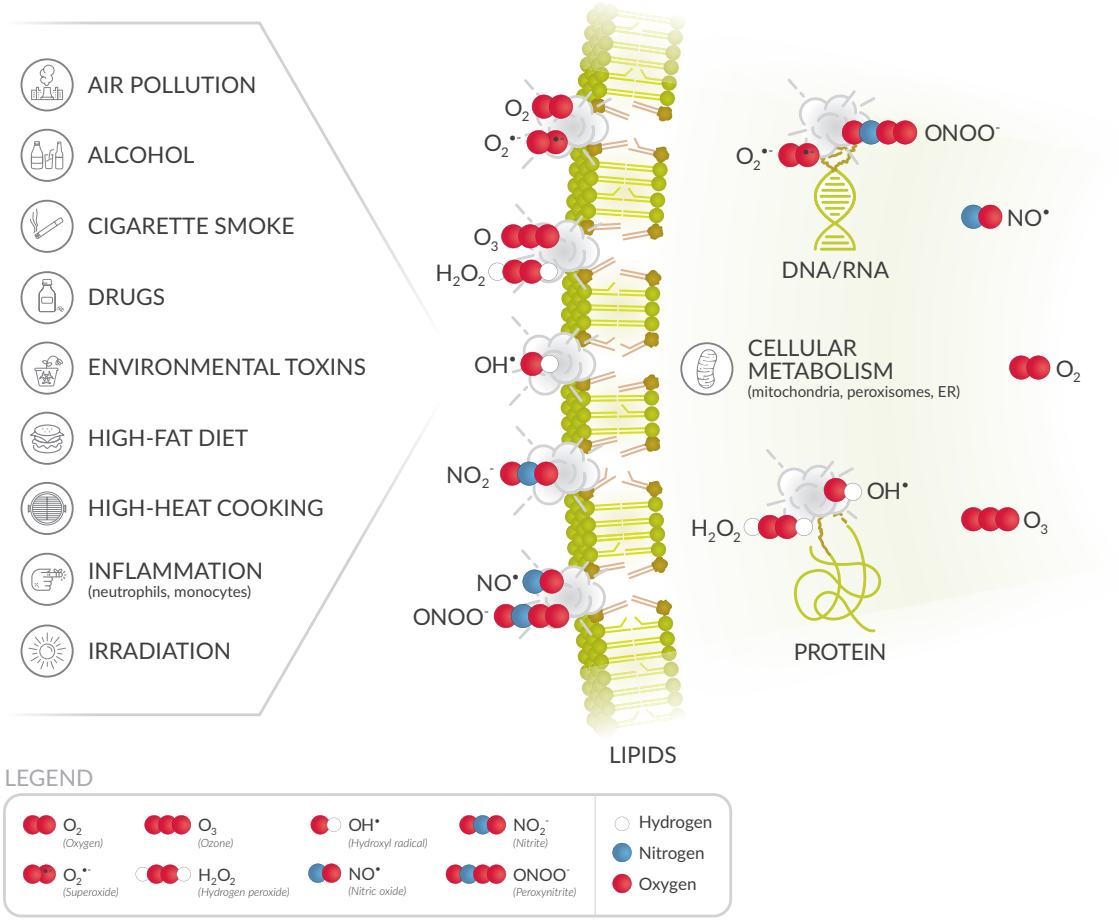
Oxidative Damage and Reactive Species

Understanding the complexities of redox signaling control and subsequent molecular damage to lipids, proteins, DNA, etc., requires technical approaches that offer precision and accuracy. From tools that directly measure reactive oxygen species (ROS) and reactive nitrogen species (RNS) to methods that identify damage to lipids, proteins, and nucleic acids, Cayman Chemical offers a broad range of research products to help better understand this complicated regulatory pathway.

- Assays and reagents to detect oxidation of lipids, proteins, and nucleic acids
- Assays and probes to detect S-nitrosylation, S-glutathionylation, or sulfenylation
- Assays to evaluate antioxidant activity and to detect ROS/RNS
- Antioxidants, free radical generators, spin traps, and NO donors
- Active, pure enzymes, validated antibodies, and assays for cellular redox systems
- Hydrogen sulfide donors and probes to study potential RSS
- Contract bioanalysis services are available



Reactive oxygen and nitrogen species: key sources, main forms, and critical targets for damage (lipids, proteins, and nucleic acids).

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Lipid Peroxidation

Lipid hydroperoxides in samples can be efficiently extracted into organic solvents and measured directly by utilizing redox reactions with ferrous ions to reveal the total hydroperoxide content present at a moment in time. Malondialdehyde (MDA) and 4-hydroxy nonenal (4-HNE) are the most well-known degradants of polyunsaturated fatty acid hydroperoxides. Cayman offers a variety of assay kits and probes to detect the formation of highly reactive hydroperoxides of unsaturated lipids.

Hydroperoxide

Item No.	Product Name
705002	Lipid Hydroperoxide (LPO) Assay Kit*

**Kit format also available for use with a reusable glass plate (Item No. 705003)*

MDA-TBA Adducts

Item No.	Product Name
10009055	TBARS Assay Kit
700870	TBARS (TCA Method) Assay Kit

4-HNE and Metabolites

Item No.	Product Name
32100	4-hydroxy Nonenal
332101	4-hydroxy Nonenal-d_3
13265	4-hydroxy Nonenal Alkyne
32110	4-hydroxy Nonenal Mercapturic Acid
9000348	4-hydroxy Nonenal Mercapturic Acid-d_3
17104	4-oxo-2-Nonenal Alkyne

8-Isoprostane: This stable product produced by random oxidation of tissue phospholipids is considered one of the most reliable biomarkers of *in vivo* lipid peroxidation. 8-Isoprostane is typically assessed using either immunoassay, LC-MS, or GC-MS methods. Cayman offers high-purity mass spectrometry standards and mixtures, sample purification kits, and validated ELISAs to quantify this specific product of lipid peroxidation.

ELISAs

Item No.	Product Name
516351	8-Isoprostane ELISA Kit
516360	8-Isoprostane Express ELISA Kit
500431	STAT-8-Isoprostane ELISA Kit

Over 30 isoprostanes, including deuterated standards available online

Sample Purification Tools

Item No.	Product Name
401111	8-Isoprostane Affinity Column
501110	8-Isoprostane Affinity Purification Kit
401113	8-Isoprostane Affinity Sorbent

Mass Spec Standards

Item No.	Product Name	Purity
16310	8,12-*iso*-iPF$_{2\alpha}$-VI	≥95%
16300	(±)5-iPF$_{2\alpha}$-VI	≥95%
10006654	(±)5-iPF$_{2\alpha}$-VI-d_{11}	≥99% (d_1-d_{11})
16290	2,3-dinor-8-*iso* Prostaglandin F$_{2\alpha}$	≥98%
15350	8-*iso* Prostaglandin F$_{1\alpha}$	≥99%
10006878	8,12-*iso*-iPF$_{2\alpha}$-VI-d_{11}	≥99% (d_1-d_{11})
16350	8-*iso* Prostaglandin F$_{2\alpha}$	≥99%
16390	8-*iso*-15-keto Prostaglandin F$_{2\alpha}$	≥95%
14350	8-*iso* Prostaglandin E$_2$	≥99%
316350	8-*iso* Prostaglandin F$_{2\alpha}$-d_4	≥99% (d_1-d_4)

Oxidative Stress LC-MS Mixture

Item No. 18701

Contains 1 µg/ml each of:

- 8-hydroxyguanosine
- 8-hydroxy-2'-deoxyguanosine
- 2,3-dinor-8-*iso* PGF$_{2\alpha}$
- 8-*iso* PGF$_{1\alpha}$
- 8-*iso* PGF$_{2\alpha}$
- (±)5-iPF$_{2\alpha}$-VI
- 8-*iso*-15-keto PGF$_{2\alpha}$
- 8-*iso* PGE$_2$
- 8,12-*iso*-iPF$_{2\alpha}$-VI

Protein Oxidation and Nitration

The most common marker of protein oxidation is protein carbonyl content. Alternatively, ROS exposure to a protein's methionine residues generates protein methionine sulfoxide. The presence of nitrotyrosine on proteins is used as a marker of peroxynitrite formation *in vivo*. Cayman offers two convenient methods to measure the two specific biomarkers of protein oxidation, as well as an immunoprecipitation kit and antibodies specific for nitrotyrosine to detect protein nitration.

Carbonyl Content

Item No.	Product Name
10005020	Protein Carbonyl Colorimetric Assay Kit

Methionine Sulfoxide

Item No.	Product Name
600160	Methionine Sulfoxide Immunoblotting Kit

Nitrotyrosine

Item No.	Product Name
89540	Nitrotyrosine
389549	Nitrotyrosine Affinity Sorbent
601220	Nitrotyrosine IP Kit
189542	Nitrotyrosine Monoclonal Antibody

Nitrotyrosine *Continued*

Item No.	Product Name
10006966	Nitrotyrosine Monoclonal Antibody - Biotinylated
10189540	Nitrotyrosine Polyclonal Antibody
10006778	Nitrotyrosine (Peptide) Polyclonal Antibody

Nitrosylation, Glutathionylation, and Sulfenylation: ROS and RNS react with proteins resulting in modifications to various amino acid residues. Cayman offers several different approaches to monitor these processes, including ascorbate-dependent switch techniques, sulfenic acid-catalyzed thiosulfonate formation, and phosphine ligations.

S-Nitrosothiol

Item No.	Product Name	Description
10006518	S-Nitrosylated Protein Detection Kit (Biotin Switch)	Directly visualize S-NO proteins in whole cells or tissues
17237	MTSEA-biotin	A thiol-reactive probe
17215	SNOB 1 Reagent	A biotinylated probe for detecting S-nitrosylation
13083	ThioFluor 623	Fluorescent probe for thiol bioimaging

Additional thiol-reactive probes available online

S-Glutathione

Item No.	Product Name	Description
10010721	S-Glutathionylated Protein Detection Kit	Directly visualize S-glutathionylated proteins in whole (permeabilized) cells
15491	L-Glutathione, oxidized (sodium salt)	A hydrogen acceptor
10007461	L-Glutathione, reduced	Nucleophilic co-substrate to glutathione transferases and electron donor to glutathione peroxidases

Sulfenic Acid

Item No.	Product Name
600320	Sulfenylated Protein Cell-Based Detection Kit
13173	DAz-1
13382	DAz-2

Sulfenic Acid *Continued*

Item No.	Product Name
11220	DYn-2
13581	Phosphine-biotin

Additional sulfenic acid detection probes available online

DNA/RNA Damage

Guanine is the base that is most prone to oxidation when DNA and RNA are damaged. The repair processes that are initiated to correct this damage release multiple oxidized guanine species into the urine: the ribose-free base (8-hydroxyguanine), the nucleoside from RNA (8-hydroxyguanosine), and the deoxynucleoside from DNA (8-hydroxy-2'-deoxyguanosine). Cayman's DNA damage assays detect multiple oxidized guanine species to capture the complete set of biologically relevant products of oxidative damage.

ELISAs

Item No.	Product Name	Measure*	LC/MS Correlation
589320	DNA/RNA Oxidative Damage (High Sensitivity) ELISA Kit	8-hydroxy-2'-deoxyguanosine, 8-hydroxyguanosine, and 8-hydroxyguanine with selectivity and sensitivity highest for 8-hydroxy-2'-deoxyguanosine	Selectivity and sensitivity highest for 8-hydroxy-2'-deoxyguanosine, though high slope indicates other unknown species are detected
501130	DNA/RNA Oxidative Damage (Clone 7E6.9) ELISA Kit	8-hydroxy-2'-deoxyguanosine and 8-hydroxyguanosine with equal selectivity and sensitivity	Correlates with LC/MS measurements of a combination of 8-hydroxy-2'-deoxyguanosine and 8-hydroxyguanosine

**For an in-depth comparison of the different monoclonal antibodies used in these assays, see our poster: "Critical comparison of three 8-hydroxy-2'-deoxyguanosine monoclonal antibodies" at www.caymanchem.com/Literature.*

Biomarkers

Item No.	Product Name	Description	Purity
89320	8-Hydroxy-2'-deoxyguanosine	DNA damage marker	≥98%
89290	8-Hydroxyguanine (hydrochloride)	DNA and RNA damage marker	≥90%
89300	8-Hydroxyguanosine	RNA damage marker	≥98%

Reactive Probes

Item No.	Product Name	Description
10009350	Aldehyde Reactive Probe (trifluoroacetate salt)	A biotinylated probe for detecting AP sites in damaged DNA
16952	4-Thiouracil	A photoactivatable probe used to detect RNA structures and nucleic acid-nucleic acid contacts

Bioanalytical Assay & Assay Development Services

Don't have the time or resources to run your samples? Cayman provides complete biological sample analysis using any of the hundreds of assays available from our catalog. Custom assay development is also possible. By combining our well-characterized immunoassays, cell-based assays, and other biochemical screening assays with the supervision of our knowledgeable and highly experienced scientists, you are guaranteed accurate data with efficiency.

Your Samples + CAYMAN ASSAYS OR QUALIFIED COMMERCIAL ASSAYS OR CUSTOM ASSAYS = High Quality Data Delivered in a Timely Manner

Antioxidant Detection/Activity

Cayman offers a collection of assay kits to evaluate distinct antioxidant mechanisms within the cell (*e.g.*, ascorbic acid, catalase, glutathione, superoxide dismutase, and thioredoxin) used to counteract the effects of ROS *in vivo*.

Assay Kits

Item No.	Product Name
709001	Antioxidant Assay Kit
700420	Ascorbate Assay Kit
707002	Catalase Assay Kit
700910	Catalase Assay Kit (without Hydrogen Peroxide)
20039	Fluorescent Thioredoxin Activity Assay Kit*
11536	Glutaredoxin Fluorescent Activity Assay Kit*
703002	Glutathione Assay Kit
600360	Glutathione Cell-Based Detection Kit (Blue Fluorescence)
703102	Glutathione Peroxidase Assay Kit
703202	Glutathione Reductase Assay Kit
703302	Glutathione S-Transferase Assay Kit
706002	Superoxide Dismutase Assay Kit
700340	Thiol Detection Assay Kit
11527	Thioredoxin Activity Fluorescent Assay Kit*
10007892	Thioredoxin Reductase Colorimetric Assay Kit
11529	Thioredoxin Reductase Fluorescent Activity Assay Kit*
11526	Thioredoxin/Thioredoxin Reductase Mammalian Assay Kit*

Antioxidants

Item No.	Product Name
10005254	AFMK
70950	Celastrol
70930	Chlorogenic Acid
70604	3,4-Dihydroxyphenyl ethanol
70530	Ebselen
70935	(–)-Epigallocatechin Gallate
10006329	EUK 134
14656	L-Ascorbic Acid
10010811	Lutein
89950	Mitoquinol
18796	MitoTEMPOL
70675	*trans*-Resveratrol
10008513	δ-Tocotrienol
10011659	Trolox
10009992	Zeaxanthin

Common antioxidants listed, over 400 antioxidants available online

Antioxidant Activity Probes

DPPH
Item No. 14805
A colorimetric detector of free radical scavengers

PBD-BODIPY
Item No. 27945
A fluorescent probe for autoxidation reactions

STY-BODIPY
Item No. 27089
A fluorogenic probe for radical-trapping antioxidant activity

Complete your tool kit for studying oxidative stress and cellular redox systems

- Active and pure recombinant thioredoxin (Trx) and glutaredoxin (Grx) enzymes
- Validated Trx and Grx antibodies
- Ready-to-use Trx and Grx activity assays supplied with active, biologically relevant enzymes and high-quality substrates

*In partnership with the IMCO Corporation of Sweden

ROS

Cayman offers a diverse collection of assays, sensitive probes, and free radical generators and scavengers to detect and characterize various species of ROS.

Selective Detection of H_2O_2 *In Vivo*

MitoB *Item No. 17116* | **MitoB-d_{15}** *Item No. 17470* — & — **MitoP** *Item No. 17117* | **MitoP-d_{15}** *Item No. 19296*

Hydrogen Peroxide Ratiometric MaxSpec® Kit (Item No. 601460) includes all necessary reagents and a detailed protocol to determine the MitoP/MitoB ratio by LC-MS/MS

Assay Kits

Item No.	Product Name
600050	Hydrogen Peroxide Cell-Based Assay Kit
701600	Mitochondrial ROS Detection Assay Kit

Assay Kits *Continued*

Item No.	Product Name
601290	ROS Detection Cell-Based Assay Kit (DHE)
10010895	Xanthine Oxidase Fluorometric Assay Kit

ROS Fluorescent Probes

Item No.	Product Name	Detect	Cell Permeable?	Excitation (nm)	Emission (nm)
10157	APF	OCl^-, $OH^\bullet$, $ONOO^-$, $^1O_2$	✓	490	515
27086	C11 BODIPY 581/591	H_2O_2	✓	581 → 500 shift	591 → 510 shift
20656	2',7'-Dichlorofluorescein diacetate	non-specific ROS	✓	492	515
12013	Dihydroethidium	$O_2^{\bullet-}$ and other oxidants	✓	490	590
62237	DPPP	$ROO^\bullet$	✓	351	380
14872	Lucigenin	H_2O_2, $O_2^{\bullet-}$	✓	chemiluminescent	
18798	MitoPerOx	mitochondrial lipid peroxidation	✓	495	590 → 520 shift
10005983	Pentafluorobenzenesulfonyl fluorescein	H_2O_2	✓	485 ±20	530 ±25

Learn more about finding the right probe for your experiment at www.caymanchem.com/oxstressprobes

Free Radical Generators

Item No.	Product Name	Description
27499	MGR1	A ROS-generating probe *(MGR2 available as negative control)*
10009642	SOTS-1 (technical grade)	A chemical source of superoxide anion in aqueous solution

ROS Spin Traps

Item No.	Product Name	Description
14958	BMPO	Detects thiyl radicals, hydroxyl radicals, and superoxide anions
10009660	CYPMPO	Detects hydroxyl and superoxide radicals
10006436	DMPO	Reacts with O-, N-, S-, and C-centered radicals
10006170	DMPO Nitrone Adduct Polyclonal Antiserum	A 'spin trap immunoassay' - a new alternative to EPR/ESR
16463	MTSSL	A spin label used in site-directed spin labeling

Additional ROS spin traps are available online

RNS

Cayman offers a variety of assays, antibodies, fluorescent probes, and free radical scavengers to detect and characterize RNS.

Assay Kits

Item No.	Product Name	Measure
780001	Nitrate/Nitrite Colorimetric Assay Kit	$NO^{\bullet}$ metabolites
760871	Nitrate/Nitrite Colorimetric Assay Kit (LDH method)	*In vitro* NOS activity and $NO^{\bullet}$ metabolites
780051	Nitrate/Nitrite Fluorometric Assay Kit	$NO^{\bullet}$ metabolites
781001	NOS Activity Assay Kit	NOS activity

Antibodies

Item No.	Product Name	Description
160862	iNOS Polyclonal Antibody	**Host:** Rabbit · **Applications:** IHC, IP, WB
160870	nNOS Polyclonal Antibody	**Host:** Rabbit · **Applications:** ICC, IHC, WB
160880	eNOS Polyclonal Antiserum	**Host:** Rabbit · **Application:** WB

RNS Fluorescent Probes

Item No.	Product Name	Detect	Cell Permeable?	Excitation (nm)	Emission (nm)
14051	Coumarin Boronic Acid	$ONOO^-$, OCl^-, H_2O_2	✓	332	470
10818	Coumarin Boronic Acid pinacolate ester	$ONOO^-$, OCl^-, H_2O_2	✓	332	470
85160	DAF-2	$NO^{\bullet}$	✗	485	538
85165	DAF-2 diacetate	$NO^{\bullet}$	✓	485	538
18767	DAF-FM diacetate	$NO^{\bullet}$	✓	495	515
85070	DAN-1 EE (hydrochloride)	$NO^{\bullet}$	✓	360-380	420-450
85100	Dihydrorhodamine 123	$ONOO^-$, H_2O_2, OCl^-	✓	500	536

Learn more about finding the right probe for your experiment at www.caymanchem.com/oxstressprobes

RNS Spin Traps

Item No.	Product Name	Description
81540	Carboxy-PTIO (potassium salt)	Reacts stoichiometrically with NO
21009	Nitrosobenzene	Used to study oxidative DNA damage and nitroso-compound-induced respiratory burst in neutrophils
16148	1-Oxyl-2,2,5,5-tetramethylpyrroline-3-carboxylate NHS ester	A nitroxide spin label used as an active acylating agent that preferentially targets α-amino groups
14982	PTIO	Reacts with NO to form NO_2 and corresponding imino nitroxides
14877	TEMPONE	Nitroxyl radical used in hydrogen transfer experiments

To view a complete list of our Oxidative Stress & Reactive Species products, visit us online at **www.caymanchem.com**

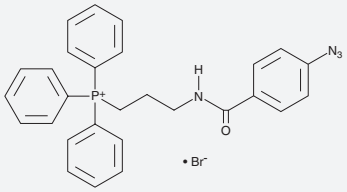
RSS

Reactive sulfur species (RSS) are sulfur-based compounds that can oxidize thiol proteins and enzymes. Cayman offers hydrogen sulfide (H_2S) fluorescent probes, donors, and inhibitors of H_2S synthesis to study the contribution of H_2S to the occurrence of RSS.

Selective Detection of H_2S *In Vivo*

MitoA - *Item No. 22702*

A mitochondria-targeted mass spectrometry probe that can be used to assess relative changes in mitochondrial matrix H_2S concentration



H_2S Fluorescent Probes

Item No.	Product Name	Detect	Excitation (nm)	Emission (nm)
26548	CAY10731	H_2S	485	535
11179	WSP-1	H_2S	465	515
16929	WSP-5	H_2S	502	525

Additional H_2S probes available online

H_2S Donors

Item No.	Product Name	Description
17102	ADT-OH	A synthetic H_2S donor
17100	AP39	A mitochondrial H_2S donor
17101	AP219	A control compound for AP39
10012577	Diallyl Trisulfide	A natural H_2S donor
13345	GYY 4137	A water-soluble, slow-releasing H_2S donor
10012555	Sodium Hydrogen Sulfide (hydrate)	A H_2S donor

Inhibitors of H_2S Synthesis

Item No.	Product Name	Description
10010947	β-cyano-L-Alanine	A reversible inhibitor of H_2S synthesis
10010948	DL-Propargyl Glycine (hydrochloride)	An irreversible inhibitor of H_2S synthesis

SZABO SCANDIC
LIFE SCIENCE MARKETPLACE

Distributed by:
SZABO-SCANDIC HandelsgmbH
Quellenstraße 110, A-1100 Vienna
T. +43 (0)1 489 3961-0
F. +43 (0)1 489 3961-7
mail@szabo-scandic.com
www.szabo-scandic.com