



A GUIDE TO

OXIDATIVE STRESS: MARKERS & DETECTION TOOLS

Oxidative stress occurs when there is an imbalance between the production of chemically reactive species such as reactive oxygen, nitrogen, and sulfur species (ROS, RNS, RSS) and antioxidant defense mechanisms. Uncontrolled oxidation can disrupt redox signaling and cause injury to cellular components like lipids, proteins, and nucleic acids, resulting in irreparable damage and eventual cell death.

Oxidative stress can be evaluated directly by measuring reactive species or indirectly by the associated damage to lipids, proteins, and nucleic acids. Although direct measurement of these reactive species is desirable, indirect methods are often more reliable due to the relative stability of damage markers on biomolecules compared to the transient nature of reactive species. Multiple biomarkers of oxidative damage have been identified for different macromolecules (e.g., proteins, lipids, and DNA/RNA).

Use this guide to find the right marker of oxidative stress and detection tool for your application.

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METHOD CONSIDERATIONS

Because of their high reactivity, ROS, RNS, and RSS are transient: they have short half-lives and are typically present at low concentrations, necessitating the use of sensitive detection methods. There are many approaches for detecting reactive species and their damage markers. Key factors to consider when selecting a method include:

- Reproducibility
- Type of reactive species
- Reaction chemistry
- Specificity
- Qualitative versus quantitative approaches
- Interfering compounds
- Technical expertise
- Equipment available



Ready-made Assay Kits

Ready-made assay kits are a convenient and simple tool for the detection of reactive species or markers of oxidative stress. Assay kits are validated and pre-optimized, saving you valuable time and resources.

BENEFITS

- ✓ Reproducible
- ✓ Easy to use
- ✓ Includes protocols & reagents
- ✓ High sample throughput
- ✓ Choice of application (e.g., ELISA, flow cytometry (FC), fluorescent microscopy)



Fluorescent Probes

Fluorescent probes are valuable tools but tend to be non-specific for any given species. A secondary method should be used to confirm results using fluorescent probes.

BENEFITS

- ✓ Easy to use
- ✓ Sensitive
- ✓ Wide range of fluorophores available
- ✓ Scavengers available to improve specificity (e.g., catalase for H_2O_2)
- ✓ Choice of application (e.g., FC, fluorescent microscopy, microplate reader)



Mass Spectrometry

Some markers of oxidative stress can be detected by mass spectrometry (LC-MS or GC-MS). There have been significant advances in MS workflows, yet it remains a highly technical, time-intensive approach that requires extensive skill.

BENEFITS

- ✓ Broad coverage
- ✓ Specific
- ✓ Sensitive
- ✓ Flexible workflows

Oxidative Stress LC-MS Mixture - Item No. 18701

- Contains a mixture of lipids and nucleic acids produced during oxidative stress





Antibody-based Techniques

Other markers of oxidative stress can be detected with antibody-based techniques like Western blot (WB), immunocytochemistry (ICC), or immunohistochemistry (IHC). WB is useful for determining abundance of a protein biomarker, and ICC and IHC can elucidate marker distribution and localization but are generally considered qualitative measures.

BENEFITS

- ✓ Target protein of interest
- ✓ Determine cellular localization
- ✓ Potential use with archived tissues



Spin Traps

Spin traps capture free radicals, producing a spin adduct that can be detected by electron spin resonance (ESR). The spin adduct has a distinct spectrum that allows for the identification of the trapped radical. While often regarded as the gold standard for the direct detection of reactive species, not all researchers have access to an ESR instrument.

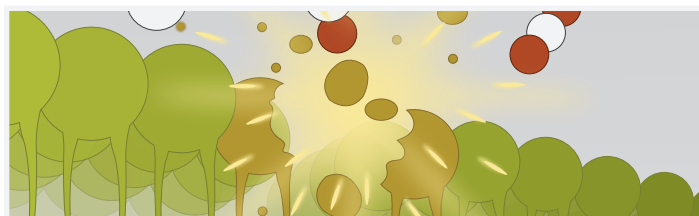
BENEFITS

- ✓ Sensitive
- ✓ Specific
- ✓ High stability of spin adduct
- ✓ Potential *in vivo* applications

Spin Traps

| Item No. | Product Name |
|----------|-------------------------------|
| 14958 | BMPO |
| 10009660 | CYPMPO |
| 10006435 | DEPMPO |
| 10006436 | DMPO |
| 20618 | EMPO |
| 14982 | PTIO |
| 81540 | Carboxy-PTIO (potassium salt) |
| 14877 | TEMPONE |

View additional spin traps online at www.caymanchem.com



Stressed about Picking an Oxidative Damage Assay?

Get dependable results with reliable assays. Explore the trusted methods used in Cayman's oxidative damage assays.

www.caymanchem.com/oxidativedamage

BIOANALYSIS & ASSAY DEVELOPMENT SERVICES

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ROS

ROS are produced from molecular oxygen during normal cellular processes or in response to harmful exogenous factors. ROS have central roles in redox regulation and cell signaling, but excessive ROS production triggers oxidative stress. Examples of ROS include superoxide ($O_2^{\bullet-}$), hydrogen peroxide (H_2O_2), and the hydroxyl radical (OH^{\bullet}).

ENDOGENOUS FACTORS



CELLULAR METABOLISM

(mitochondria, xanthine oxidase, peroxisomes)



INFLAMMATION

(neutrophils, monocytes/macrophages)



IRRADIATION



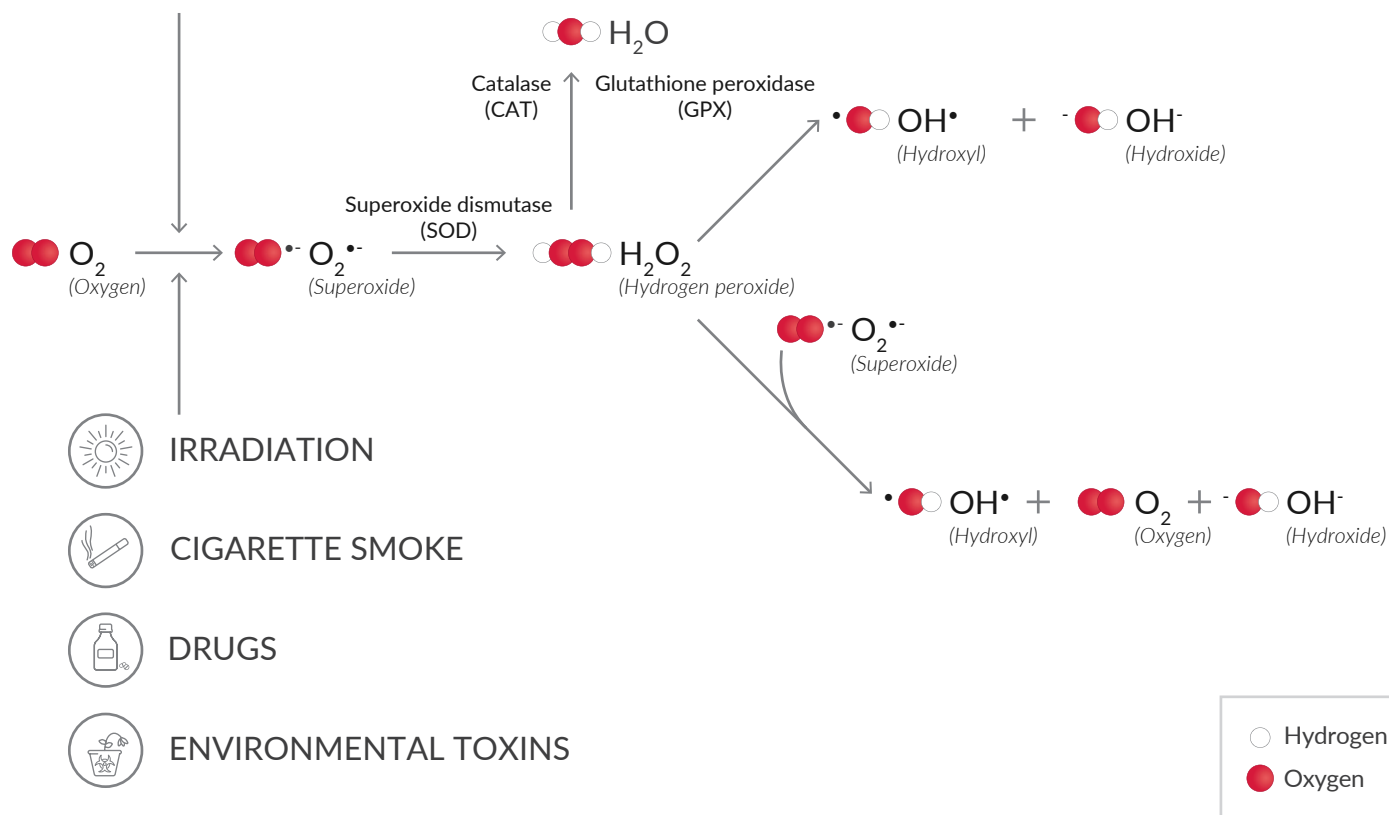
CIGARETTE SMOKE



DRUGS



ENVIRONMENTAL TOXINS



EXOGENOUS FACTORS



$O_2^{\bullet-}$ is the precursor for many ROS. It is rapidly converted to H_2O_2 by superoxide dismutase (SOD).



H_2O_2 is relatively stable compared to other ROS, making it more readily detectable. Although it is less reactive than other ROS, H_2O_2 can easily diffuse across biological membranes to injure nearby cells.



OH^{\bullet} is the strongest and most injurious ROS. It is highly reactive and can damage lipids, proteins, and DNA.

Find small molecule inhibitors for ROS at www.caymanchem.com



Free radical generators & ROS-producing probes available at www.caymanchem.com

ROS Assay Kits

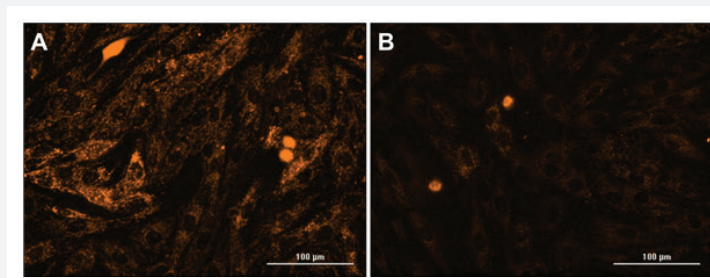
| Item No. | Product Name | Format | Sample Types | Key Features |
|----------|--|--|------------------------------|--|
| 600050 | Hydrogen Peroxide Assay Kit | Plate-based fluorometric (Ex/Em = 530-560/590 nm) or colorimetric (570 nm) assay | Cell samples | Includes catalase as specificity control |
| 701600 | Mitochondrial ROS Detection Assay Kit | Plate-based fluorometric assay, FC (Ex/Em = 480-515/560-600 nm) | Adherent or suspension cells | Includes positive and negative controls |
| 601520 | ROS Detection Cell-Based Assay Kit (DCFDA) | Plate-based fluorometric assay, FC (Ex/Em = 480-500/510-550 nm) | Adherent or suspension cells | Includes positive and negative controls |
| 601290 | ROS Detection Cell-Based Assay Kit (DHE) | Plate-based fluorometric assay, FC (Ex/Em = 480-520/570-600 nm) | Adherent or suspension cells | Includes positive and negative controls |

Mitochondrial ROS Detection Assay Kit

Item No. 701600

FEATURES:

- Measure mitochondrial ROS directly in living cells
- Includes antimycin A as positive control
- Flexible: Compatible with FC, fluorescence, and plate-based fluorometric formats (Ex/Em = 480-515/560-600 nm)



H9c2 cells were stained with 0.62 μM Mitochondrial ROS Detection Reagent following the Adherent Cells Protocol treated with 3 μM antimycin A (A) or vehicle (B). Images were captured one hour after treatment with antimycin A using Biotek's Cytation™ 5 Multi-Mode Reader.

MitoCheck® Assays

Measure the activity of complexes I-V of the electron transport chain with Cayman's MitoCheck® Assays.



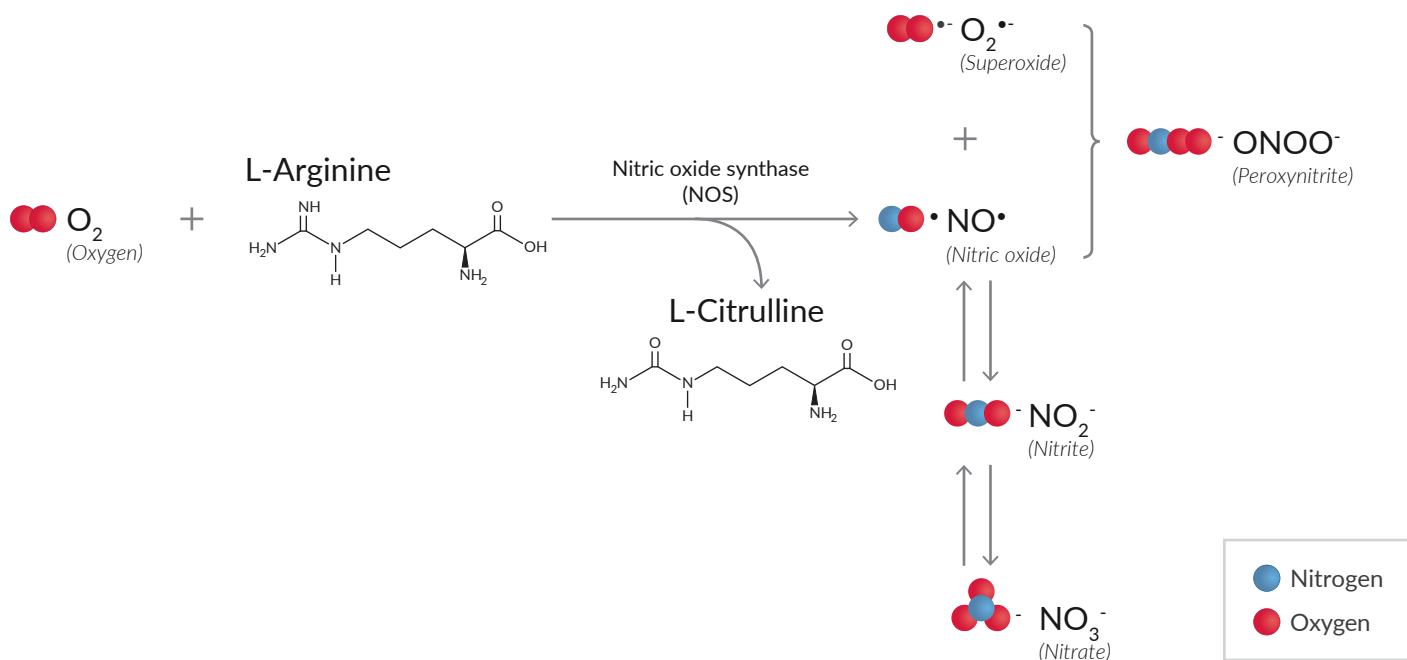
ROS Probes

| Item No. | Product Name | Detects | Excitation (nm) | Emission (nm) | Key Features |
|----------|---|--|------------------|---------------|--|
| 10010469 | 10-Acetyl-3,7-dihydroxyphenoxazine (ADHP) | H ₂ O ₂ | ■ 520-550 | ■ - ■ 585-595 | A sensitive, stable substrate for HRP that detects H ₂ O ₂ |
| 20656 | 2',7'-Dichlorofluorescein diacetate | Non-specific ROS | ■ 492 | ■ 515 | Rapidly de-esterified and oxidized in cells to form the fluorescent product 2',7'-dichlorofluorescein |
| 10157 | APF | OCI ⁻ , OH [•] , ONOO ⁻ , [•] O ₂ | ■ 490 | ■ 515 | Low intrinsic fluorescence |
| 12013 | Dihydroethidium | O ₂ ^{•-} & other oxidants | ■ 490 | ■ 590 | Also detectable by HPLC |
| 27307 | Homovanillic Acid | H ₂ O ₂ | ■ 312 | ■ 420 | Forms a fluorescent dimer upon oxidation |
| 14872 | Lucigenin | H ₂ O ₂ , O ₂ ^{•-} | Chemiluminescent | | Fluorescence is also quenched by chloride |
| 16803 | Luminol | Non-specific ROS | Chemiluminescent | | Chemiluminescence reaction can be enhanced with <i>p</i> -substituted phenols |
| 25169 | MitoROS™ 580 | O ₂ ^{•-} | ■ 510 | ■ 580 | Targets mitochondria |
| 10005983 | Pentafluorobenzenesulfonyl fluorescein | H ₂ O ₂ | ■ 485 | ■ 530 | Fluoresces upon perhydrolysis of the sulfonyl linkage and is selective for H ₂ O ₂ |

View additional ROS probes online at www.caymanchem.com

RNS

RNS are also produced during oxidative stress. Nitric oxide synthase (NOS) uses L-arginine and O_2 to produce nitric oxide (NO^\bullet), which can be oxidized to other RNS. The reaction between NO^\bullet and $O_2^{\bullet-}$ forms peroxynitrite ($ONOO^-$), a strong oxidant and nitrating agent.



NO^\bullet



NO^\bullet is a signaling molecule and RNS that can rapidly diffuse across cell membranes. Since it is short-lived and physiological concentrations are typically low, NOS activity assays are often used as an indirect measurement of cellular NO^\bullet production.

NO_2^-/NO_3^-



NO_2^-/NO_3^- are degradation products of NO^\bullet that can be converted back to NO^\bullet . These products are more stable than NO^\bullet and are used as an indirect measurement of NO^\bullet production.

$ONOO^{\bullet-}$



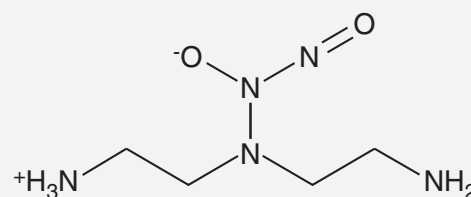
$ONOO^{\bullet-}$ is a potent oxidant and antimicrobial and cytotoxic agent. It can react with tyrosine residues to form nitrotyrosine (pg. 10), a marker of nitrative stress.

Nitric Oxide Donors

DETA NONOate - Item No. 82120

A NO donor that spontaneously dissociates in a pH-dependent, first-order process to liberate two moles of NO per mole of parent compound.

See all nitric oxide donors at www.caymanchem.com



Discover Cayman's small molecule inhibitors for RNS at www.caymanchem.com

RNS Assay Kits

| Item No. | Product Name | Format | Sample Types | Key Features |
|----------|---|---|--|--|
| 780001 | Nitrate/Nitrite Colorimetric Assay Kit* | Plate-based colorimetric assay (540-550 nm) | Plasma, serum, urine, cell supernatant, & tissue homogenates | Avoids NADPH interference by using a catalytic system to recycle spent NADP ⁺ back to NADPH |
| 760871 | Nitrate/Nitrite Colorimetric Assay Kit (LDH method) | Plate-based colorimetric assay (530-550 nm) | Plasma, serum, urine, & tissue homogenates | Includes LDH to remove interfering NADPH |
| 781001 | NOS Activity Assay Kit | Scintillation | Cell lysates & purified preparations | Monitors the conversion of arginine to citrulline by NOS |

* Item No. 780051 is available as a fluorometric alternative

RNS Probes

| Item No. | Product Name | Detects | Excitation (nm) | Emission (nm) | Key Features |
|----------|--|--|-----------------|---------------|---|
| 85155 | 2,7-Dichlorodihydrofluorescein diacetate | ONOO ⁻ | 502 | 523 | Does not appear to be oxidized by NO [•] , H ₂ O ₂ , or O ₂ ^{•-} alone |
| 14051 | Coumarin Boronic Acid | ONOO ⁻ , OCl ⁻ , H ₂ O ₂ | 332 | 470 | Reacts with ONOO ⁻ at a faster rate than H ₂ O ₂ or OCl ⁻ |
| 10818 | Coumarin Boronic Acid pinacolate ester | ONOO ⁻ , OCl ⁻ , H ₂ O ₂ | 332 | 470 | More soluble form of Item No. 14051 |
| 85160 | DAF-2 | NO [•] | 485 | 538 | NO [•] detection limit: ~5 nM |
| 85165 | DAF-2 diacetate | NO [•] | 485 | 538 | Improved cell permeability over Item No. 85160 ; NO [•] detection limit: 2-5 nM (at neutral pH) |
| 18767 | DAF-FM diacetate | NO [•] | 495 | 515 | NO [•] detection limit: ~3 nM |
| 85070 | DAN-1 EE (hydrochloride) | NO [•] | 360-380 | 420-450 | A cell-permeable form of DAN |
| 85100 | Dihydrorhodamine 123 | ONOO ⁻ | 500 | 536 | Does not appear to be oxidized by NO [•] , H ₂ O ₂ , or O ₂ ^{•-} alone |

View additional RNS probes online at www.caymanchem.com

RNS Antibodies

| Item No. | Product Name | Key Features |
|----------|---------------------------|---|
| 160862 | iNOS Polyclonal Antibody | Host: Rabbit · Reactivity: Mouse · Applications: IHC, IP, WB |
| 160870 | nNOS Polyclonal Antibody | Host: Rabbit · Reactivity: Human, rat · Applications: ICC, IHC, WB |
| 160880 | eNOS Polyclonal Antiserum | Host: Rabbit · Reactivity: Human, bovine · Applications: WB |

CELLULAR METABOLISM ANALYSIS

Explore therapeutic avenues in various disease models using high-content imaging, enzymatic screening, and the Agilent Seahorse™ XF Pro.

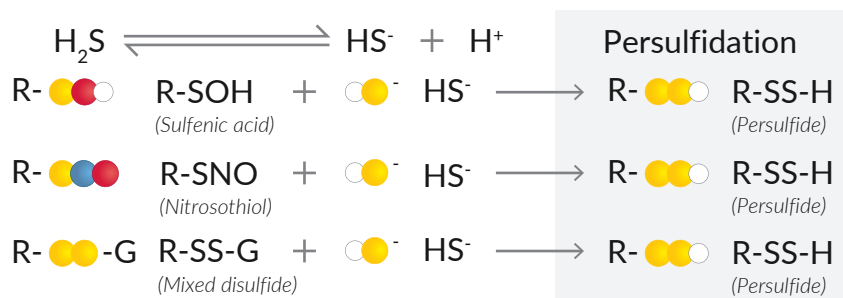
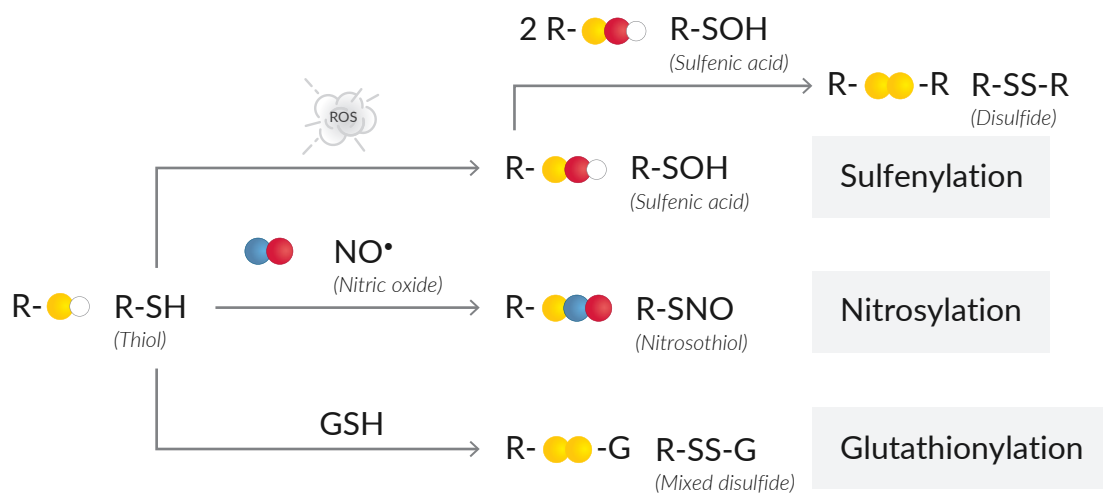
- Mitochondrial biogenesis & function
- ROS generation & oxidative stress
- Immunometabolism studies
- Custom cellular models of disease

www.caymanchem.com/cellmetabolism



RSS

RSS are redox-active sulfur-based compounds. They may be inorganic RSS, like hydrogen sulfide (H_2S), or organic RSS, which may be formed by the oxidation of cysteine thiol groups ($R-SH$) or *via* reactions between H_2S and other RSS. Oxidative modifications to proteins like disulfide formation, sulfenylation, nitrosylation, glutathionylation, or persulfidation can lead to altered protein structure and/or function. Simplified select RSS reactions are shown below.



R-SOH

R-SOH is highly reactive. It is formed by the reaction of R-SH and various ROS, resulting in a protein modification known as sulfenylation. R-SOH is rapidly converted to other RSS, like sulfinic or sulfonic acids and protein disulfides (R-SS-R).

R-SNO

R-SNO is formed by the reaction of R-SH and NO^\bullet , forming nitrosothiol, a protein modification known as nitrosylation. The biotin-switch technique is commonly used method to detect nitrosylated proteins.

R-SS-G

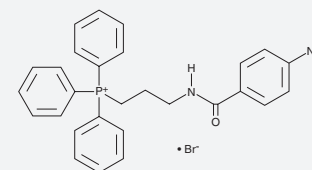
R-SS-G is formed by the reaction of R-SH with glutathione (GSH), a process that forms glutathionylated proteins.

H_2S/HS^-

H_2S exists predominantly in the anionic form (HS^-) at physiological pH. HS^- reacts with other RSS to form persulfides (R-SS-H), a protein modification known as persulfidation.

MitoA - Item No. 22702

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



RSS Probes

| Item No. | Product Name | Detects | Excitation (nm) | Emission (nm) | Key Features |
|----------|--------------|-------------------------------|-----------------|---------------|---|
| 35589 | PSP | H ₂ S _n | | | A two-photon fluorescent probe |
| 11179 | WSP-1 | H ₂ S | ■ 465 | ■ 515 | A turn-on fluorescent probe |
| 16929 | WSP-5 | H ₂ S | ■ 502 | ■ 525 | Faster turn-on rate & improved sensitivity for H ₂ S over Item No. 11179 |

Thiol-reactive Probes

Monitor thiol depletion in response to oxidative stress with these thiol-reactive probes.

| Item No. | Product Name | Excitation (nm) | Emission (nm) |
|----------|---|-----------------|---------------|
| 34564 | 7-Fluoro-2,1,3-benzoxadiazole-4-sulfonate (ammonium salt) | ■ 380 | ■ 515 |
| 17097 | Monobromobimane | ■ 398 | ■ 490 |
| 13083 | ThioFluor 623 | ■ 563 | ■ 623 |
| 13235 | ThioGlo1 | ■ 384 | ■ 513 |

S-Nitrosothiol Reagents

These reagents can be used in the biotin-switch technique to tag S-nitrosylated proteins.

| Item No. | Product Name |
|----------|-----------------|
| 16459 | Biotin-HPDP |
| 14656 | L-Ascorbic Acid |
| 9002267 | MTSEA |
| 17237 | MTSEA-biotin |
| 16529 | MTSES |
| 17215 | SNOB 1 Reagent |

Sulfenic Acid Clickable Tags

Isolate and identify sulfenic acid-modified proteins with these clickable tags available from Cayman.

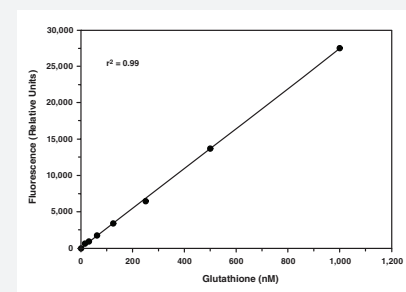
| Item No. | Product Name | Key Features |
|----------|------------------|--|
| 13038 | Alkynyl-biotin | Can be used to capture sulfenic acid-modified proteins tagged with DAz-2 |
| 21287 | BCN-E-BCN | Selective over free thiol, sulfenic, or sulfonic forms of proteins |
| 13173 | DAz-1 | Cell-permeable & can be conjugated to biotin or various fluorophores for detection |
| 13382 | DAz-2 | Cell-permeable & more sensitive than DAz-1 |
| 11220 | DYn-2 | Can be used with intact cells |
| 13581 | Phosphine-biotin | Has been used in conjunction with DAz-1 & DAz-2 |

Measure Free Thiol Content

Thiol Detection Assay Kit Item No. 700340

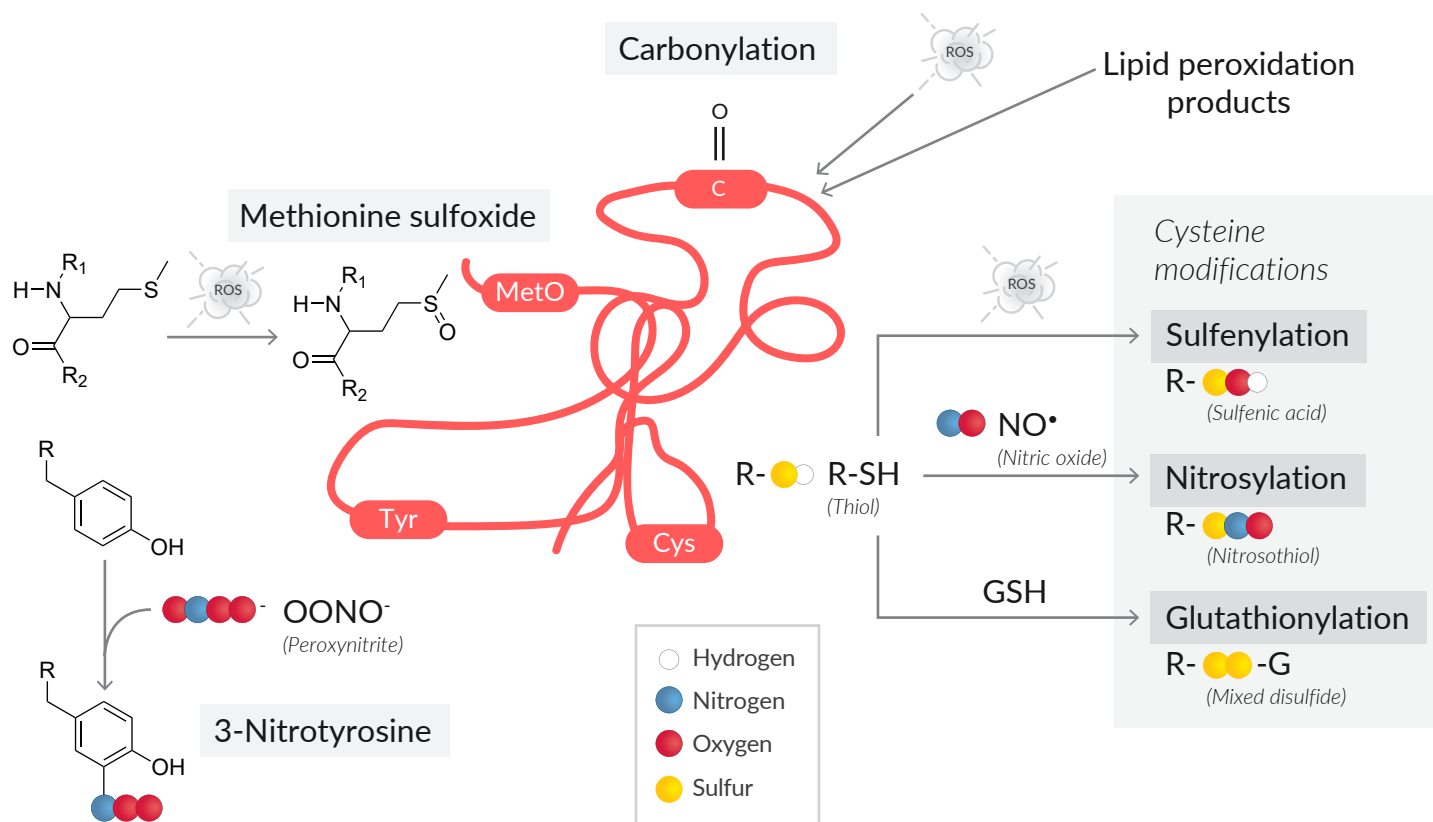
A simple, sensitive, and reproducible assay for free thiol content in a variety of sample types.

Format: Plate-based fluorometric assay
(Ex/Em = 380-390/510-520 nm)



PROTEIN OXIDATIVE MODIFICATIONS

ROS, RNS, and RSS react with proteins, resulting in modifications to various amino acid residues that can alter the structure and/or function of cellular proteins. These reactive species can either directly oxidize amino acids, especially those containing thiol groups like methionine or cysteine, or introduce carbonyl groups in the side chains of certain amino acids.



Carbonylation

Protein carbonylation is the most common and general marker of protein oxidation. It is induced by reactive species and lipid peroxidation products. Protein carbonylation introduces a reactive carbonyl group (e.g., aldehydes, ketones) into a protein.

Methionine sulfoxide

ROS damage at methionine residues produces methionine sulfoxide (MetO). MetO reductases can reverse this modification.

3-Nitrotyrosine

3-Nitrotyrosine is a marker of ONOO⁻. Tyrosine, an aromatic amino acid containing a hydroxyl group, is susceptible to nitration.

PROTEOMICS & POST-TRANSLATIONAL MODIFICATION ANALYSES

With support from our facilities and through our partnership with MS Bioworks, we offer full-service targeted and untargeted conventional and mass spectrometry-based proteomics services ranging from immunoprecipitation to data analysis.

www.caymanchem.com/bioanalysis



Protein Modification Kits

| Item No. | Product Name | Format | Samples Types | Key Features |
|----------|--|--|--|--|
| 600160 | Methionine Sulfoxide Immunoblotting Kit | WB | Cell or tissue lysates, semi-pure or purified proteins | Uses an antibody with minimal cross-reactivity to methionine sulfone |
| 10005020 | Protein Carbonyl Colorimetric Assay Kit* | Plate-based colorimetric assay (360-385 nm) | Plasma, serum, tissue homogenates, & cell lysates | Utilizes DNPH for reaction chemistry |
| 10010721 | S-Glutathionylated Protein Detection Kit | FC or fluorescent microscopy (Ex/Em = 488/518-535 nm) | Cells | Uses a modified biotin-switch method |
| 10006518 | S-Nitrosylated Protein Detection Kit (Biotin Switch) | Plate-based colorimetric (substrate-dependent) or fluorometric (Ex/Em = 490/520 nm) assay, or fluorescent microscopy | Cells or tissues | Uses a modified biotin-switch method |
| 600320 | Sulfenylated Protein Cell-Based Detection Kit | Plate-based fluorometric assay, fluorescent microscopy, or FC (Ex/Em = 485/535 nm) | Cells | Can be used with viable cells |

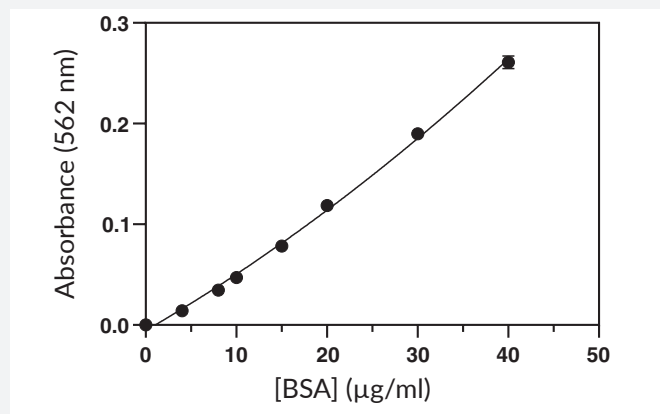
* Item No. 701530 is available as a fluorometric alternative

Complementary Kits

Determine the total protein concentration in your samples with these plate-based colorimetric assays (562 nm). Knowing the concentration of protein in your samples allows for normalization of results between samples.

Micro BCA Protein Assay Kit

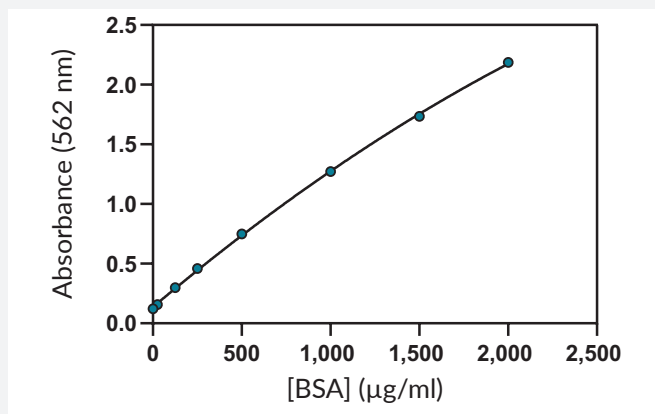
Item No. 760200



Assay Range: 4-40 µg/ml

Protein Determination (BCA) Kit

Item No. 701780



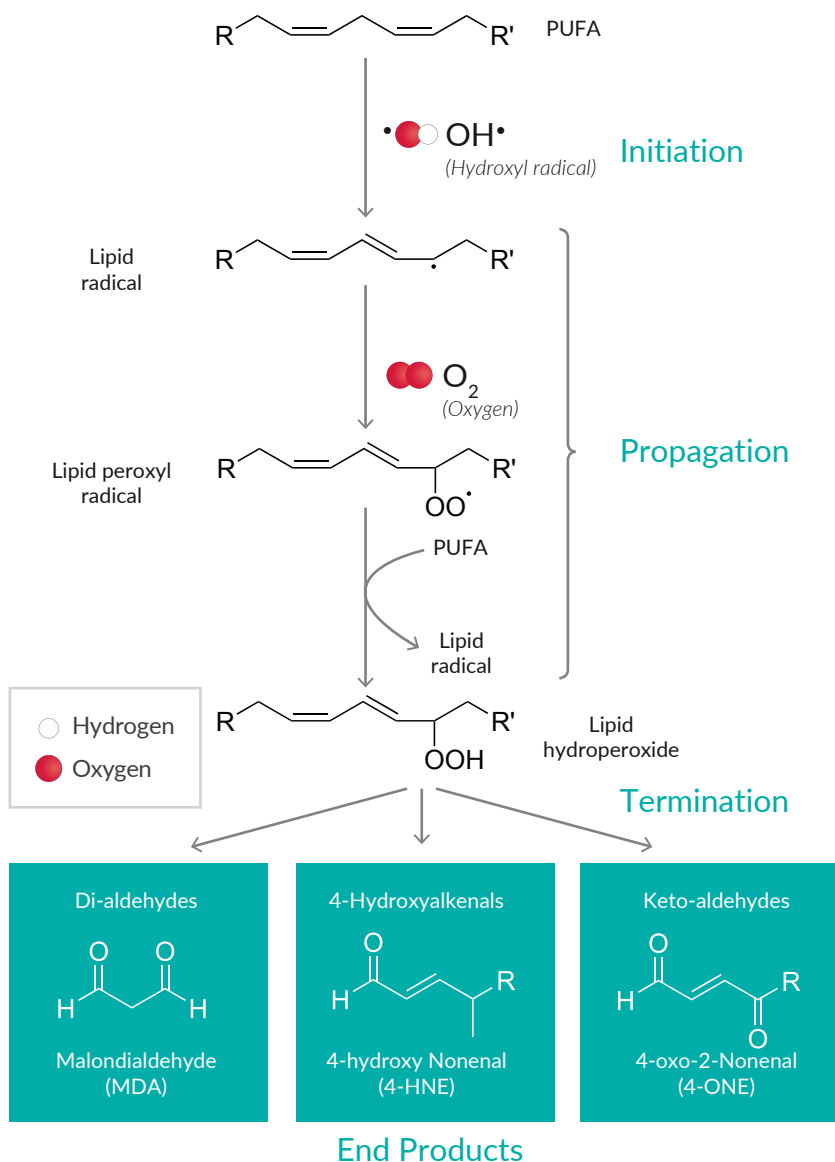
Assay Range: 25-2,000 µg/ml

Nitrotyrosine Antibodies

| Item No. | Product Name | Key Features |
|----------|--|--|
| 389549 | Nitrotyrosine Affinity Sorbent | For immunoprecipitation of nitrotyrosine-containing proteins |
| 601220 | Nitrotyrosine IP Kit | For the capture & pulldown of nitrated proteins |
| 10006778 | Nitrotyrosine (Peptide) Polyclonal Antibody | Host: Rabbit · Reactivity: Species independent · Applications: WB |
| 189542 | Nitrotyrosine Monoclonal Antibody | Host: Mouse · Reactivity: Species independent · Applications: ELISA, WB |
| 10006966 | Nitrotyrosine Monoclonal Antibody - Biotinylated | Host: Mouse · Reactivity: Species independent · Applications: ELISA, WB |
| 10189540 | Nitrotyrosine Polyclonal Antibody | Host: Rabbit · Reactivity: Species independent · Applications: WB |

LIPID PEROXIDATION

Lipid peroxidation is most often initiated by ROS like OH^\bullet , which target polyunsaturated fatty acids (PUFAs). This initiates a chain reaction that results in the formation of highly reactive and unstable lipid hydroperoxides (LPOs). LPOs are rapidly degraded into various products (e.g., alkanes, ketones, aldehydes) like malondialdehyde (MDA) and 4-hydroxy nonenal (4-HNE) that can be assayed as markers of lipid peroxidation.



LPOs

LPOs can be measured either directly or assessed indirectly by the various decomposition products.

MDA

MDA assays use a thiobarbituric acid reaction and are thus referred to as Thiobarbituric Acid Reactive Substances (TBARS) assays. Thiobarbituric acid reacts with various aldehydes produced during lipid peroxidation in addition to MDA.

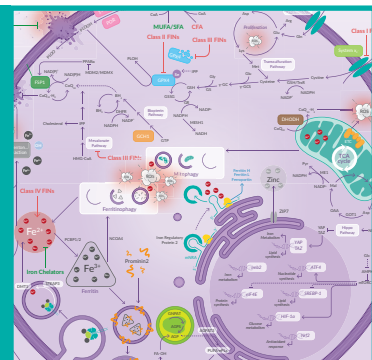
4-HNE

4-HNE protein adducts are typically more stable than MDA protein adducts. 1,4-Dihydroxynonane mercapturic acid (DHN-MA), the major urinary metabolite of 4-HNE, is an additional biomarker that may be assayed.

EXPLORE FERROPTOSIS: AN IRON-DEPENDENT FORM OF CELL DEATH DRIVEN BY LIPID PEROXIDATION

Learn more about ferroptosis and download or request a physical copy of our ferroptosis wall poster.

www.caymanchem.com/ferroptosis



Lipid Peroxidation Assay Kits

| Item No. | Product Name | Format | Sample Types | Assay Range | Key Features |
|----------|--------------------------------------|--|--|--|--|
| 705002 | Lipid Hydroperoxide (LPO) Assay Kit* | Plate-based colorimetric assay (500 nm) | Tissues, cells, plant materials, food, & biological fluids | 0.25-5 nmol hydroperoxide/tube | Extraction protocol removes most interfering substances |
| 501140 | DHN-MA-EIA Kit | Plate-based colorimetric assay (405 or 414 nm) | Urine | 7.8-1,000 pg/ml | Can be measured without extraction |
| 10009055 | TBARS Assay Kit | Plate-based colorimetric (530-540 nm) or fluorometric (Ex/Em = 530/550 nm) assay | Plasma, serum, urine, tissue homogenates, & cell lysates | Colorimetric: 0.625-50 µM Fluorometric: 0.0625-5 µM | Flexible platform |
| 700870 | TBARS (TCA Method) Assay Kit | Plate-based colorimetric (530-540 nm) or fluorometric (Ex/Em = 530/550 nm) assay | Plasma, serum, urine, tissue homogenates, & cell lysates | Colorimetric: 0.625-50 µM Fluorometric: 0.0625-5 µM | Includes sample acid precipitation protocol to avoid confounding soluble TBARS |

*Item No. 705003 is designed for use with a 96-well reusable glass plate

8-Isoprostane Assay Kits

| Item No. | Product Name | Format | Sample Types | Assay Range | Key Features |
|----------|---------------------------------|---|-------------------------------------|-----------------|--|
| 516351 | 8-Isoprostane ELISA Kit | Plate-based colorimetric assay (405-420 nm) | Plasma, urine, & other sample types | 0.8-500 pg/ml | Most sensitive assay offered by Cayman |
| 516360 | 8-Isoprostane Express ELISA Kit | Plate-based colorimetric assay (405-420 nm) | Plasma, urine, & other sample types | 2.5-1,500 pg/ml | Results in <4 hrs |
| 500431 | STAT-8-Isoprostane ELISA Kit | Plate-based colorimetric assay (405-420 nm) | Plasma, urine, & other sample types | 4.9-3,000 pg/ml | Results in <2.5 hrs |

Lipid Peroxidation Probes

| Item No. | Product Name | Excitation (nm) | Emission (nm) | Key Features |
|----------|--------------------|---|--|--|
| 27086 | C11 BODIPY 581/591 | Reduced: ■ 581 | ■ 591 | A ratiometric fluorescent indicator of lipid oxidation |
| | | Oxidized: ■ 500 | ■ 510 | |
| 18798 | MitoPerOx | ■ 495 | ■ 590 → ■ 520 shift | A ratiometric fluorescent probe for mitochondrial lipid peroxidation |
| 62237 | DPPP | ■ 351 | ■ 380 | A fluorescent probe for the detection of hydroperoxides |

Clickable Tags

Isolate and identify the reaction products of lipid peroxidation with these clickable tags available from Cayman.

| Item No. | Product Name |
|----------|--------------------------|
| 13265 | 4-hydroxy Nonenal Alkyne |
| 17104 | 4-oxo-2-Nonenal Alkyne |

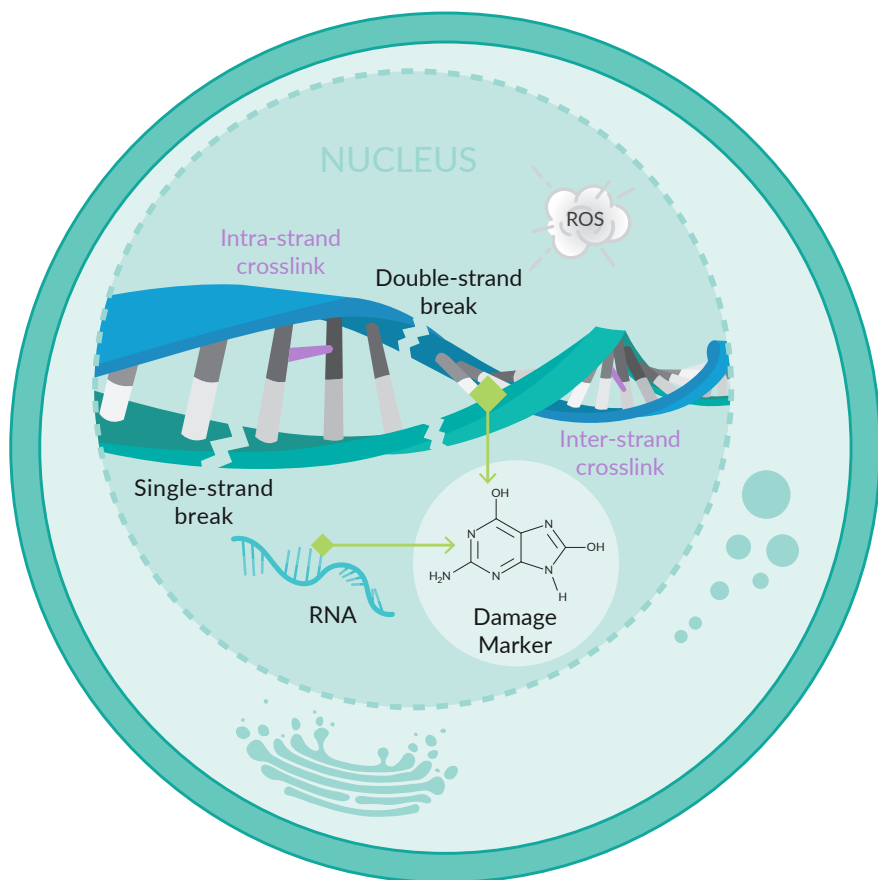
OXIDIZED PHOSPHOLIPID LIPIDOMIC SERVICES

A targeted panel of phospholipids containing oxidized acyl chains (e.g., 20:4-OH, 20:4-OOH) will help identify hydroperoxy and hydroxy phospholipids in your samples.

www.caymanchem.com/lipidomics

DNA & RNA DAMAGE

Oxidative stress can damage DNA and RNA, resulting in nucleobase lesions, double- and single-strand breaks, and inter- and intra-strand crosslinks, among other damage markers. Guanine is the base most prone to oxidation when DNA and RNA are damaged. The repair processes that are initiated to correct this damage result in the excretion of oxidized guanine species into the urine.



Damage Markers

8-Hydroxyguanine

Item No. 89290

8-Hydroxyguanine is a marker of both DNA and RNA oxidative damage.

8-Hydroxyguanosine

Item No. 89300

8-Hydroxyguanosine is a marker of RNA damage.

8-Hydroxy-2'-deoxyguanosine (8-OHdG)

Item No. 89320

8-Hydroxy-2'-deoxyguanosine is a marker of DNA damage.

Tools to Measure DNA Damage

DNA/RNA Oxidative Damage (High Sensitivity) ELISA Kit

Item No. 589320

Measure the major oxidative damage markers 8-hydroxy-2'-deoxyguanosine, 8-hydroxyguanosine, and 8-hydroxyguanine in a variety of sample types.

DNA/RNA Oxidative Damage (Clone 7E6.9) ELISA Kit

Item No. 501130

Measure the DNA oxidative damage marker 8-hydroxy-2'-deoxyguanosine and the RNA damage marker 8-hydroxyguanosine with equal selectivity and sensitivity.



Read our article to compare these assay kits side-by-side and choose the best one for your experiments at www.caymanchem.com/DNA-RNA-Damage

Complementary Assays

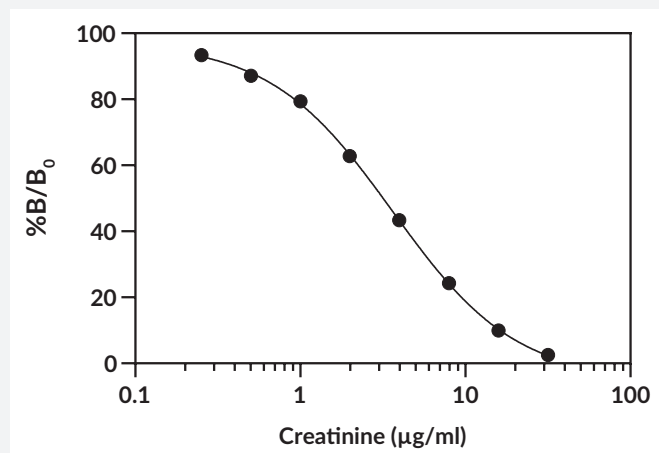
The concentration of urinary analytes may be impacted by hydration status. It is recommended that values obtained from urine samples be standardized to creatinine levels.

Creatinine ELISA Kit

Item No. 502330

FEATURES:

- Measure creatinine in plasma, serum, and urine samples
- Assay 24 samples in triplicate or 36 samples in duplicate
- Lower limit of detection is 0.27 µg/ml
- Results in 2.5 hours

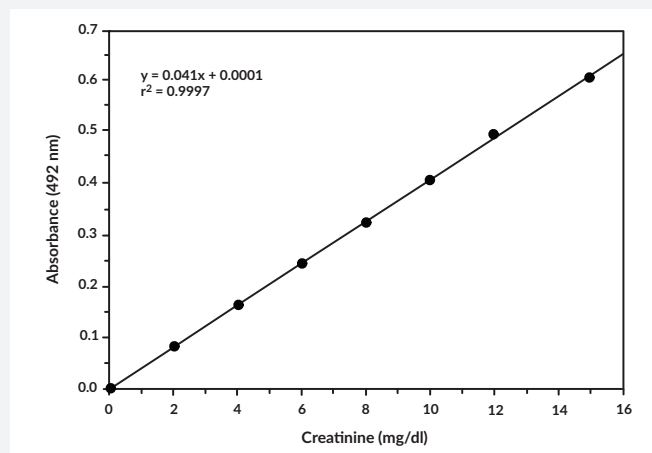


Creatinine (urinary) Colorimetric Assay Kit

Item No. 500701

FEATURES:

- Measure creatinine levels in urine
- Assay 40 samples in duplicate
- Measure creatinine levels down to 0.1 mg/dl
- Plate-based colorimetric measurement (490-500 nm)



Reactive Probes & Antibodies

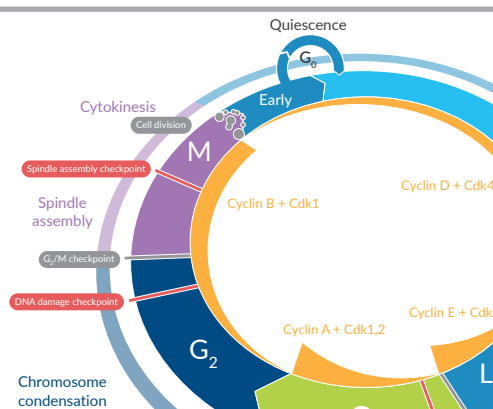
| Item No. | Product Name | Key Features |
|----------|--|---|
| 16952 | 4-Thiouracil | A photoactivatable probe used to detect RNA structures & nucleic acid-nucleic acid contacts |
| 10009350 | Aldehyde Reactive Probe (trifluoroacetate salt) | A biotinylated probe for detecting AP sites in damaged DNA |
| 20094 | DNA/RNA Oxidative Damage Monoclonal Antibody (Clone 7E6) | Host: Mouse · Reactivity: Species independent · Applications: Affinity purification, ELISA |
| 25781 | H2AX Phospho-Ser139 (1H2) Monoclonal Antibody | Host: Mouse · Reactivity: Human, mouse · Applications: ELISA, ICC, WB |
| 32183 | Histone H2AX (C-Term) Monoclonal Antibody | Host: Rabbit · Reactivity: Vertebrates · Applications: ELISA, ICC, multiplex assays, WB |

Cell Cycle & Viability Assay Kits

Cellular detection of DNA damage can activate cell cycle checkpoints in G₁ phase, S phase, and at the G₂/M transition to arrest the cell cycle and allow for DNA repair. Failure to repair DNA can force cells with damaged DNA to progress into mitosis, leading to mitotic catastrophe and cell death or senescence.

Cell Cycle Phase Determination Kit - Item No. 10009349

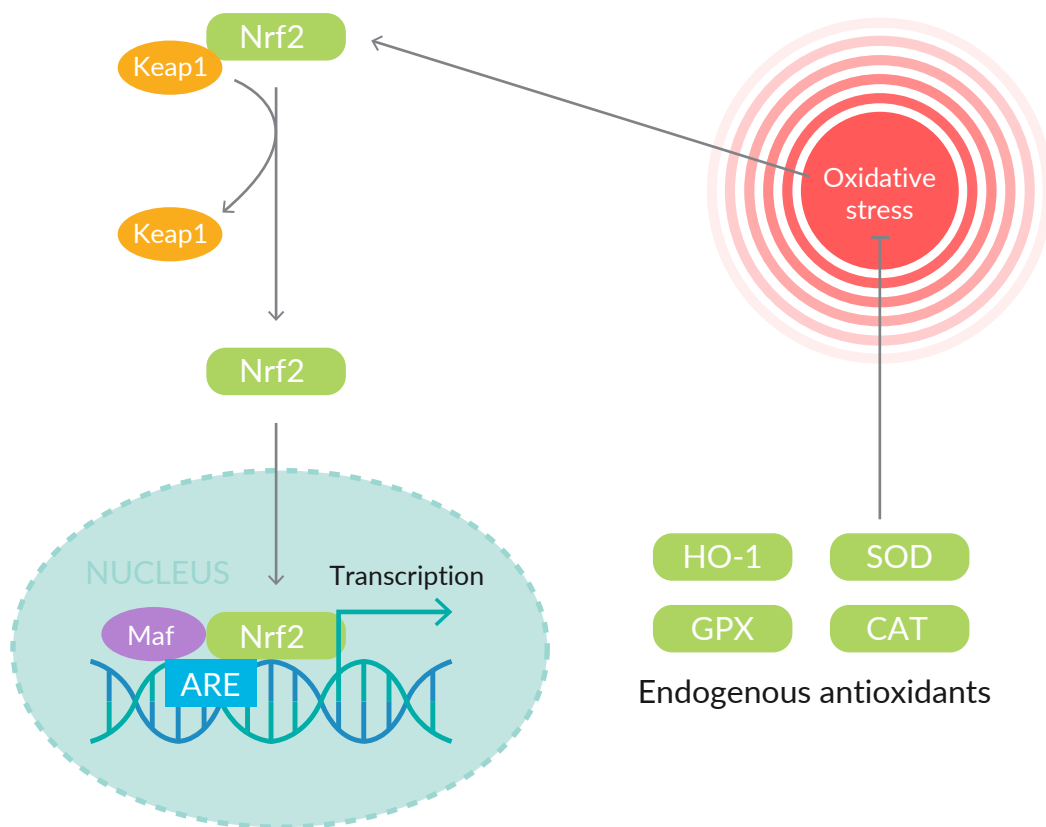
- Easy-to-use kit for flow cytometric analysis of cell cycle progression
- Determine the percentage of cells in G₀/G₁, G₂, or S phase



Browse all Cell Health & Viability Assays at www.caymanchem.com

ANTIOXIDANTS

The expression of many enzymatic antioxidants is regulated by nuclear factor erythroid 2-related factor 2 (Nrf2). In normal conditions, Nrf2 is associated with the repressor protein Keap1. Under oxidative stress, Keap1 is degraded and Nrf2 translocates to the nucleus, where it binds to antioxidant response elements (AREs) in the promoter regions of many genes encoding antioxidant enzymes to enhance their expression.



Enzymatic Antioxidant Assay Kits

| Item No. | Product Name | Format | Sample Types | Assay Range |
|----------|----------------------------------|---|---|--------------------|
| 707002 | Catalase Assay Kit* | Plate-based colorimetric assay (540 nm) | Plasma, serum, tissue homogenates, erythrocyte & cell lysates | 2-35 nmol/min/ml |
| 703102 | Glutathione Peroxidase Assay Kit | Plate-based colorimetric assay (340 nm) | Plasma, tissue homogenates, erythrocyte & cell lysates | 50-344 nmol/min/ml |
| 706002 | Superoxide Dismutase Assay Kit | Plate-based colorimetric assay (440-460 nm) | Plasma, serum, tissue homogenates, & cell lysates | 0.005-0.05 U/ml |

*Item No. 700910 is provided without H₂O₂ to our international customers with shipping restrictions

Nrf2 Transcription Factor Assay Kit

Item No. 600590

- A sensitive, non-radioactive method of detecting Nrf2 from whole cell lysates

SOD Mimetics

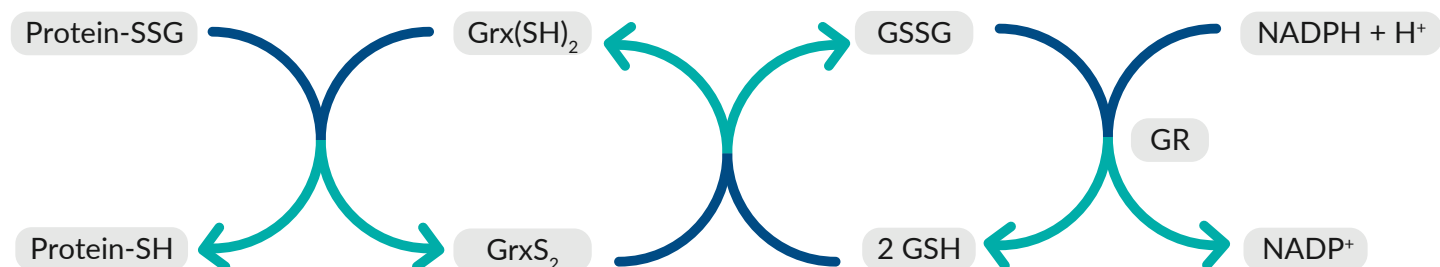
| Item No. | Product Name | Key Features |
|----------|----------------------|---------------------------------------|
| 31112 | Imisopasem Manganese | A non-peptide SOD mimetic |
| 18796 | MitoTEMPOL | A mitochondrial-targeting SOD mimetic |
| 27051 | TEMPOL | A spin label & SOD mimetic |

Glutaredoxin & Thioredoxin

The glutaredoxin (Grx) and thioredoxin (Trx) systems balance cellular redox status.

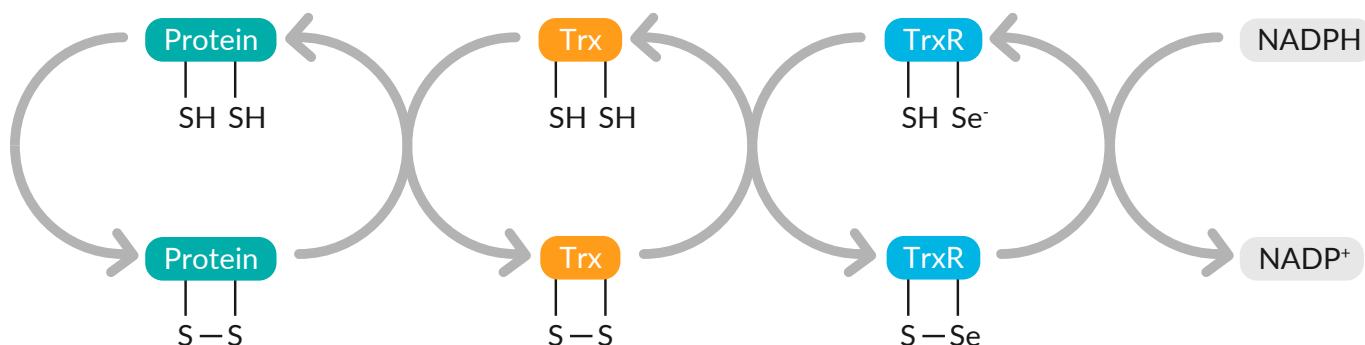
Glutaredoxin System

Grx catalyzes the deglutathionylation of glutathionylated proteins and the reduction of protein disulfides. Oxidized Grx (GrxS_2) is reduced ($\text{Grx}(\text{SH})_2$) by glutathione (GSH), which produces GSSG, the oxidized form of GSH. GSSG is reduced back to GSH by glutathione reductase (GR) at the expense of NADPH. The GSH:GSSG ratio is often used as a marker of oxidative stress.



Thioredoxin System

Trx is responsible for the reduction of protein disulfides. Upon reduction of oxidized protein disulfides, Trx is oxidized. Oxidized Trx ($\text{Trx}(\text{S}_2)$) is restored to its reduced state by thioredoxin reductase (TrxR) at the expense of NADPH.



Enzymatic Antioxidant Assay Kits

| Item No. | Product Name | Format | Sample Types | Assay Range |
|----------|---|---|---|---|
| 703002 | Glutathione Assay Kit | Plate-based colorimetric assay (405-414 nm) | Plasma, serum, cell & erythrocyte lysates, & tissue homogenates | 0.5-16 μM (GSH) or 0.25-8 μM (GSSG) |
| 500239 | Glutaredoxin Fluorometric Activity Assay Kit | Plate-based fluorometric assay (Ex/Em = 520/560 nm) | Cell lysates & tissue samples | 0.066 \pm 0.013 $\mu\text{M}/\text{min}$ |
| 703202 | Glutathione Reductase Assay Kit | Plate-based colorimetric assay (340 nm) | Plasma, cell & erythrocyte lysates, & tissue homogenates | 20 U/ml |
| 500228 | Thioredoxin Fluorometric Activity Assay Kit | Plate-based fluorometric assay (Ex/Em = 520/560 nm) | Cell lysates | 0.01 \pm 0.002 $\mu\text{M}/\text{min}$ |
| 10007892 | Thioredoxin Reductase Colorimetric Assay Kit* | Plate-based colorimetric assay (405-414 nm) | Tissue homogenates & cell lysates | 0.08 U/ml |

*Item No. 11529 is available as a fluorometric alternative

Natural Product Antioxidants

| Item No. | Product Name | Key Features |
|----------|------------------------------|---|
| 70935 | (-)-Epigallocatechin Gallate | A phenol with diverse biological activities |
| 26758 | (±)-β-Tocopherol | A form of vitamin E |
| 10004235 | cis-Resveratrol | A phenolic antioxidant in red wine |
| 14656 | L-Ascorbic Acid | A reducing agent |
| 70945 | Lycopene | A natural carotenoid |
| 20261 | N-acetyl-L-Cysteine | An antioxidant & GSH precursor |
| 70675 | trans-Resveratrol | A polyphenol with diverse biological activities |
| 10008377 | α-Tocotrienol | An antioxidant with neuroprotective properties |
| 16837 | β-Carotene | An antioxidant & vitamin A precursor |

View additional natural product antioxidants online at www.caymanchem.com

Synthetic Antioxidants

| Item No. | Product Name | Key Features |
|----------|----------------|-------------------------------------|
| 89910 | BHT | A synthetic antioxidant |
| 17730 | Liproxstatin-1 | An inhibitor of lipid peroxidation |
| 89950 | Mitoquinol | A mitochondria-targeted antioxidant |
| 10011659 | Trolox | A vitamin E derivative |

Antioxidant Activity Probes

| Item No. | Product Name | Key Features |
|----------|----------------------|--|
| 27317 | ABTS (ammonium salt) | Used to assess antioxidant capacity in the Trolox equivalent antioxidant capacity (TEAC) assay |
| 14805 | DPPH | A colorimetric probe (515 nm) for free radical scavengers |
| 27089 | STY-BODIPY | An indicator of radical-trapping antioxidant activity |

Assay Kits for Antioxidants

Antioxidant Assay Kit - Item No. 709001

- Measure the total antioxidant capacity of a variety of sample types in Trolox equivalents
- Plate-based colorimetric assay (405 or 750 nm)

Ascorbate Assay Kit - Item No. 700420

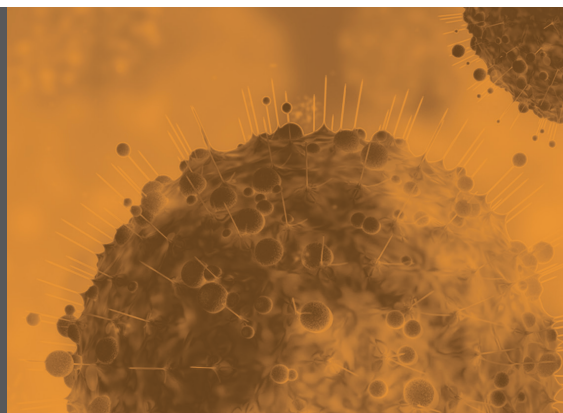
- Quantify ascorbate from plasma, serum, urine, & fruit juice
- Plate-based fluorometric assay (Ex/Em = 340-350/420-430 nm)

CELL DEATH MECHANISMS & DETECTION TOOLS GUIDE

Assess the ultimate consequence of oxidative injury with a cell death assay. This guide can help you determine the cell death mechanism(s) occurring in your experiment.

www.caymanchem.com/celldeath

[DOWNLOAD THE GUIDE](#)



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