEGA 8

Octanoyl-N-methylglucamide

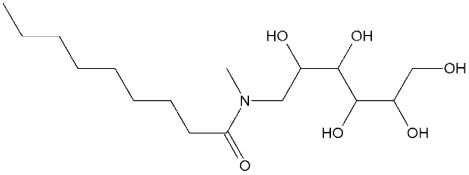


Type: Non-ionic detergent
Molecular Formula: $C_{15}H_{31}NO_6$
Molecular Weight: 321.4
Form: White powder
Purity: >99%
Solubility: Water soluble
Critical Micelle Conc. (CMC): 58mM (25°C)
Application: Non-ionic detergent that is water soluble and readily removed by dialysis. Used for the solubilization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

Cat.#	Description	Size
DG017	MEGA 8	1gm
DG018	MEGA 8	5gm

MEGA 9

Nonanoyl-N-methylglucamide

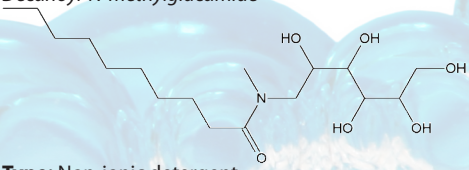


Type: Non-ionic detergent
Molecular Formula: $C_{16}H_{33}NO_6$
Molecular Weight: 335.4
Form: White powder
Purity: >99%
Solubility: Water soluble
Critical Micelle Conc. (CMC): 19-25mM (25°C)
Application: Non-ionic detergent that is water soluble and readily removed by dialysis. Used for the solubilization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

Cat.#	Description	Size
DG019	MEGA 9	1gm
DG020	MEGA 9	5gm

MEGA 10

Decanoyl-N-methylglucamide

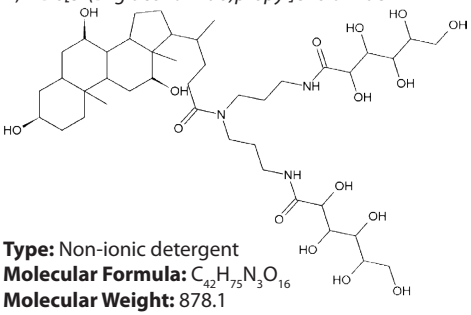


Type: Non-ionic detergent
Molecular Formula: $C_{17}H_{35}NO_6$
Molecular Weight: 349.5
Form: White powder
Purity: >99%
Solubility: Water soluble
Critical Micelle Conc. (CMC): 6-7mM (25°C)
Application: Non-ionic detergent that is water soluble and readily removed by dialysis. Used for the solubilization of membranes.
Available as Research Grade detergents.

Cat.#	Description	Size
DG021	MEGA 10	1gm
DG022	MEGA 10	5gm

BigCHAP

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

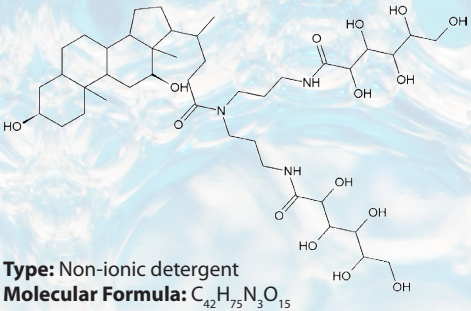


Type: Non-ionic detergent
Molecular Formula: $C_{42}H_{75}N_3O_{16}$
Molecular Weight: 878.1
Form: Fine colorless crystals
Purity: >99%
Solubility: Water soluble
Conductivity: <25µS in a 10% solution
Critical Micelle Conc. (CMC): 3.4mM (25°C)
Aggregation number: 10
Average micellar weight: 8800
Application: Non-ionic detergent for membrane solubilization.
Available as Research Grade detergents.

Cat.#	Description	Size
DG023	BigCHAP	1gm
DG024	BigCHAP	5gm

Deoxy Big CHAP

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



Type: Non-ionic detergent
Molecular Formula: $C_{42}H_{75}N_3O_{15}$
Molecular Weight: 862.1
Form: White powder
Purity: >95%
Solubility: Water soluble
Critical Micelle Conc. (CMC): 1.1-1.4mM (25°C)
Aggregation number: 8-16
Average micellar weight: 10,500
Application: Non-ionic detergent that is water soluble and has increased solubility compared to CHAPS. Used for the solubilization of membranes.
Available as Research Grade detergents.

Cat.#	Description	Size
DG025	Deoxy Big CHAP	1gm
DG026	Deoxy Big CHAP	5gm

PROTEOMIC GRADE DETERGENT SOLUTIONS (10%)

Low Carbonyl & Peroxide Contaminants

Many commercial grade detergents contain elevated levels of sulfhydryl oxidizing agents, peroxides, salts and carbonyl compounds (Figure 7). 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 interfere with its structure.

Our Proteomic Grade Detergent Solutions contain reduced peroxides and carbonyl compounds (Figure 7). In addition, the detergents have less than 50µS conductivity. These detergents are offered as 10% aqueous solutions, sealed under inert gas and are suitable for protein applications. These non-ionic detergents are suitable for isolating membrane-protein complexes.

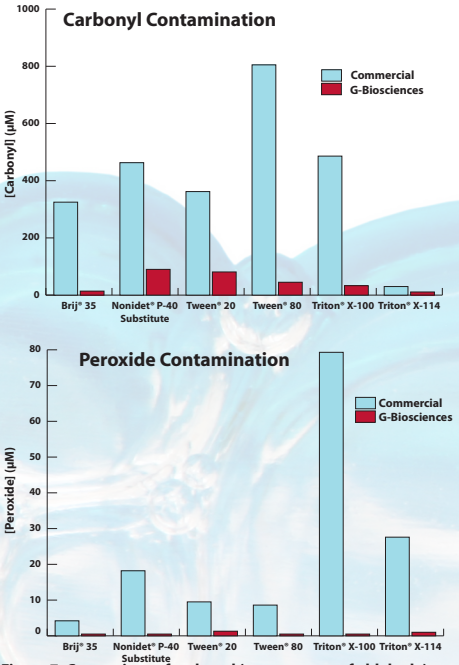


Figure 7: Comparison of carbonyl (as a measure of aldehyde) (top) and peroxide (bottom) concentration in G-Biosciences Proteomic Grade Detergent Solutions and non-proteomic grade commercially available detergents.

Features

- Low peroxide contamination
- Low carbonyl contamination
- Low conductivity
- Reduced metal ions
- Ready to use 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.

2D-DETERGENT™

Ultra Low Conductivity & Low Carbonyl & Peroxide Contaminants

Our 2D-Detergent™ solutions contain reduced peroxides and carbonyl compounds (Figure 8). 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.

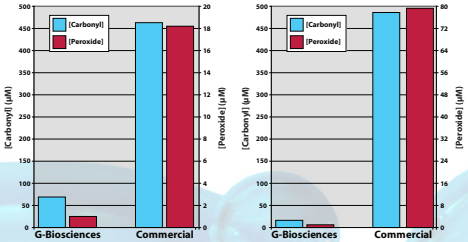


Figure 8: Comparison of carbonyl (as a measure of aldehyde) (blue) and peroxide (red) concentration in G-Biosciences 2D-Detergent™ NP-40 Substitute (left) or 2D-Detergent™ Triton® X-100 (right) and non-proteomic grade commercially available detergents.

Cat.#	Description	Size
DG007	Triton® X-100, 10% PG solution	5 x 10ml vials
DG008	Triton® X-100, 10% PG solution	10 x 10ml vials
DG009	Triton® X-114, 10% PG solution	5 x 10ml vials
DG010	Triton® X-114, 10% PG solution	10 x 10ml vials
DG003	Brij® 35, 10% PG solution	5 x 10ml vials
DG004	Brij® 35, 10% PG solution	10 x 10ml vials
DG005	Brij® 58, 10% PG solution	5 x 10ml vials
DG006	Brij® 58, 10% PG solution	10 x 10ml vials
DG011	Tween® 20, 10% PG solution	5 x 10ml vials
DG012	Tween® 20, 10% PG solution	10 x 10ml vials
DG013	Tween® 80, 10% PG solution	5 x 10ml vials
DG014	Tween® 80, 10% PG solution	10 x 10ml vials
DG001	Nonidet® P-40 Substitute, 10% PG solution	5 x 10ml vials
DG002	Nonidet® P-40 Substitute, 10% PG solution	10 x 10ml vials
DG907	2D-Detergent™ Triton® X-100	5 x 10ml vials
DG908	2D-Detergent™ Triton® X-100	10 x 10ml vials
DG901	2D-Detergent™ Nonidet® P-40 Substitute	5 x 10ml vials
DG902	2D-Detergent™ Nonidet® P-40 Substitute	10 x 10ml vials

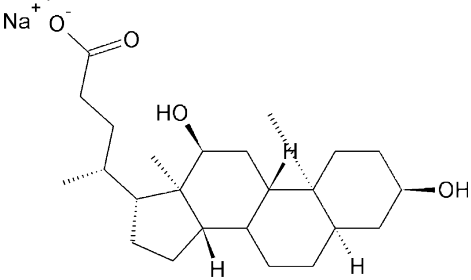
The 10% PG (Proteomic Grade) solutions are also available in 50ml and 100ml bottles. See the individual detergent sections for ordering information.

• IONIC DETERGENTS •

Ionic detergents have a hydrophilic head group that is charged and can be either negatively (anionic) or positively (cationic) charged. Ionic detergents are used for the complete disruption of cellular structures and denaturation 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.

Deoxycholate

Deoxycholic acid, sodium salt

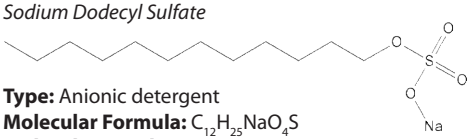


Type: Anionic detergent
Molecular Formula: $C_{24}H_{39}NaO_4$
Molecular Weight: 414.6
Form: White to off white powder
Purity: >99%
Solubility: Water soluble
Critical Micelle Conc. (CMC): 4-8mM (25°C)
Aggregation number: 3-12
Average micellar weight: 1,200-5,000
Application: Anionic detergent useful for extraction of membrane proteins and nuclei isolation. Not recommended for use with Mn^{2+}.

Cat.#	Description	Size
DG090	Deoxycholate, sodium salt	100gm
DG091	Deoxycholate, sodium salt	500gm

SDS

Sodium Dodecyl Sulfate

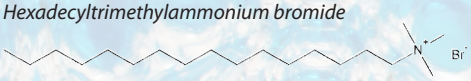


Type: Anionic detergent
Molecular Formula: $C_{12}H_{25}NaO_4S$
Molecular Weight: 288.38
Form: White to off white powder or 10% solution
Purity: >99%
Solubility: Water
Critical Micelle Conc. (CMC): 7-10mM (25°C)
Aggregation number: 62
Cloud point: >100°C
Average micellar weight: 18,000
Application: An anionic detergent 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 the overall negative charge of the ionic detergent.

Cat.#	Description	Size
DG092	SDS	100gm
DG093	SDS	500gm
R014	SDS, 10% Solution	100ml

CTAB

Hexadecyltrimethylammonium bromide



Type: Cationic detergent
Molecular Formula: $CH_3(CH_2)_{15}N(Br)(CH_3)_3$
Molecular Weight: 364.5
Form: White to off white powder
Purity: >99%
Solubility: Water soluble
Critical Micelle Conc. (CMC): 1mM (25°C)
Aggregation number: 61 in H_2O; 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.

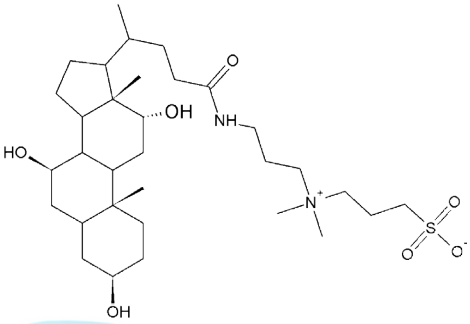
Cat.#	Description	Size
DG094	CTAB	25gm
DG095	CTAB	100gm

• ZWITTERIONIC DETERGENTS •

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

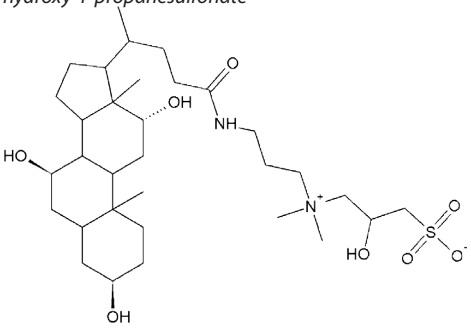


Type: Zwitterionic detergent
Molecular Formula: $C_{32}H_{58}N_2O_7S$
Molecular Weight: 614.9
Form: White solid
Purity: >99%
Solubility: Water soluble
Conductivity: <25µS in a 10% solution
Critical Micelle Conc. (CMC): 6-10mM (25°C)
Aggregation number: 10
Cloud point: >100°C
Average micellar weight: 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.

Cat.#	Description	Size
DG050	CHAPS	5gm
DG051	CHAPS	25gm

CHAPSO

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



Type: Zwitterionic detergent
Molecular Formula: $C_{32}H_{58}N_2O_8S$
Molecular Weight: 630.9
Form: White solid
Purity: >99%
Solubility: Water soluble
Conductivity: <50µS in a 10% solution
Critical Micelle Conc. (CMC): 8mM (25°C)
Aggregation number: 11
Cloud point: 90°C
Average micellar weight: 7000
Application: Zwitterionic detergent. Non-denaturing. Electrically neutral. Higher solubility than CHAPS because of a more polar head group. Solubilizes membrane proteins in their native state. Solubilizes opiate receptor to a state exhibiting reversible binding of opiates.

Cat.#	Description	Size
DG052	CHAPSO	1gm
DG053	CHAPSO	5gm

Sulfobetaine 3-10 (SB 3-10)

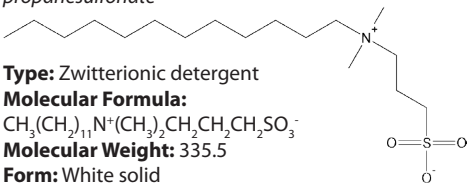
N-Decyl-N,N-dimethyl-3-ammonio-1-propanesulfonate

Type: Zwitterionic detergent
Molecular Formula:
$CH_3(CH_2)_9N^+(CH_3)_2CH_2CH_2CH_2SO_3$
Molecular Weight: 307.5
Form: White solid
Purity: >99%
Solubility: Water soluble
Critical Micelle Conc. (CMC): 25-40mM (25°C)
Aggregation number: 41
Average micellar weight: 12,600
Application: Zwitterionic detergent for solubilization of membrane proteins in their native state.

Cat.#	Description	Size
DG054	Sulfobetaine 3-10	1gm
DG055	Sulfobetaine 3-10	5gm

Sulfobetaine 3-12 (SB 3-12)

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

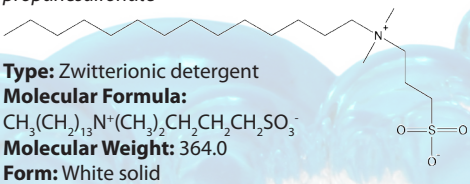


Type: Zwitterionic detergent
Molecular Formula:
$CH_3(CH_2)_{11}N^+(CH_3)_2CH_2CH_2CH_2SO_3^-$
Molecular Weight: 335.5
Form: White solid
Purity: >99%
Solubility: Water soluble
Critical Micelle Conc. (CMC): 2-4mM (25°C)
Aggregation number: 55
Average micellar weight: 18,500
Application: Zwitterionic detergent for solubilization of membrane proteins in their native state.

Cat.#	Description	Size
DG056	Sulfobetaine 3-12	1gm
DG057	Sulfobetaine 3-12	5gm

Sulfobetaine 3-14 (SB 3-14)

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

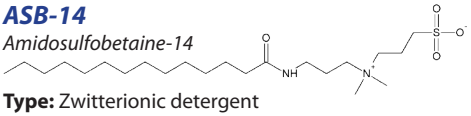


Type: Zwitterionic detergent
Molecular Formula:
$CH_3(CH_2)_{13}N^+(CH_3)_2CH_2CH_2CH_2SO_3^-$
Molecular Weight: 364.0
Form: White solid
Purity: >99%
Solubility: Water soluble
Critical micelle concentration (CMC): 0.1-0.4mM (25°C)
Aggregation number: 83
Average micellar weight: 30,200
Application: Zwitterionic detergent for solubilization of membrane proteins in their native state.

Cat.#	Description	Size
DG058	Sulfobetaine 3-14	1gm
DG059	Sulfobetaine 3-14	5gm

ASB-14

Amidosulfobetaine-14

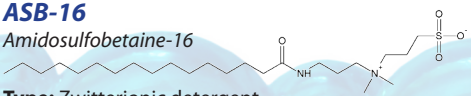


Type: Zwitterionic detergent
Molecular Formula: $C_{22}H_{46}N_2O_4S$
Molecular Weight: 434.7
Form: White to off white powder
Purity: >99%
Solubility: Water soluble
Conductivity: <50µS in a 10% solution
Critical Micelle Conc. (CMC): 8mM (25°C)
Application: Zwitterionic detergent.
Aminosulfobetaine with C_{14} 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.#	Description	Size
DG060	ASB-14	1gm
DG061	ASB-14	5gm

ASB-16

Amidosulfobetaine-16

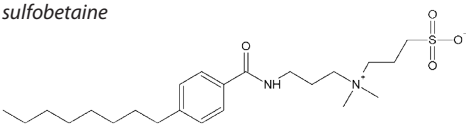


Type: Zwitterionic detergent
Molecular Formula: $C_{24}H_{50}N_2O_4S$
Molecular Weight: 462.7
Form: White to off white powder
Purity: >99%
Solubility: Water soluble
Conductivity: <50µS in a 10% solution
Critical Micelle Conc. (CMC): 8mM (25°C)
Application: Zwitterionic detergent.
Aminosulfobetaine with 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.

Cat.#	Description	Size
DG062	ASB-16	1gm
DG063	ASB-16	5gm

ASB-C8Ø

4-n-Octylbenzoylamido-propyl-dimethylammonio sulfobetaine



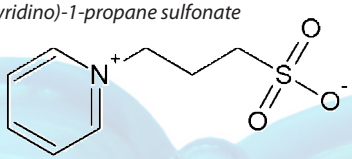
Type: Zwitterionic detergent
Molecular Formula: $C_{23}H_{40}N_2O_4S$
Molecular Weight: 440.6
Form: Off white powder
Purity: >99%
Solubility: Water soluble
Application: A Zwitterionic aminosulfobetaine with an aromatic core that stabilizes and solubilizes integral membrane proteins. Useful for solubilizing proteins for 2D analysis.

Cat.#	Description	Size
DG064	ASB-C8Ø	1gm
DG065	ASB-C8Ø	5gm

• NON-DETERGENT SULFOBETAINE •

NDSB 201

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



Type: Non-detergent sulfobetaine
Molecular Formula: $C_8H_{11}NO_3S$
Molecular 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.

Cat.#	Description	Size
DG080	NDSB 201	25gm
DG081	NDSB 201	100gm

DETERGENT REMOVAL SYSTEMS

DetergentOUT™

Rapid Column Based Protocol

A one step, column based system for removing free detergent from protein solutions in under 10 minutes. Protein solutions containing detergent are loaded onto a Detergent*OUT*™ column and spun to elute the detergent free protein solution. Protein recovery is generally >95%, however, when used for highly hydrophobic proteins, depending on their hydrophobicity, some protein may be lost due to the interaction with the column matrix. For removal of detergents from hydrophobic proteins, use of OrgoSol-Detergent-*OUT*™ is recommended.

Two types of Detergent-*OUT*™ kits are offered

DetergentOUT™ SDS-300

Specifically developed for the removal of SDS and supplied with a SDS detection and estimation kit to determine efficiency of SDS removal.

DetergentOUT™ DTG-100X

For the removal of a wide variety of detergents, including Triton® X-100, Nonidet® P-40, Tween® 20, CTAB, CHAPS, and deoxycholate from protein solutions.

Both Detergent*OUT*™ kits are offered in two sizes:

- Micro Kit for up to 0.5ml protein solution/ column
- Medi Kit for up to 2ml protein solution/ column

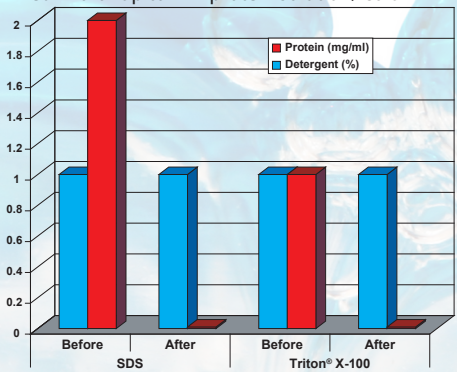


Figure 9: Removal of Detergents: 1mg/ml BSA solution in 2% SDS before and after treatment with Detergent*OUT*™ SDS -300. 1mg/ml BSA solution in 1% Triton® X-100 before and after treatment with Detergent*OUT*™ DTG-100X.

REFERENCES

Removal of SDS from human milk used to inactivate HIV type1 (1) and from alveolar cell homogenates prior to protein concentration determination (2), removal of Triton® X-100 during the polymerization of lipid II into peptidoglycan (3, 4) and in the isolation of basolateral membranes from rat AT2 cells (5).

1. *Hartmann, S.U., (2006) J. Hum. Lact. 22: 61-74.*
2. *Cavanaugh, K.J., et al. (2001) Am. J. Respir. Cell Mol. Biol. 25: 584-91.*
3. *Higgins, D.L. et al (2005) Antimicrob. Agents Chemother. 49: 1127-34.*
4. *Baizman, E.R., (2000) Microbiology. 146: 3129-40.*
5. *Fisher, J.L. and Margulies, S.S. (2002) 283: L737-46*

OrgoSol DetergentOUT™

Suitable for hydrophobic proteins, removes detergents and concentrates protein solutions

OrgoSol Detergent*OUT*™ is suitable for removal of detergents from protein solutions, including hydrophobic protein solutions and is compatible with all detergent types. Its performance is not dependent on the concentration of detergents in the solution, is highly flexible and can be used to process small and large sample volumes.

OrgoSol Detergent*OUT*™ first concentrates the protein solution through precipitation and then the detergent is extracted and removed with the supplied OrgoSol™ buffer. The proprietary precipitation agent ensures >99% protein recovery, however precipitation may result in some loss of a protein's biological activity.

Two sizes are offered: Micro Kit for processing up to a total of 10ml protein solution and Medi Kit for processing up to a total of 30ml protein solution, either in a single or multiple experiments.

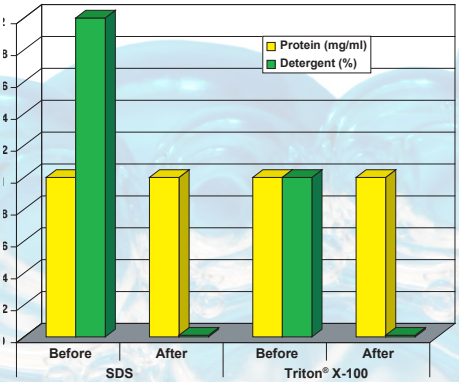


Figure 10: Removal of Detergent. Hydrophobic nuclear fraction proteins (1mg/ml) in 2% SDS before and after OrgoSol Detergent*OUT*™ treatment.

Cat.#	Description	Size
786-150	Detergent*OUT*™ SDS-300, Micro	10
786-151	Detergent*OUT*™ SDS-300, Medi	10
786-152	Detergent*OUT*™ DTG-100X, Micro	10
786-153	Detergent*OUT*™ DTG-100X, Medi	10
786-127	OrgoSol Detergent*OUT*™, Micro	For 10ml
786-128	OrgoSol Detergent*OUT*™, Micro	For 30ml

SDS Detection & Estimation Reagent Kit

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.

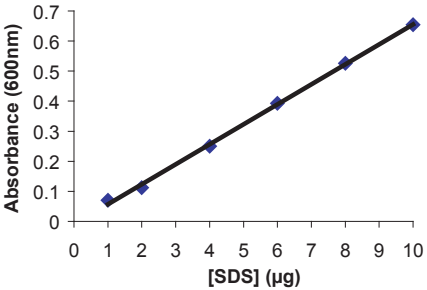


Figure 11: SDS Detection Assay. A standard plot of SDS detection shows a linear response over a range of 1-10µg SDS.

Cat.#	Description	Size
786-129	SDS Detection & Estimation Reagent Kit	15 assays

Detergent	Type	Cat #	Size	Molecular Weight	CMC[1] (mM)	Aggr. No.[2]	HLB[3]	Average Micellar Weight	Cloud Point (°C)	Conductivity (µS)
NON IONIC DETERGENTS										
BigCHAP	Research Grade	DG023	1gm	878.1	3.4	10	-[4]	8,800	-	<25 in 10% solution
		DG024	5gm							
Deoxy BigCHAP	Research Grade	DG025	1gm	862.1	1.1-1.4	8-16	-	10,500	-	-
		DG026	5gm							
Brij® 35	Research Grade	786-521	500gm	627	0.09	24-40	16.9	48,000	>100	-
	Proteomic Grade (10% aqueous solution)	DG003	5 x 10ml							<50
		DG004	10 x 10ml							
		DG503	50ml							
		DG515	100ml							
Brij® 58	Research Grade	786-522	500gm	1122	0.007-0.077	70	15.7	79,000	>100	-
	Proteomic Grade (10% aqueous solution)	DG005	5 x 10ml							<50
		DG006	10 x 10ml							
		DG505	50ml							
		DG516	100ml							
MEGA 8	Research Grade	DG017	1gm	321.4	58	-	-	-	-	-
		DG018	5gm							
MEGA 9	Research Grade	DG019	1gm	335.4	19-25	-	-	-	-	-
		DG020	5gm							
MEGA 10	Research Grade	DG021	1gm	349.5	6-7	-	-	-	-	-
		DG022	5gm							
Nonidet® P-40 Substitute	Research Grade	786-511	500ml	573	0.05-0.3	-	-	-	45-50	<50
		786-512	1 liter							
	Proteomic Grade (10% aqueous solution)	DG001	5 x 10ml							
		DG002	10 x 10ml							
		DG501	50ml							
		DG514	100ml							
	2D-Detergent™ (10% aqueous solution)	DG901	5 x 10ml							<15
		DG902	10 x 10ml							
Octyl ß Glucoside	Research Grade	DG015	1gm	292.4	20-25	84	-	25,000	>100	-
		DG016	5gm							
Triton® X-100	Research Grade	786-513	500ml	647	0.2-0.9	100-155	13.5	80,000	65	-
		786-514	1 liter							
	Proteomic Grade (10% aqueous solution)	DG007	5 x 10ml							<50
		DG008	10 x 10ml							
		DG507	50ml							
		DG517	100ml							
	2D-Detergent™ (10% aqueous solution)	DG907	5 x 10ml							<15
		DG908	10 x 10ml							
Triton® X-114	Research Grade	786-515	500ml	537	0.35	-	12.4	-	23	-
		786-516	1 liter							
	Proteomic Grade (10% aqueous solution)	DG009	5 x 10ml							<50
		DG010	10 x 10ml							
		DG509	50ml							
		DG518	100ml							
Tween® 20	Research Grade	786-517	500ml	1227	0.06	-	16.7	-	76	-
		786-518	1 liter							
	Proteomic Grade (10% aqueous solution)	DG011	5 x 10ml							<50
		DG012	10 x 10ml							
		DG511	50ml							
		DG519	100ml							

Detergent	Type	Cat #	Size	Molecular Weight	CMC[1] (mM)	Aggr. No.[2]	HLB[3]	Average Micellar Weight	Cloud Point (°C)	Conductivity (µS)
Tween® 80	Research Grade	786-519	500ml	1325	0.012	60	15	76,000	65	-
		786-520	1 liter							
	Proteomic Grade (10% aqueous solution)	DG013	5 x 10ml							<50
		DG014	10 x 10ml							
		DG513	50ml							
		DG520	100ml							
IONIC DETERGENTS										
CTAB	Proteomic Grade	DG094	25gm	364.5	1	170	-	62,000	-	-
		DG095	100gm							
Deoxycholate	Proteomic Grade	DG090	100gm	414.6	4-8	3-12	16	1,200-5,000	-	-
		DG091	500gm							
SDS	Proteomic Grade	DG092	100gm	288.38	7-10	62	40	18,000	>100	-
		DG093	500gm							
	10% Solution	R014	100ml							
ZWITTERIONIC DETERGENTS										
ASB-14	Proteomic Grade	DG060	1gm	434.7	8	-	-	-	-	<50 in 10% solution
		DG061	5gm							
ASB-16	Proteomic Grade	DG062	1gm	462.7	8	-	-	-	-	<50 in 10% solution
		DG063	5gm							
ASB-C8Ø	Proteomic Grade	DG064	1gm	440.6	-	-	-	-	-	-
		DG065	5gm							
CHAPS	Proteomic Grade	DG050	5gm	614.9	6-10	10	-	6,150	>100	<25 in 10% solution
		DG051	25gm							
CHAPSO	Proteomic Grade	DG052	1gm	630.9	8	11	-	7,000	90	<50 in 10% solution
		DG053	5gm							
Sulfobetaine 3-10	Proteomic Grade	DG054	1gm	307.5	25-40	41	-	12,600	-	-
		DG055	5gm							
Sulfobetaine 3-12	Proteomic Grade	DG056	1gm	335.5	2-4	55	-	18,500	-	-
		DG057	5gm							
Sulfobetaine 3-14	Proteomic Grade	DG058	1gm	364	0.1-0.4	83	-	30,200	-	-
		DG059	5gm							
NON-DETERGENT SULFOBETAINE										
NDSB 201	Proteomic Grade	DG080	25gm	201.4	No micelles are formed				-	-
		DG081	100gm							

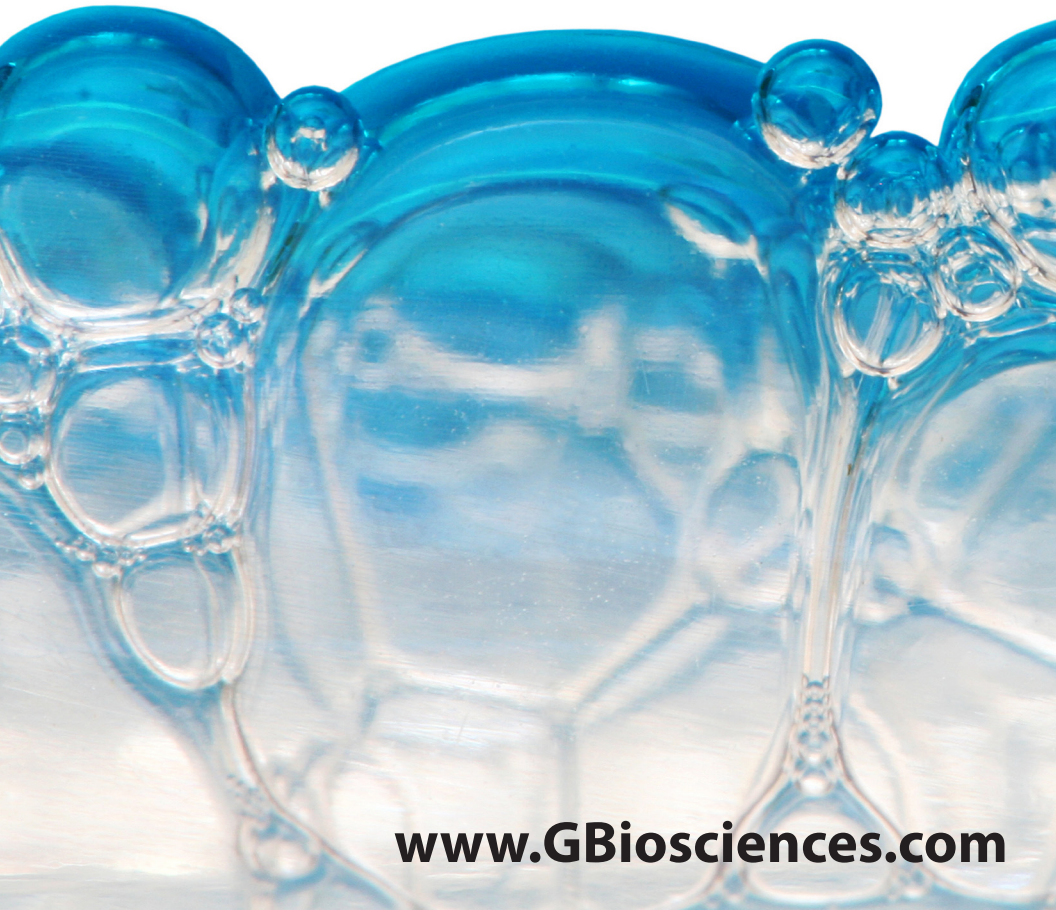
[1]**Critical Micellular Concentration (CMC)** determined at 20-25°C. CMC is the concentration at which micelles begin to form.

[2]**Aggregation number** is the average number of monomers in a micelle.

[3]**Hydrophile-Lipophile Balance (HLB)** defines the hydrophilic character of a detergent.

[4]Data not available

BIOSCIENCES®



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