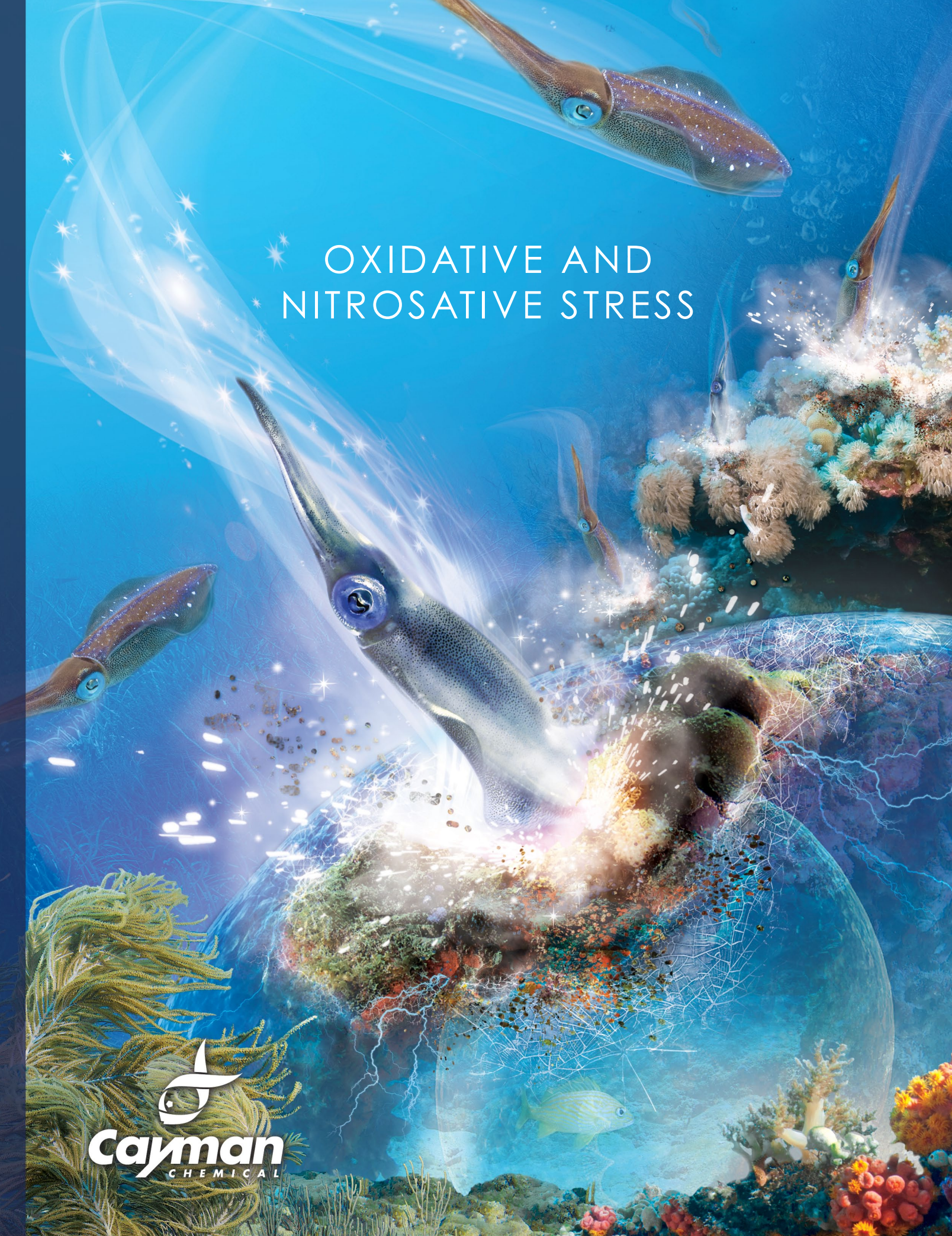
OXIDATIVE AND
NITROSATIVE STRESS
Cayman
CHEMICAL

Thomas G. Brock, Ph.D.
&
Kirk M. Maxey, M.D.

Introduction to Oxidative Injury

Oxidative and nitrosative stresses are fundamental forces of human physiology and are obligate manifestations of the biochemistry of life. An ongoing issue centers on how to define and measure these stresses. Our cover for this catalog uses marine imagery to evoke the dynamic nature of focused stress at the cell surface. A more imaginative interpretation brings to mind the well-known superconducting quantum interference devices (SQUIDs), which are used to measure magnetic fields in diverse settings, including the brain, heart, and lung. SQUID-based magnetoencephalography is a cutting-edge approach for assessing neuronal functionality during oxidative stress, as may occur in acute ischemic stroke. This non-invasive method for linking stresses with changes in functionality is currently being developed to study developmental and pathological events in humans.

A more biochemical definition of oxidative stress is failure by the cell to properly manage the generation and quenching of reactive free radicals that are essential to respiration and immunologic defense. This failure manifests in chemical modification of 3 basic biomolecules: proteins, lipids, and chromatin. Depletion of our network of antioxidant defenses precedes this damage, and is a sentinel warning of oxidative stress. Cayman Chemical's 8-Isoprostane EIA Kit is one of the most popular methods for quantifying oxidative stress. It has been used to measure 8-isoprostane levels in plasma, serum, urine, exhaled breath condensate, bronchoalveolar lavage, induced sputum, and cell culture media. Of course, 8-isoprostane levels more specifically reflect lipid peroxidation, which occurs during oxidative stress. Cayman offers additional assays to evaluate other processes, such as oxidative damage to DNA (see our 8-hydroxy-2-deoxy Guanosine EIA Kit). Cayman's Glutathione Assay Kit, S-Nitrosylated Protein Detection Kit, and Lipid Hydroperoxide (LPO) Assay Kit can be found within pages 18 to 29 along with many others.

As always, Cayman's goal is to make your research possible. If you can't find the chemicals, assay kits, recombinant proteins, or antibodies that you need in this catalog or on our website (caymanchem.com), please contact us to determine how we can help.

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abbreviations

cAMP	Adenosine 3′,5′-cyclic monophosphate
BLT	Leukotriene B Receptor
BSA	Bovine Serum Albumin
CB	Cannabinoid
COX	Cyclooxygenase
CRTH2	Chemoattractant Receptor-homologous Molecule Expressed on Th2 Cells
CYP450	Cytochrome P450
CysLT	Cysteinyl Leukotriene
DHA	Docosahexaenoic Acid
DP	D-type Prostanoid Receptor
DTNB	5,5′-Dithio-*bis*-(2-nitrobenzoic acid); Ellman's Reagent
DTT	Dithiothreitol
EDTA	Ethylenediaminetetraacetic Acid
EIA	Enzyme Immunoassay
EP	Prostaglandin E_2 Receptor
EPA	Eicosapentaenoic Acid
FAAH	Fatty Acid Amide Hydrolase
FC	Flow Cytometry
FITC	Fluorescein Isothiocyanate
FP	Prostaglandin $F_{2\alpha}$ Receptor
FPIA	Fluorescence Polarization Immunoassay
cGMP	Guanosine 3′,5′-cyclic monophosphate
GPCR	G Protein-Coupled Receptor
H_2S	Hydrogen Sulfide
ICC	Immunocytochemistry
IgG	Immunoglobulin G
IHC	Immunohistochemistry
IL	Interleukin
IP	Immunoprecipitation
LO	Lipoxygenase
LPS	Lipopolysaccharide
LT	Leukotriene
LX	Lipoxin
MPO	Myeloperoxidase
NF-κB	Nuclear Factor-κB
NO	Nitric Oxide
NOS	Nitric Oxide Synthase
NSAID	Non-steroidal Anti-inflammatory Drug
PAF	Platelet-Activating Factor
PAF-AH	PAF Acetylhydrolase
PBS	Phosphate Buffered Solution
PDE	Phosphodiesterase
PE	Phycoerythrin
PG	Prostaglandin
PGES	Prostaglandin E Synthase
PL	Phospholipase
$cPLA_2$	Calcium-dependent Cytosolic Phospholipase A_2
$iPLA_2$	Calcium-independent Phospholipase A_2
$sPLA_2$	Secretory Phospholipase A_2
PMNL	Polymorphonuclear Leukocyte
PPAR	Peroxisome Proliferator-activated Receptor
PUFA	Polyunsaturated Fatty Acid
S1P	Sphingosine 1-phosphate
SRS-A	Slow-Reacting Substance of Anaphylaxis
TMPD	N,N,N′,N′-Tetramethyl-p-Phenylenediamine
TNF-α	Tumor Necrosis Factor-α
TNFR	Tumor Necrosis Factor Receptor
TP	Thromboxane Receptor
TX	Thromboxane
VR	Vanilloid Receptor
WB	Western Blot

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Thomas G. Brock, Ph.D.

Radiation Linked to Oxidative Injury

Radiation can be divided into two primary categories: ionizing and non-ionizing. The latter includes microwaves, which are relatively low energy and evoke effects primarily through heating. Ionizing radiation, on the other hand, has sufficient energy to displace electrons from atoms or molecules, producing ions. Ultraviolet light, X-rays, and gamma rays, as were released from the Fukushima Daiichi nuclear power plant disaster in Japan recently, are examples of ionizing radiation. Other interesting considerations include collateral effects arising during radiation treatment for cancer and exposure in the laboratory resulting from radiation used for research purposes.

While there are many types of ionizing radiation (*e.g.*, α, β, and γ radiation), the key effect is the ejection of electrons. Atoms or molecules with unpaired electrons are referred to as 'radicals', often termed 'free radicals'. The unpaired electrons generally cause radicals to be highly chemically reactive. In biological systems, this means that ionizing radiation can directly damage all types of molecules (*e.g.*, DNA, proteins, lipids) or the effect may be secondary to the generation of free radicals, which react with nearby molecules. As described below, this may range from a good, or even necessary, action to a deleterious (*i.e.*, lethal) event. Radicals tend to attack double bonds, favoring carbonyl, vinyl, and phenolic groups that are common on antioxidants. While radicals are typically highly reactive, some are more stable or persistent. For example, the radical derived from α-tocopherol (vitamin E) is long-lived. As a result, vitamin E, a well known antioxidant because of its ability to react with free radicals, may instead be converted by ionizing radiation to a radical form.

Reactive Oxygen Species

Many cells synthesize the reactive oxygen species (ROS) superoxide, O_2^-, enzymatically by an NADPH oxidase complex. Superoxide is also generated as a by-product of mitochondrial respiration. Superoxide is efficiently metabolized by a family of superoxide dismutases (SOD) to produce oxygen and hydrogen peroxide (Figure 1). Hydrogen peroxide, in turn, is converted by catalase to water and oxygen *via* hydroxyl radical. In humans, there are three distinct SOD genes and gene products (soluble (cytoplasmic) SOD1, mitochondrial SOD2, and extracellular SOD3); the ubiquitous catalase occurs as a single form. The formation and elimination of ROS by this pathway involves the sequential addition of electrons. Ionizing radiation, on the other hand, involves the removal of an electron from water, producing the highly reactive hydroxyl radical. This can be followed, to a lesser extent, by further electron ejection to give H_2O_2.

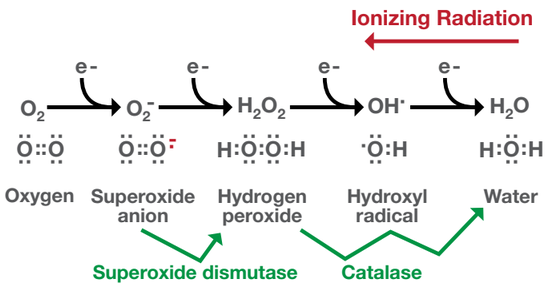

Figure 1. Formation and elimination of ROS

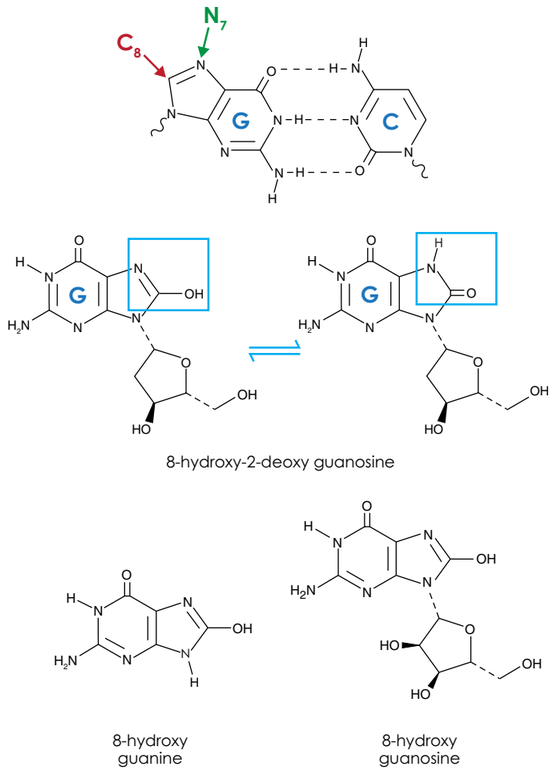

Figure 2. Oxidative damage to nucleotides: focus on guanosine

In concert with SOD, catalase, and other enzymes, antioxidants react with ROS to take them out of play. One of the most important natural antioxidants is glutathione, a tripeptide composed of glycine, cysteine, and glutamine. Normally, glutathione is maintained in a reduced form through the activity of glutathione reductase, which is constitutively active. As a result, the thiol group of the cysteine within glutathione is protonated, with reduced glutathione being abbreviated as GSH. This thiol group is able to donate a reducing equivalent to reactive molecules, including ROS. Upon donating an electron, glutathione itself becomes reactive, joining similarly oxidized molecules to produce the glutathione disulfide (GSSG). Cayman carries a Glutathione Assay Kit (Item No. 703002) as well as a variety of assay kits for enzymes which process glutathione (see pages 19,20).

DNA Damage

The effects of ionizing radiation can be divided into direct and indirect. Each has distinct ramifications. Radiation can directly disrupt DNA, introducing isolated nucleotide damage, double-strand breaks, or clustered DNA damage. Each type of damage induces its own type of repair pathway. For example, double-strand breaks are mended by homologous recombination if the damage is minimal, but nonhomologous end-joining may occur if the radiation damage produces large or multiple strand breaks. The steps involved in repairing DNA that has been directly damaged by ionizing radiation are complicated, although the basic processes are well-understood.

ROS, produced by ionizing radiation, also damage DNA. The most vulnerable site for oxidative damage on DNA is on guanosine and, specifically on carbon-8 (Figure 2). Note that this site is not normally involved in bonding between guanosine and cytosine. As a result, it can be attacked in both single- and double-stranded DNA. The abstraction of a proton from carbon 8 leads to the production of 8-OH-dG. Tautomerization with nitrogen-7 produces 8-oxo-2-deoxyguanosine (8-oxo-dG), in reference to the carbonyl group at C8; the term 8-oxo-dG is used interchangeably with 8-OH-dG. Other bases can undergo oxidative damage as well. Interestingly, the other purine, adenosine, can be oxidized on either carbon-2 or -8. The pyrimidines typically are hydroxylated on carbon-5.

Consequent to this DNA damage is base excision repair, which involves removal and replacement of the oxidized base from the sugar-phosphate backbone.[1] The result is the generation of free 8-hydroxy guanine (referred to as either 8-OH-G or 8-OH-Gua). This product is uncharged and thought to be readily secreted from intact cells; it is unclear whether this requires endosomal packaging. Like DNA, RNA can be damaged by reactive oxygen and reactive nitrogen species. A common product of RNA oxidative damage is 8-hydroxy guanosine (8-OH-Guo). Similarly, individual nucleotides can be oxidized: GTP can become 8-OH GTP. Cayman offers an 8-hydroxy-2-deoxy Guanosine EIA Kit (Item No. 589320) for evaluating oxidative damage of DNA (see page 21).

Lipid Damage

The direct effects of ionizing radiation on lipids are less significant, compared to those on DNA: a damaged lipid molecule is easily replaced, whereas damaged DNA must be repaired. The indirect damage of lipids by radiation-induced ROS, however, can be devastating. In membranes, nature has created the ideal setting for a remarkable chain reaction. One important attribute of the membrane is its localized chemistry. Of course, membrane phospholipids commonly have a PUFA in the *sn*-2 position. These may be any of the medium to long chain fatty acids, with variable numbers or positions of the sites of unsaturation. Significantly, pairs of double bonds on PUFAs are always separated by an intervening methylene group (Figure 3). This configuration makes a hydrogen atom on the methylene group very reactive, so it is readily abstracted by a free radical. The removal of this hydrogen is the initiating step in lipid peroxidation, and the product itself is a fatty acid radical. Molecular oxygen can then react with the lipid radical to produce an unstable peroxyl fatty acid.

This brings to bear the second important attribute of membranes: the abundance and proximity of PUFAs. These fatty acids contribute to membrane fluidity. However, adjacent PUFAs make very nice hydrogen atom donors from the reactive methylene groups to stabilize peroxyl-fatty acids. While this stabilizes the peroxyl by formation of a peroxide on the first lipid, the adjacent fatty acid now contains a radical that can react with oxygen, propagating the chain reaction. In this way, regions of membranes can be rapidly oxidized unless something terminates the cycle. Chemicals that act as antioxidants can effectively terminate the peroxidase chain reaction.

Hormesis

An important concept in toxicology, which also applies to radiation biology as well as physiology in general, is hormesis. Hormesis is defined by Merriam-Webster as "a theoretical phenomenon of dose-response relationships in which something (as a heavy metal or ionizing radiation) that produces harmful biological effects at moderate to high doses may produce beneficial effects at low doses". In fact, hormesis has strong scientific proponents. Over 20 years ago, a group of scientists, representing federal, industrial, and academic interests, formed the Biological Effects of Low Level Exposures (BELLE) Advisory Committee. From the beginning it was clear that 'biological systems have an impressive array of adaptations that may be turned on in response to various stresses, including physiological stress, as well as exposure to radiation, toxic chemicals, and dietary alterations (belleonline.com). The key concept centers on the adaptive response to an initial, low level cue, which leads to tolerance to subsequent stimuli. For example, ischemic preconditioning (defined, generally, as producing resistance to the loss of oxygen in tissues) is so effective in reducing ischemia/reperfusion injury following surgery that the current question centers on the best of many methods.[2] In fact, the initial cue can be the same as (homologous) or different from (heterologous) the subsequent stimulus.[3] Thus, ischemic preconditioning can be achieved by ischemia, by antioxidants, or by trimetazidine, a fatty acid oxidation inhibitor. With respect to radiation, there is conflicting evidence as to whether low-level, whole body irradiation can be protective or is uniformly deleterious.[4] Recent reports from BELLE summarize the extensive literature demonstrating the beneficial health effects of low-level exposures to ionizing radiation, as well as reasons why these studies are poorly appreciated.[5-7] Clearly, additional research is necessary.

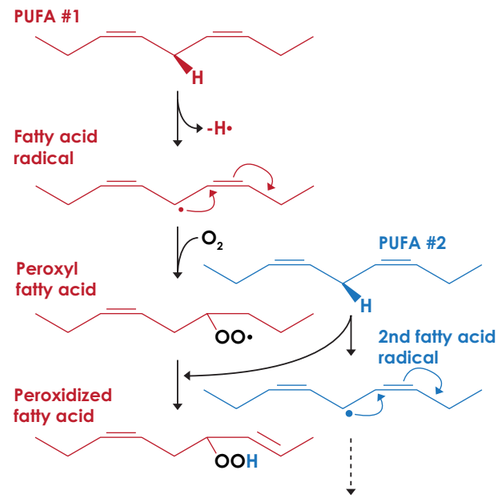

Figure 3. The lipid peroxidation chain reaction

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2. Theodoraki, K., Tympa, A., Karmaniolou, I., *et al. Surg. Today* **41,** 620-629 (2011).
3. Wiegant, F.A.C., Prins, H.A.B., and Wijk, R.V. *Dose Response* **9,** 209-224 (2011).
4. Vaiserman, A.M. *Dose Response* **8,** 172-191 (2010).
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6. Jaworowski, Z. *Hum. Exp. Toxicol.* **29,** 263-270 (2010).
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Antibodies

CD36 Monoclonal Antibody (Clone JC63.1) 188150

GPIIIb, GPIV, Hexarelin Receptor, oxLDL Receptor, Thrombospondin Receptor
Purified IgA **Stability:** ≥1 year at -20°C
Summary: Antigen: adenovirus expressing full-length mouse recombinant CD36 • Host: CD36 null mouse, clone JC63.1 • Cross Reactivity: (+) mouse, rat, and human CD36 • Application(s): FC and functional blocking • Functioning as a receptor for oxidized LDL, CD36 is a type-B scavenger receptor that is necessary for the formation of foam cells in atherosclerotic lesions.

100 µg
500 µg

CD36 Monoclonal Antibody (Clone JC63.1) (azide free) 10009893

GPIIIb, GPIV, Hexarelin Receptor, oxLDL Receptor, Thrombospondin Receptor
Purified IgA **Stability:** ≥1 year at 4°C
Summary: Antigen: recombinant adenovirus expressing full-length mouse CD36 • Host: CD36 null mouse, clone JC63.1 • Cross Reactivity: (+) human, mouse, and rat CD36 • Application(s): FC, functional blocking, and ICC • Functioning as a receptor for oxidized LDL, CD36 is a type-B scavenger receptor that is necessary for the formation of foam cells and thereby atherosclerotic lesions.

100 µg
500 µg

CD36 Monoclonal FITC Antibody (Clone JC63.1) 10009870

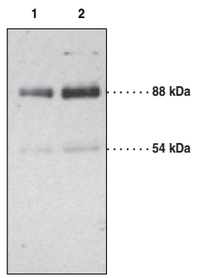
GPIIIb, GPIV, Hexarelin Receptor, oxLDL Receptor, Thrombospondin Receptor
Purified IgA-FITC **Stability:** ≥1 year at -20°C
Summary: Antigen: recombinant adenovirus expressing full-length mouse CD36 • Host: CD36 null mouse, clone JC63.1 • Cross Reactivity: (+) mouse, rat, and human CD36 • Application(s): FC and ICC • Functioning as a receptor for oxidized LDL, CD36 is a type-B scavenger receptor that is necessary for the formation of foam cells and thereby atherosclerotic lesions.

1 ea

CD36 Polyclonal Antibody 100011

GPIIIb, GPIV, Hexarelin Receptor, oxLDL Receptor, Thrombospondin Receptor
Peptide affinity-purified IgG **Stability:** ≥1 year at -20°C
Summary: Antigen: human CD36 amino acids 99-114 • Host: rabbit • Cross Reactivity: (+) human, mouse, and rat CD36 • Application(s): WB • Functioning as a receptor for oxidized LDL, CD36 is a type-B scavenger receptor that is necessary for the formation of foam cells in atherosclerotic lesions.

1 ea



Lane 1: Human platelet lysate (15 µg)
Lane 2: Human platelet lysate (30 µg)

•Also Available: **CD36 Blocking Peptide (300011)**

Cu/Zn SOD (human) Polyclonal Antibody 10011388

Cu/Zn Superoxide Dimutase, SOD1
Affinity-purified **Stability:** ≥1 year at -20°C
Summary: Antigen: human Cu/Zn SOD • Host: rabbit • Cross Rreactivity: (+) human, mouse, bovine, monkey, coral, canine, hamster, porcine, rabbit, ovine, and rat Cu/Zn SOD • Applications: EIA, IHC, IP, and WB • SOD1 contains Cu and Zn ions as a homodimer and exists in the cytoplasm where it plays a major role in antioxidant defense mechanisms by catalyzing the dismutation of the superoxide radical O_2^- to O_2 and H_2O_2.

25 µl
100 µl

Cu/Zn SOD (rat) Polyclonal Antibody 10011387

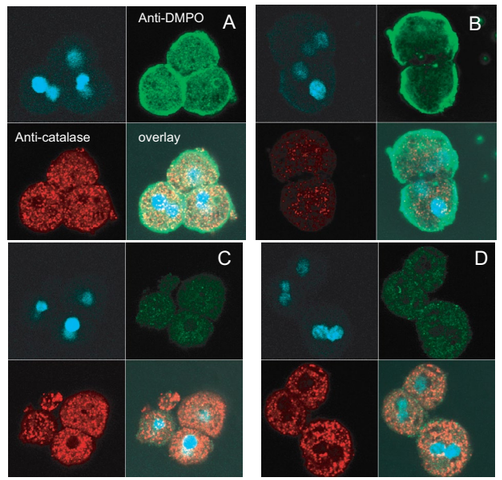
Cu/Zn Superoxide Dimutase, SOD1
Affinity-purified **Stability:** ≥1 year at -20°C
Summary: Antigen: rat Cu/Zn SOD • Host: rabbit • Cross Reactivity: (+) human, mouse, bovine, and rat Cu/Zn SOD • Applications: IHC, IP, and WB • SOD1 contains Cu and Zn ions as a homodimer and exists in the cytoplasm where it plays a major role in antioxidant defense mechanisms by catalyzing the dismutation of the superoxide radical O_2^- to O_2 and H_2O_2.

25 µl
100 µl

DMPO Nitrone Adduct Polyclonal Antiserum 10006170

5,5-Dimethyl-1-Pyrroline-N-Oxide Nitrone Adduct
Antiserum **Stability:** ≥2 years at -20°C
Summary: Antigen: DMPO coupled to ovalbumin • Host: rabbit • Cross Reactivity: species independent • Application(s): ELISA, ICC, and WB • Proteins with endogenous peroxidase activity are susceptible to forming radical adducts. Immunodetection of spin trap products allows a higher level of sensitivity and throughput with greatly reduced sample consumption.

96 wells



Representative confocal microscopy images of the colocalization of catalase (red stain) and protein-DMPO adducts (green stain) obtained by treating mouse hepatocytes (2.5 x 10^6 cells/ml) with HOCl. (**A**) cells were treated with three pulses of HOCl (50 mM, 30-minute intervals) in the presence of DMPO; (**B**) same as A, hepatocytes from catalase knockout mice were used; (**C**) same as B, but in the absence of DMPO; (**D**) same as B, but in the absence of HOCl. (Courtsey of M.G. Bonini et al. FRBM **42** (2007) 530-540.)

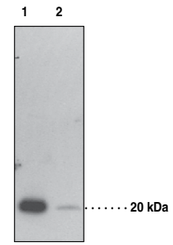
DNA/RNA Damage Monoclonal Antibody (Clone 15A3) 10011446

Protein G-purified **Stability:** ≥1 year at -20°C
Summary: Antigen: 8-hydroxy guanosine-BSA and casein conjugates • Host: mouse, clone 15A3 • Cross Reactivity: (+) 8-hydroxy-2-deoxy guanosine, 8-hydroxy guanine, and 8-hydroxy guanosine • Applications: ELISA, IHC, and immunoaffinity columns • Isotype: IgG_{2a} • 8-hydroxy guanine, 8-hydroxy-2'-deoxy guanosine, and 8-hydroxy guanosine are all RNA and DNA markers of oxidative damage. 8-hydroxy-2'-deoxy guanosine, produced by RONS including hydroxyl radical peroxynitrite, induces G to T transversions, which is one of the most frequent somatic mutations. 8-hydroxy guanine DNA base damage arises from radical-induced hydroxylation and cleavage reactions of the purine ring. 8-hydroxy guanosine also induces a mutagenic transversion of G to T in DNA.

GPx4 Polyclonal Antibody 10005258

Glutathione Peroxidase 4, PhGPx
Peptide affinity-purified IgG **Stability:** ≥1 year at -20°C
Summary: Antigen: human GPx4 amino acids 81-93 • Host: rabbit • Cross Reactivity: (+) mouse, rat, and porcine GPx4; other species not tested • Application: WB • GPx4 is found primarily in the testis where it functions both to protect membrane phospholipids from oxidation in spermatids and as an insoluble structural protein in mature spermatozoa.

500 µl



Lane 1: Rat testis (30 µg)
Lane 2: Mouse brain (30 µg)

HIF-1α Monoclonal Antibody (Clone H1α67) 10347

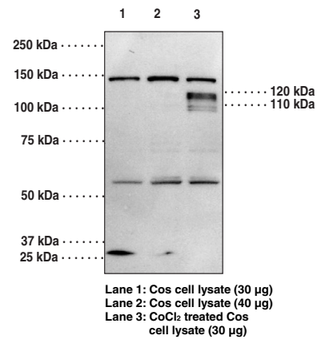
Hypoxia Inducible Factor-1α
Protein-A purified IgG_{2b} **Stability:** ≥1 year at -20°C
Summary: Antigen: human HIF-1α amino acids 432-528 • Host: mouse • Cross Reactivity: (+) ferret, human, mouse, and ovine HIF-1α • Application(s): IHC and WB • HIF-1α is a transcription factor that accumulates under low-oxygen conditions and helps to drive the production of stress-adaptive proteins.

1 ea

HIF-1α (C-Term) Polyclonal Antibody 10006421

Hypoxia Inducible Factor-1α
Protein G-purified IgG **Stability:** ≥1 year at -20°C
Summary: Antigen: HIF-1α C-terminal amino acids 809-826 • Host: rabbit • Cross Reactivity: (+) human, mouse, and simian HIF-1α • Application(s): (+) WB; (-) ICC and IP • HIF-1α is a transcription factor that accumulates under low-oxygen conditions. Following hypoxic stimulus and cytoplasmic accumulation, HIF-1α migrates to the nucleus where, with other transcription factors, it drives the production of stress-adaptive proteins. This response is essential for maintenance of normal oxidative physiology; however, overexpression in cancer cells promotes tumor survival.

1 ea



Lane 1: Cos cell lysate (30 µg)
Lane 2: Cos cell lysate (40 µg)
Lane 3: $CoCl_2$ treated Cos cell lysate (30 µg)

•Also Available: **HIF-1α (C-Term) Blocking Peptide (300003)**

HIF-2α Polyclonal Antibody 13505

Hypoxia Inducible Factor-2α
Protein G-purified IgG **Stability:** ≥1 year at -20°C
Summary: Antigen: synthetic peptide from human HIF-2α amino acids 426-443 • Host: rabbit • Cross Reactivity: (+) human HIF-2α • Application(s): WB • The hypoxia inducible factors (HIF-1α and HIF-2α) are transcription factors that directly respond to hypoxic stress. After exposure of normal and cancer cells to hypoxia, a rapid increase of HIF-1α and HIF-2α heterodimerization with the HIF-1α protein (ARNT) occurs, leading to increased transcription of HIF target genes.

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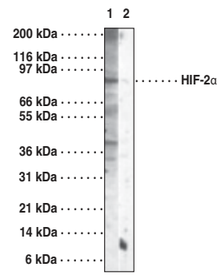


Lane 1: $CoCl_2$-Treated HeLa cell lysate
Lane 2: Untreated HeLa cell lysate

Mn SOD (human) Polyclonal Antibody 10011390

Manganese Superoxide Dismutase, SOD2
Affinity-purified antibody **Stability:** ≥1 year at -20°C
Summary: Antigen: human Mn SOD • Host: rabbit • Cross Reactivity: (+) human, rat, mouse, bovine, canine, chicken, gerbil, guinea pig, porcine, hamster, monkey, rabbit, ovine, and *Xenopus* Mn SOD • Application(s): IHC, IP, and WB • SOD2 is a manganese-containing enzyme in the mitochondrial matrix that catalyzes the dismutation of the superoxide radical O_2^- to O_2 and H_2O_2.

25 µl
100 µl

Mn SOD (rat) Polyclonal Antibody 10011389

Manganese Superoxide Dismutase, SOD2
Affinity-purified antibody **Stability:** ≥1 year at -20°C
Summary: Antigen: rat Mn SOD • Host: rabbit • Cross Reactivity: (+) human, rat, mouse, bovine, canine, chicken, *Drosophila*, guinea pig, porcine, hamster, monkey, rabbit, ovine, and *Xenopus* Mn SOD • Application(s): EIA, IHC, IP, and WB • SOD2 is a manganese-containing enzyme in the mitochondrial matrix that catalyzes the dismutation of the superoxide radical O_2^- to O_2 and H_2O_2.

25 µl
100 µl

Nitrotyrosine Monoclonal Antibody 189542

Purified IgG, lyophilized **Stability:** ≥2 years at -20°C
Summary: Antigen: peroxynitrite-treated KLH • Host: mouse • Isotype: IgG_{2b} • Application(s): EIA, IHC, IP, and WB • The presence of nitrotyrosine on proteins can be used as a marker for peroxynitrite formation *in vivo*. Nitrotyrosine has been shown to be present in proteins from a variety of clinical conditions including atherosclerotic lesions of human coronary arteries, postischemic heart, and placenta during preeclampsia.

50 µg
200 µg

Nitrotyrosine Monoclonal Antibody - Biotinylated 10006966

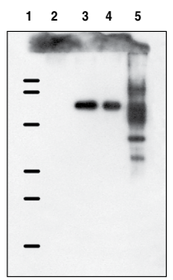
Peptide affinity-purified IgG **Stability:** ≥1 year at -20°C
Summary: Antigen: peroxynitrite-treated KLH • Host: mouse • Cross Reactivity: (+) species independent detection of nitrotyrosine; ≤5% chlorotyrosine • Application(s): ELISA, IHC, IP, and WB • Cayman Chemical's biotinylated nitrotyrosine monoclonal antibody can be used for the species-independent detection of nitrotyrosine using a variety of immunochemical techniques. Biotinylation of the antibody allows for detection using avidin-enzyme or avidin-fluorophore conjugates and provides approximately 2-fold better sensitivity compared to the unbiotinylated antibody (Item No. 189542).

100 µg

Nitrotyrosine Polyclonal Antibody 10189540

Affinity-purified IgG **Stability:** ≥2 years at -20°C
Summary: Antigen: peroxynitrite-treated KLH • Host: rabbit • Application(s): WB • The presence of nitrotyrosine on proteins can be used as a marker for peroxynitrite formation *in vivo*. Nitrotyrosine has been shown to be present in proteins from a variety of clinical conditions including artherosclerotic lesions of human coronary arteries, postischemic heart, and placenta during preeclampsia.

1 ea



Lane 1: Low molecular weight standards
Lane 2: BSA (2 µg)
Lane 3: Peroxynitrite-treated BSA (40 ng)
Lane 4: Peroxynitrite-treated BSA (20 ng)
Lane 5: Peroxynitrite-treated cell lysate (38 ng)

Nitrotyrosine (Peptide) Polyclonal Antibody 10006778

Peptide affinity-purified IgG **Stability:** ≥1 year at -20°C
Summary: Antigen: nitrotyrosine-containing synthetic peptide • Host: rabbit • Cross Reactivity: (+) nitrotyrosine (species independent) less than 10% reactivity with chlorotyrosine; (-) synthetic peptide containing unmodified tyrosine • Application(s): WB • Cayman's nitrotyrosine (peptide) polyclonal antibody has been carefully prepared by affinity-purification to exclude non-nitrotyrosine antibodies generated against the antigenic peptide backbone.

500 µl

eNOS Polyclonal Antiserum 160880

ecNOS, Endothelial Nitric Oxide Synthase, NOS III
Lyophilized antiserum **Stability:** ≥2 years at -20°C
Summary: Antigen: human eNOS amino acids 1186-1203 • Host: rabbit • Cross Reactivity: (+) bovine and human eNOS; (-) iNOS and nNOS • Application(s): IP and WB • eNOS catalyzes the formation of NO from L-arginine in many cell types including vascular endothelium, bronchiolar epithelium, cardiac myocytes, spleen, and kidney.

1 ea

• Also Available: **eNOS Blocking Peptide** (360881)

iNOS Polyclonal Antibody 160862

Inducible Nitric Oxide Synthase, NOS II
Protein A-purified IgG, lyophilized **Stability:** ≥3 years at -20°C
Summary: Antigen: purified enzyme from mouse macrophages (RAW 264.7 cells) • Host: rabbit • Cross Reactivity: (+) iNOS from most mammalian species and nNOS (~5%); (-) eNOS • Application(s): ICC, IP, and WB • NOS catalyzes the biosynthesis of nitric oxide from L-arginine. iNOS is a soluble enzyme found in a variety of tissues including macrophages, hepatocytes, vascular smooth muscle cells, and chondrocytes. iNOS expression is increased by a variety of factors including LPS, IFN-γ, IL-1β, and TNF-α.

1 ea

nNOS Polyclonal Antibody 160870

ncNOS, Neuronal Nitric Oxide Synthase, NOS I
Peptide affinity-purified IgG **Stability:** ≥1 year at -20°C
Summary: Antigen: human nNOS amino acids 1422-1433 • Host: rabbit • Cross Reactivity: (+) rat and human nNOS; (-) iNOS and eNOS • Application(s): ICC, IHC, IP, and WB • NOS catalyzes the oxidation of arginine to nitric oxide and citrulline. nNOS is a soluble enzyme found in brain, the peripheral nervous system and skeletal muscle. In neurons, protein-protein interactions with PSD95 and PSD93 *via* the PZD domain at the N-terminus of nNOS localizes the enzyme with NMDA receptors.

500 µl

• Also Available: **nNOS Blocking Peptide (360871)**

PDI Polyclonal Antibody 13025

Protein Disulphide Isomerase
Whole serum **Stability:** ≥1 year at -20°C
Summary: Antigen: rat PDI synthetic peptide conjugated to KLH • Host: rabbit • Cross Reactivity: (+) human, mouse, rat, canine, hamster, monkey, guinea pig, bovine, ovine, porcine, and *Xenopus* PDI • Application(s): ICC, IHC, IP, and WB • PDI is involved in disulphide-bond formation *via* its oxidase activity and isomerization *via* its isomerase activity, as well as the reduction of disulphite bonds in proteins. Studies suggest BiP and PDI work together sequentially to increase oxidation of these proteins.

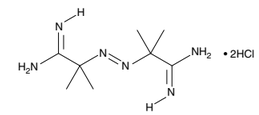
25 µL
100 µL

Antioxidants & Prooxidants

AAPH 82235

[2997-92-4]
MF: $C_8H_{18}N_6$ • 2HCl **FW:** 271.2 **Purity:** ≥98%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A water-soluble azo compound used extensively as a free radical generator

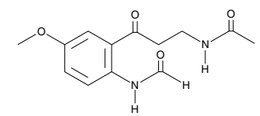
1 g
5 g
10 g
25 g



AFMK 10005254

[52450-38-1]
MF: $C_{13}H_{16}N_2O_4$ **FW:** 264.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A melatonin metabolite first identified in rat brain that has antioxidant and free radical scavenging activities in several experimental models; may be measured in plasma as an index of melatonin synthesis and metabolism

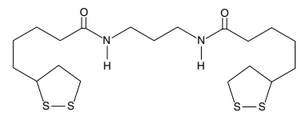
1 mg
5 mg
10 mg
50 mg



AN-7 10006212

[691410-93-2]
MF: $C_{19}H_{34}N_2O_2S_4$ **FW:** 450.7 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A more lipophilic analog of α-lipoic acid, a cyclic disulfide antioxidant with enhanced potency

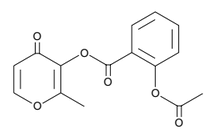
5 mg
10 mg
50 mg
100 mg



Aspalatone 13644

[147249-33-0]
MF: $C_{15}H_{12}O_6$ **FW:** 288.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: An anti-platelet aggregator (IC_{50} = 180 µM, *in vitro*) that prolongs bleeding time significantly in a rodent model of thromboembolism; at 24 mg/kg, generates antioxidant and neuroprotective effects against kainic acid-induced epilepsy in rat hippocampus

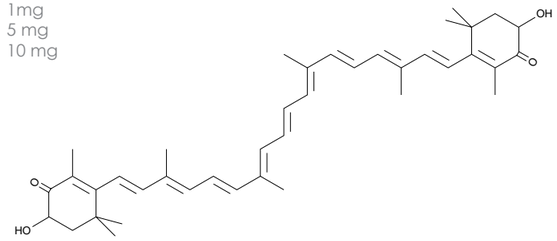
5 mg
10 mg
50 mg
100 mg



Astaxanthin 70685

[7542-45-2] AstaREAL, AstaXin, BioAstin, Carophyll Pink, Lucantin Pink, NatuRose, Ovoester
MF: $C_{40}H_{52}O_4$ **FW:** 596.9 **Purity:** ≥98%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A carotenoid pigment found primarily in marine animals including shrimp and salmon; it is a potent lipid-soluble antioxidant

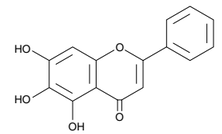
1mg
5 mg
10 mg



Baicalein 70610

[491-67-8]
MF: $C_{15}H_{10}O_5$ **FW:** 270.2 **Purity:** ≥95%
A yellow crystalline solid **Stability:** ≥1 year at -20°C
Summary: A flavonoid originally isolated from the roots of *Scutellaria baicalensis* Georgi; inhibits platelet 12-LO with an ID_{50} value of 0.12 µM, with minimal inhibition of platelet COX-1 (IC_{50} = 0.83 mM); inhibits lipid peroxidation, as assessed by production of TBARS, with an IC_{50} value of 5 µM

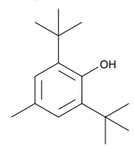
50 mg
100 mg
500 mg
1 g



BHT 89910

[128-37-0] Butylated Hydroxy Toluene
MF: $C_{15}H_{24}O_6$ **FW:** 220.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥1 year at room temperature
Summary: A widely used synthetic antioxidant found in all types of manufactured items from foodstuff to cosmetics to rubber and paint

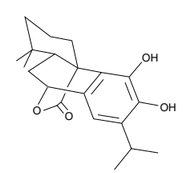
500 mg
1 g



Carnosol 89800

[5957-80-2]
MF: $C_{20}H_{26}O_4$ **FW:** 330.4 **Purity:** ≥96%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: One of the phenolic antioxidants present in extracts of rosemary; inhibits the formation of tumors derived using irritants such as TPA and DMBA

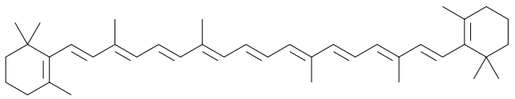
1 mg
5 mg
10 mg
50 mg



β-Carotene 16837

[7235-40-7] Food Orange 5, KPMK, Lucarotin, NSC 62794, Provatene, Provitamin A, Solatene
MF: $C_{40}H_{56}$ **FW:** 536.9 **Purity:** ≥95%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A red/orange-colored fat-soluble terpenoid with antioxidant properties; can be cleaved to produce vitamin A and retinoic acid

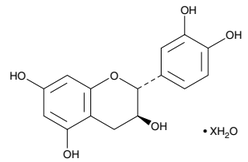
5 g
10 g
25 g
50 g



(+)-Catechin hydrate 70940

[225937-10-0] D-(+)-Catechin, Catechuic Acid, Cyanidol
MF: $C_{15}H_{14}O_6 \bullet XH_2O$ **FW:** 290.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at 4°C
Summary: A polyphenolic flavonoid antioxidant which has been isolated from a variety of natural sources including tea leaves, grape seeds, and the wood and bark of trees

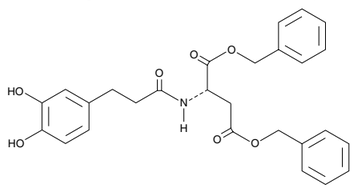
1 g
5 g
10 g
25 g



CAY10485 10006482

[615264-62-5] 3,4-dihydroxy Hydrocinnamic acid (L-Aspartic acid dibenzyl ester) amide
MF: $C_{27}H_{27}NO_7$ **FW:** 477.1 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: An inhibitor of human ACAT-1 and ACAT-2 with an IC_{50} values of 95 and 81 µM, respectively; inhibits cooper-mediated oxidation of LDL by 91% at a concentration of 2 µM

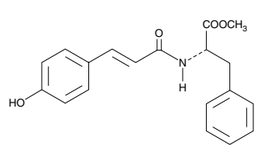
5 mg
10 mg
50 mg
500 mg



CAY10486 10006452

[615264-52-3] 4-Hydroxycinnamic acid (L-phenylalanine methyl ester) amide
MF: $C_{19}H_{19}NO_4$ **FW:** 325.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: An inhibitor of human ACAT-1 and ACAT-2 with an IC_{50} value of approximately 60 µM for both enzymes; also inhibits copper-mediated oxidation of LDL by about 20% at a concentration of 3 µM

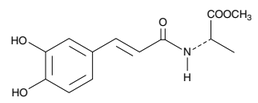
5 mg
10 mg
50 mg
500 mg



CAY10487 10006480

[778624-05-8] 3,4-Dihydrocinnamic Acid (L-alanine methyl ester) amide
MF: $C_{13}H_{15}NO_5$ **FW:** 265.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: An inhibitor of fatty streak lesion formation; also inhibits copper-mediated oxidation of LDL by about 75% at a concentration of 2 µM

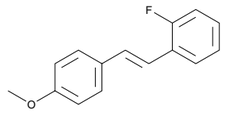
5 mg
10 mg
50 mg
500 mg



CAY10512 10009536

[139141-12-1]
MF: $C_{15}H_{13}FO$ **FW:** 228.3 **Purity:** ≥97%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A substituted *trans*-stilbene analog of resveratrol that is 100-fold more potent as measured by antioxidant activity; inhibits TNF-α-induced activation of NF-κB (IC_{50} = 0.15 µM)

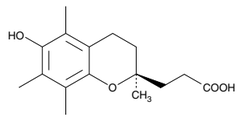
10 mg
50 mg
100 mg
500 mg



α-CEHC 10007705

MF: $C_{16}H_{22}O_4$ **FW:** 278.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: Major urinary metabolite of α-tocopherol following vitamin E supplementation

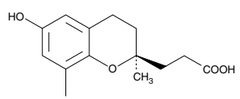
1 mg
5 mg
10 mg
25 mg



δ-CEHC 10007706

[1221504-67-1]
MF: $C_{14}H_{18}O_4$ **FW:** 250.3 **Purity:** ≥95%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A major β-oxidation metabolite of δ-tocopherol

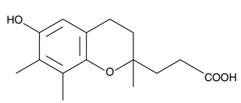
1 mg
5 mg
10 mg
25 mg



γ-CEHC 89630

[178167-75-4] GTM, 2,7,8-trimethyl-2-(β-carboxy-ethyl)-6-Hydroxychroman, γ-Tocopherol Metabolite
MF: $C_{15}H_{20}O_4$ **FW:** 264.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A β-oxidized metabolite of dietary γ-tocopherol that functions as a natriuretic hormone

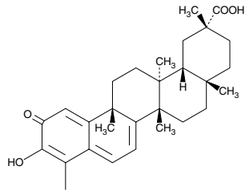
1 mg
5 mg
10 mg
25 mg



Celastrol 70950

[34157-83-0]
MF: $C_{29}H_{38}O_4$ **FW:** 450.6 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A naturally-occurring triterpenoid antioxidant compound with about 15 times the antioxidant potency of β-tocopherol

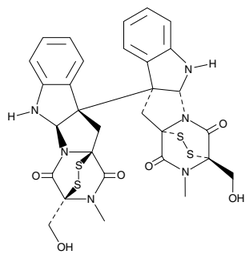
5 mg
10 mg
50 mg
100 mg



Chaetocin 13156

[28097-03-2]
MF: $C_{30}H_{28}N_6O_6S_4$ **FW:** 696.8 **Purity:** ≥95%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A fungal mycotoxin that inhibits the Lys9-specific histone methyltransferases SU(VAR)3-9 (IC_{50} = 0.8 µM), G9a (IC_{50} = 2.5 µM), and DIM5 (IC_{50} = 3 µM); potently induces cellular oxidative stress, selectively killing cancer cells; acts as a competitive and selective substrate for thioredoxin reductase-1 (K_m = 4.6 µM)

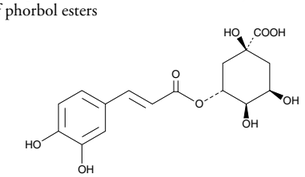
1 mg
5 mg
10 mg



Chlorogenic Acid 70930

[327-97-9] 3-O-Caffeoylquinic Acid, Heriguard, NSC 407296
MF: $C_{16}H_{18}O_9$ **FW:** 354.3 **Purity:** ≥95%
A crystalline solid **Stability:** ≥2 years at 4°C
Summary: A phenolic natural product with antioxidant activity; also inhibits the tumor promoting activity of phorbol esters

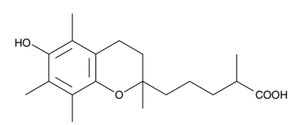
100 mg
500 mg
1 g
5 g



(±)-α-CMBHC 10008652

[7083-09-2]
MF: $C_{19}H_{28}O_4$ **FW:** 320.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A longer side-chain precursor of α-CEHC and a minor metabolite of α-tocopherol

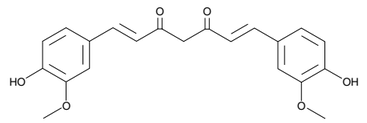
1 mg
5 mg
10 mg
25 mg



Curcumin 81025

[458-37-7] Indian Saffron, Turmeric Yellow
MF: $C_{21}H_{20}O_6$ **FW:** 368.4 **Purity:** ≥90%
A crystalline solid **Stability:** ≥2 years at room temperture
Summary: A natural product with antioxidant, anti-tumor and anti-inflammatory properties

1 g
5 g
10 g
50 g

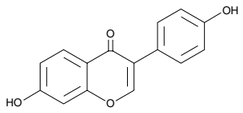


• Also Available: **Curcumin (technical grade) (81025.1)**
dimethoxy Curcumin (10009986)

Daidzein 10005166

[486-66-8] Isoflavone
MF: $C_{15}H_{10}O_4$ **FW:** 254.2 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: An isoflavonoid phytoestrogenic compound found in soybeans, pea pods, clover, kudzu, and other legumes

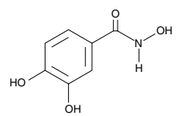
100 mg
500 mg
1 mg
5 mg



Didox 10009081

[69839-83-4]
MF: $C_7H_7NO_4$ **FW:** 169.1 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A simple, synthetic antioxidant that has been found to reduce the levels of oxidative injury markers in the brains of HIV patients with dementia; increases the radiosensitivity of cancer cells by inhibition of ribonucleotide reductase

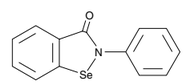
1 mg
5 mg
10 mg
50 mg



Ebselen 70530

[60940-34-3]
MF: $C_{13}H_9NOSe$ **FW:** 274.2 **Purity:** ≥99%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A glutathione peroxidase mimic and excellent scavenger of peroxynitrite with a rate constant of 2 x 10^6 $M^{-1}s^{-1}$

5 mg
10 mg
50 mg
100 mg

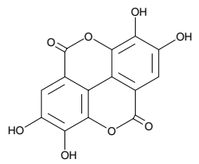


• Also Available: **Ebselen Oxide (10012298)**

Ellagic Acid 10569

[476-66-4] Gallogen, Lagistase, TBBD
MF: $C_{14}H_6O_8$ **FW:** 302.2 **Purity:** ≥95%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A polyphenolic antioxidant that is abundant in many fruits, vegetables, plant bark, and peels; has anti-carcinogenic, anti-mutagenic, anti-inflammatory, and organ-preserving properties; blocks methylation of H3R17 by CARM1 without significantly altering histone acetylase or DNA methyltransferase activity

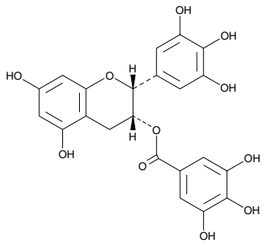
100 mg
500 mg
1 g



Epigallocatechin Gallate 70935

[989-51-5] EGCG, Tea Catechin
MF: $C_{22}H_{18}O_{11}$ **FW:** 458.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A principle phenolic antioxidant found in a variety of plants, including green and black tea

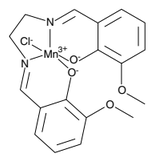
5 mg
10 mg
50 mg
100 mg



EUK 134 10006329

[81065-76-1]
MF: $C_{18}H_{18}ClMnN_2O_4$ **FW:** 416.7 **Purity:** ≥98%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A salen-manganese complex with catalase and SOD mimetic activity

5 mg
10 mg
50 mg
100 mg

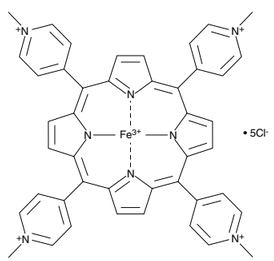


•Also Available: **EUK 118 (10271)**
EUK 124 (12500)

FeTMPyP 75854

[133314-07-5]
MF: $C_{44}H_{36}Cl_5N_8Fe$ **FW:** 909.9 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A synthetic porphyrin complexed with iron which acts as a peroxynitrite decomposition catalyst

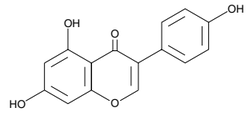
10 mg
25 mg
50 mg
100 mg



Genistein 10005167

[446-72-0]
MF: $C_{15}H_{10}O_5$ **FW:** 270.2 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: An isoflavonoid phytoestrogenic compound found in soybeans, pea pods, and other legumes; acts as a tyrosine kinase inhibitor, has chemopreventive effects on breast, prostate, and other endocrine-dependent tumors

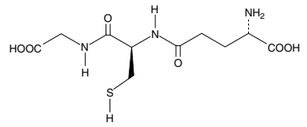
100 mg
250 mg
500mg
1 g



L-Glutathione, reduced 10007461

[70-18-8] GSH
MF: $C_{10}H_{17}N_3O_6S$ **FW:** 307.3 **Purity:** ≥99%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A tripeptide (γ-glutamylcysteinylglycine) widely distributed in both plants and animals that is involved in detoxification of xenobiotics, oxidative stress, amino acid transport, and maintenance of protein sulfhydryl reduction status

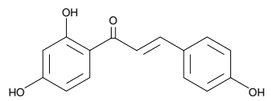
1 g
5 g
10 g
25 g



Isoliquiritigenin 10739

[961-29-5] GU 17, ISL
MF: $C_{15}H_{12}O_4$ **FW:** 256.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A flavonoid found in licorice root that displays antioxidant, anti-inflammatory, and antitumor activities; induces quinone reductase-1 with a CD value of 1.8 µM in mouse hepatoma cells

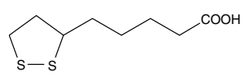
1 mg
5 mg
10 mg
50 mg



DL-α-Lipoic Acid 10005728

[1077-28-7] Thioctic Acid
MF: $C_8H_{14}O_2S_2$ **FW:** 206.3 **Purity:** ≥95%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A cyclic disulfide antioxidant that interconverts with its reduced dithiol form; can act as a direct radical scavenger, as a cofactor to regenerate reduced glutathione, and as a metal chelator

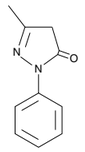
1 g
5 g
10 g
25 g



MCI-186 13320

[89-25-8] Endaravone, NSC 2629
MF: $C_{10}H_{10}N_2O$ **FW:** 174.2 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A free radical scavenger with diverse protective effects *in vivo*; reduces damage due to ischemia-reperfusion injury in lung, liver, and brain in animal models of transplant, infection, traumatic brain injury, and stroke

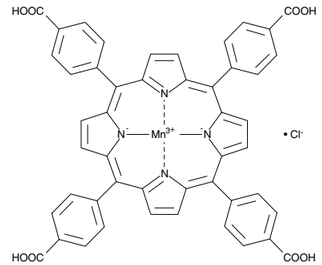
500 mg
1 g
5 g
10 g



Mn(III)TBAP 75850

MF: $C_{48}H_{28}MnN_4O_8$ • Cl **FW:** 879.2 **Purity:** ≥95%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A cell-permeable SOD mimic

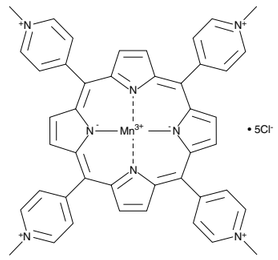
10 mg
25 mg
50 mg
100 mg



Mn(III)TMPyP 75852

MF: $C_{44}H_{36}MnN_8$ • 5Cl **FW:** 909.0 **Purity:** ≥95%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A cell-permeable SOD mimic and peroxynitrite decomposition catalyst

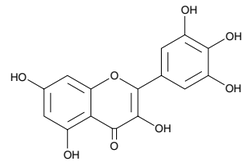
10 mg
25 mg
50 mg
100 mg



Myricetin 10012600

[529-44-2] Cannabiscetin, NSC 407290
MF: $C_{15}H_{10}O_8$ **FW:** 318.2 **Purity:** ≥98%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A flavonoid compound that acts as a powerful antioxidant; inhibits TBARS formation with an IC_{50} value of 6.34 µM; blocks oxLDL uptake by U937-derived macrophages at 20 µM

10 mg
25 mg
50 mg
100 mg



Peroxynitrite 81565

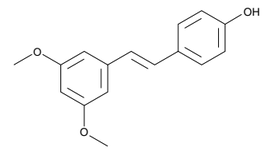
[14042-01-4] Sodium Peroxynitrite
MF: ONO_2 • Na **FW:** 85.0 **Purity:** ≥90% (balance is NO_2/NO_3)
A solution in 0.3 M sodium hydroxide **Stability:** ≥6 months at -80°C
Summary: A highly reactive oxygen species formed *in vivo* by the reaction of NO with superoxide; acts as a powerful oxidizing agent that can initiate lipid peroxidation, oxidize sulfhydryls, and nitrate the aromatic residues of proteins

1 ml
5 ml
10 ml

Pterostilbene 13000

[537-42-8] 3',5'-Dimethoxy-4-Stilbenol, trans-3,5-Dimethoxy-4'-Hydroxystilbene
MF: $C_{16}H_{16}O_3$ **FW:** 256.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A naturally-occurring dimethyl ether analog of resveratrol; acts as a powerful antioxidant, suppresses the synthesis of PGE_2 from LPS-stimulated human peripheral blood mononuclear cells (IC_{50} = 1.0 µM), and inhibits cell proliferation (IC_{50} ~60 µM); evokes effects that prevent cancer, inflammation, and diabetes

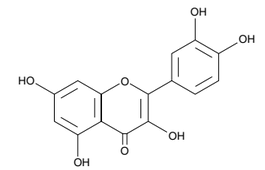
50 mg
100 mg
250 mg
500 mg



Quercetin 10005169

[117-39-5]
MF: $C_{15}H_{10}O_7$ **FW:** 302.2 **Purity:** ≥95%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A flavonoid compound found in the bark and rinds of many plants and fruits

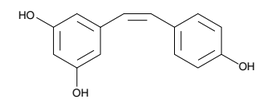
5 g
10 g
50 g
100 g



cis-Resveratrol 10004235

[61434-67-1](Z)-Resveratrol
MF: $C_{14}H_{12}O_3$ **FW:** 228.2 **Purity:** ≥98% (may contain 1-5% *trans*)
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: Double bond isomer of *trans*-resveratrol, the more often-studied and naturally abundant of the two resveratrol isomers; exhibits antioxidant activity in the micromolar range similar to that observed with *trans*-resveratrol

5 mg
10 mg
50 mg
100 mg

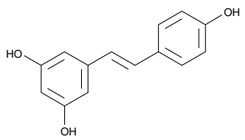


•Also Available: ***cis*-trismethoxy Resveratrol (13199)**

trans-Resveratrol 70675

[501-36-0] (E)-Resveratrol
MF: $C_{14}H_{12}O_3$ **FW:** 228.2 **Purity:** ≥98%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A potent phenolic antioxidant found in grapes and red wine that also has antiproliferative and anti-inflammatory activity; activates sirtuins and, in *C. elegans*, extends lifespan

50 mg
100 mg
250 mg
500 mg

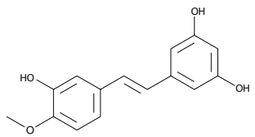


• Also Available: **CAY10616 (13291)**
***trans*-Resveratrol-d_4 (13130)**
***trans*-trismethoxy Resveratrol (10188)**
Resveratrol-3-O-Sulfate (13900)
3,4',5-Trismethoxybenzophenone (10004185)

Rhapontigenin 13293

[500-65-2]
MF: $C_{15}H_{14}O_4$ **FW:** 258.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A natural analog of resveratrol with antioxidant and anti-cancer activity; a mechanism-based, selective inactivator of CYP450 1A1 (IC_{50} = 400 nM); inhibits the proliferation of cancer cell lines (IC_{50} = 48 µM)

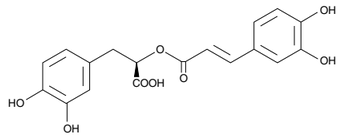
1 mg
5 mg
10 mg
25 mg



Rosmarinic Acid 70900

[20283-92-5]
MF: $C_{18}H_{16}O_8$ **FW:** 360.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at room temperature
Summary: A naturally-occurring phenolic compound with antioxidant and anti-inflammatory properties

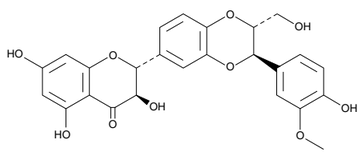
5 mg
10 mg
50 mg
100 mg



Silybin 10006211

[22888-70-6] Silibinin, Silymarin
MF: $C_{25}H_{22}O_{10}$ **FW:** 482.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A major flavonolignan from the extracts of milk thistle seed, *S. marianum*; blocks the production of superoxide in PMA-activated rat Kupffer cells (EC_{50} ~100 µM); inhibits the synthesis of LTB_4 (IC_{50} ~15 µM)

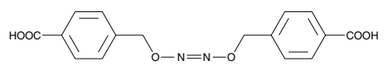
1 g
5 g
10 g
50 g



SOTS-1 (technical grade) 10009642

[223507-96-8] Di-(4-Carboxybenzyl)Hyponitrite, Superoxide Thermal Source
MF: $C_{16}H_{14}N_2O_6$ **FW:** 330.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥1 year at -80°C
Summary: An azo-compound that can be thermally decomposed in aqueous solution to generate superoxide radical anion at a constant, controlled rate; follows first order kinetics, and exhibits a half-life of 4,900 seconds at physiological pH and temperature

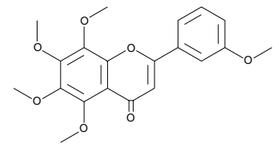
500 µg
1 mg
5 mg
10 mg



Tangeritin 10009911

[481-53-8] NSC 53909, NSC 618905, Ponkanetin
MF: $C_{20}H_{20}O_7$ **FW:** 372.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A polymethoxylated flavone isolated from citrus peels; inhibits signaling in cancer cells, reducing ERK signaling in T47D breast cancer cells (IC_{50} ~ 3 µM)

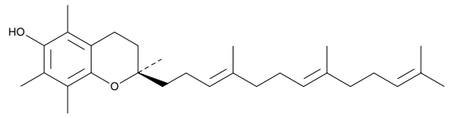
1 mg
5 mg
50 mg
100 mg



α-Tocotrienol 10008377

[58864-81-6]
MF: $C_{29}H_{44}O_2$ **FW:** 424.7 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: One of four tocotrienol forms of vitamin E, which is known for its antioxidant activity

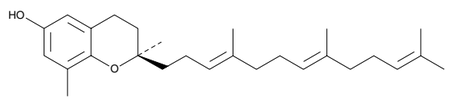
1 mg
5 mg
10 mg
25 mg



δ-Tocotrienol 10008513

[25612-59-3]
MF: $C_{27}H_{40}O_2$ **FW:** 396.6 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: One of four tocotrienol forms of vitamin E, which is known for its antioxidant activity

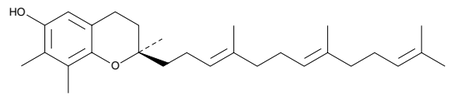
1 mg
5 mg
10 mg
25 mg



γ-Tocotrienol 10008494

[14101-61-2]
MF: $C_{28}H_{42}O_2$ **FW:** 410.6 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: One of four tocotrienol forms of vitamin E, which is known for its antioxidant activity

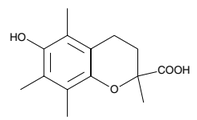
1 mg
5 mg
10 mg
25 mg



Trolox 10011659

[53188-07-1] 6-hydroxy-2,5,7,8-tetramethylchroman-2-Carboxylic Acid
MF: $C_{14}H_{18}O_4$ **FW:** 250.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A cell-permeable, water-soluble derivative of vitamin E with potent antioxidant properties; commonly used as a standard or positive control in antioxidant assays

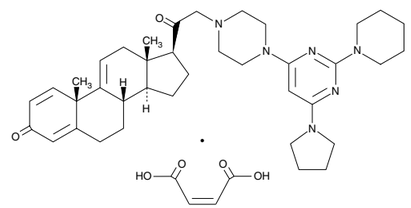
50 mg
100 mg
250 mg
500 mg



U-74389G 75860

[153190-29-5] Methylated Tirilazad
MF: $C_{38}H_{52}N_6O_2 \bullet C_4H_4O_4$ **FW:** 740.9 **Purity:** ≥99%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: An antioxidant which prevents iron-dependent lipid peroxidation; protects against ischemia-reperfusion injury in animal heart, liver, and kidney models

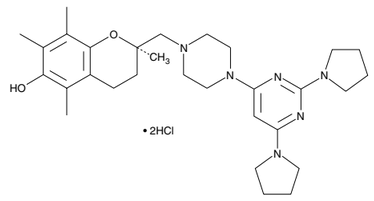
50 mg
100 mg
500 mg
1 g



U-83836E 10010245

[137018-55-4] PNU-83836E
MF: $C_{30}H_{44}N_6O_2 \bullet 2HCl$ **FW:** 593.6 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: An antioxidant that inhibits iron-dependent lipid peroxidation (IC_{50} = 0.6 µM); has potent neuroprotective effects against ischemia reperfusion injury and diabetic neuropathy

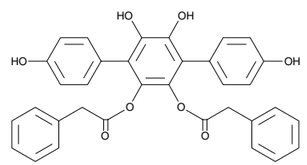
10 mg
25 mg
50 mg
100 mg



Vialinin A 10010519

[858134-23-3] Terrestrin A
MF: $C_{34}H_{26}O_8$ **FW:** 562.6 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A natural compound with strong antioxidant activity; potently inhibits the release of TNF-α (IC_{50} = 0.09 nM) and IL-4 (IC_{50} = 2.8 nM), as well as β-hexosaminidase and CCL2 (MCP-1) from IgE-stimulated RBL-2H3 mast cells

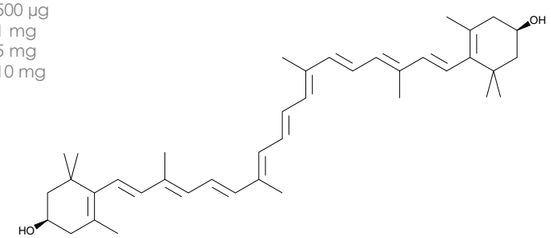
1 mg
5 mg
10 mg
25 mg



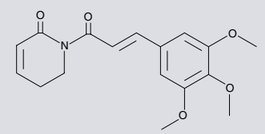
Zeaxanthin 10009992

[144-68-3] Anchovyxanthin, Xanthophyll 3, Zeaxanthol
MF: $C_{40}H_{56}O_2$ **FW:** 568.9 **Purity:** ≥98%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A dietary carotenoid present in the macula region of the eye; high dietary intake correlates with reduced risk of age-related macular degeneration

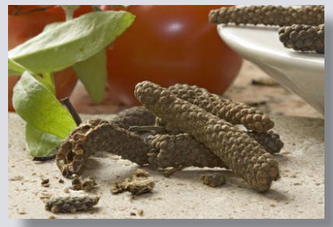
500 µg
1 mg
5 mg
10 mg



Piperlongumine
Item No.11006



Cancer cell survival appears partly dependent on antioxidative enzymes, whose expression is regulated by the Keap1-Nrf2 pathway (see page 32), to quench potentially toxic reactive oxygen species (ROS) generated by their metastatic transformation. To the advantage of cancer researchers, this adaptation of malignant cells to the ROS stress-response pathway might provide a promising, selective target to treat cancer. Raj et al., 2011 have demonstrated



that piperlongumine, a natural product isolated from the Long pepper (*Piper longum*), a plant indigenous to southern India and southeast Asia, selectively increases the levels of ROS and apoptosis in cancer cells but not in normal cells. Piperlongumine was shown to induce cell death specifically in cancer cells, upregulating the expression of proapoptotic genes and repressing the expression of pro-survival genes. In established bladder, breast, lung, and melanoma tumor xenografts in mice, piperlongumine significantly inhibited tumor growth and angiogenesis without affecting normal tissues. These investigators hypothesize that compared to basal ROS levels found in normal cells, malignantly transformed cells have a higher capacity to generate ROS, creating a greater dependence on redox and ROS homeostasis to maintain a favorable environment for their growth. This adaption to increased oxidative stress is proposed to underlie the selectivity of piperlongumine. Indeed, piperlongumine binds directly to proteins known to regulate oxidative stress, including glutathione-S-transferase-P1 (GSTP1) and carbonyl reductase 1 (CBR1). Redox-sensitive fluorescent probes revealed that piperlongumine treatment increased ROS levels in both cancer cells and normal cells engineered to have a cancer genotype, but did not cause an increase in ROS levels in normal cells. This difference in response of cancer cells versus normal cells suggests that piperlongumine targets a mechanism associated with ROS homeostasis that is activated during cell transformation. Previously, piperlongumine has been used as a crude treatment to improve poor blood circulation as it affects platelet function by inhibiting platelet aggregation. This latest research, however, presents a novel strategy to selectively target cancer cells by manipulating the ROS stress-response pathway. Further studies will be needed to determine the *in vivo* capabilities of this small molecule and its effects on different forms of cancer.

Raj, L., Ide, T., Gurkar, A.U., *et al. Nature* **475,** 231-234 (2011).

vol. 14 Ox

Thomas G. Brock, Ph.D.

Sphingosine 1-Phosphate *vs.* Ceramide:

The Battle of the Burn

The luxurious warmth of the sun's rays on the face and shoulders slowly, subtly, gives way to redness and tenderness. Without attention, continued exposure produces a painful burn, followed days later by sloughing of a layer of dead skin tissue. This familiar experience is one demonstration of the ability of ionizing radiation, in the form of ultraviolet light from the sun, to generate reactive oxygen species (ROS) that trigger the release of ceramide within cells, leading to cell death. Remarkably, the effects of ceramide can be diminished by its related metabolite, sphingosine 1-phosphate (S1P). This article introduces these lipids and their complex interrelationship.

Ceramide Metabolism

Sphingolipids are, like phospholipids, integral components of biological membranes. Ceramide, the simplest of the sphingolipids, is composed of a sphingosine base and an amide-linked acyl chain of variable length. Ceramide can be synthesized *de novo* in the endoplasmic reticulum through the serine palmitoyl transferase pathway, which involves the production of the intermediate sphinganine and its conversion to the immediate precursor dihydroceramide by ceramide synthases, CerS (Figure 1). Interestingly, CerS was initially identified in yeast as the longevity assurance gene 1 (LAG1), because deletion of LAG1 prolongs the replicative lifespan of *Saccharomyces cerevisiae*. The mouse homolog of LAG1 is called longevity assurance homolog 1 (LASS1) or upstream of growth and differentiation factor 1 (UOG1). LASS1 activity, which specifically regulates the synthesis of C18-ceramide, determines cell longevity rather than mouse aging, since reduced activity is associated with a proliferative, cancerous phenotype.[1]

Ceramide can be rapidly released from membrane-associated sphingomyelin by sphingomyelinases (SMase, or sphingomyelin phosphodiesterases). There are several SMases in man, including three neutral SMases that have greatest activity at neutral pH and an acidic SMase (ASMase) that, while active at neutral pH, shows increased functionality in acidic environments. This latter enzyme is abundant in lysosomal membranes but can also be found in plasma membranes associated with lipid rafts. Defects in ASMase cause Niemann-Pick disease, a lysosome storage disease. Lymphoblasts from Niemann-Pick patients fail to respond to ionizing radiation with ceramide generation and apoptosis.[2] These abnormalities are reversed by the transfected expression of ASMase, demonstrating the central role of this SMase in radiation-induced apoptosis. Furthermore, ASMase is activated by ROS as well as by peroxynitrite, a product formed from nitric oxide and superoxide.[3] Thus, ROS produced by ionizing radiation activates ASMase, causing the production of ceramide.

Ceramide can be de-acylated by ceramidases to give sphingosine plus a carboxylate, and sphingosine in turn can be phosphorylated by sphingosine kinases (SPHK) to produce S1P. S1P is a potent signal transduction-inducing molecule that is involved in such diverse biological processes as cell proliferation, differentiation, migration, and cell survival. There are at least two human ceramidases, an acidic form that is associated with lysosomes and a neutral ceramidase that is associated with the plasma membrane. Similarly, there are two human SPHK forms. SPHK1, the better studied form, is activated by many stimuli, including TGF-β, IL-1β, TNF-α, platelet-derived growth factor, insulin, and LPS. Phosphorylation of Ser^{311} on SPHK1 by ERK1/2, reversed by PP2A, causes plasma membrane targeting and activation of SPHK1. SPHK1 is best known as a survival, or anti-apoptosis, enzyme with additional positive effects on cell motility and proliferation resulting from the production of S1P. In addition, SPHK1-derived S1P activates endothelium, regulating endothelial barrier homeostasis, primes neutrophils, activates macrophages and promotes phagosome maturation, and increases immune cell motility and function. While some of the actions of SPHK2-derived S1P overlap those of SPHK1, SPHK2 may promote, rather than prevent, apoptosis.

Ceramide Actions

Ceramide is a bioactive lipid which regulates many cell functions, including apoptosis, proliferation, and differentiation. Its biological effects depend on its concentration, the time frame of activation, and the activation or differentiation status of the cell. In addition, ceramide may be produced in one membrane site and trafficked to others, *e.g.*, from the plasma membrane to the mitochondrial membrane.[4] Ceramide signals along several pathways, including ceramide-activated protein kinases (*e.g.*, PKC and MEK isoforms) and protein phosphatases (*e.g.*, PP1 and PP2A). This indicates that there is no general pathway of ceramide action, that the specific effects must be evaluated for each cellular situation.

Ionizing radiation-induced ROS activate PKCδ, which phosphorylates ASMase on Ser^{508} and causes the relocation of ASMase from lysosomes to the plasma membrane, as shown in Figure 2.[5] Activated ASMase catalyzes the release of ceramide from lipid raft-associated sphingomyelin (SM) within minutes; additional ceramide production occurs hours later, when, in response to DNA damage, the *de novo* synthesis pathway is activated. More specifically, DNA damage induces proteasome-dependent processing of CerS1, followed by the translocation of the modified enzyme from the ER to the Golgi and increased ceramide production.[6] Within the plasma

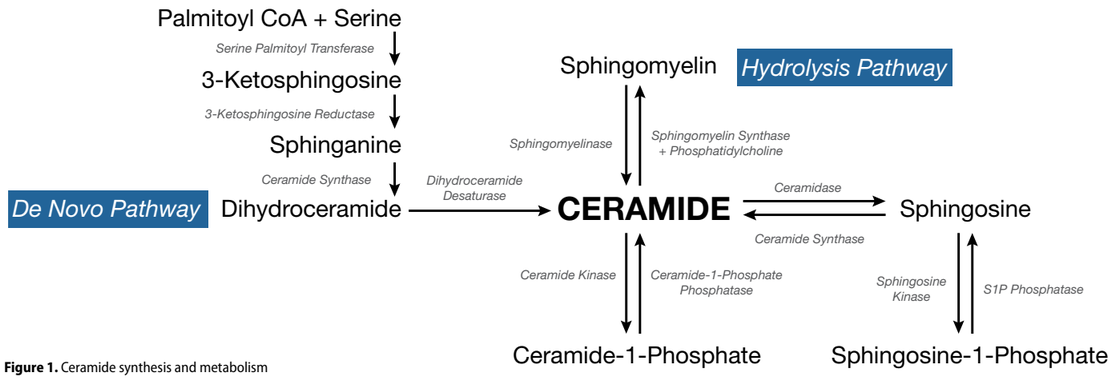


Figure 1. Ceramide synthesis and metabolism

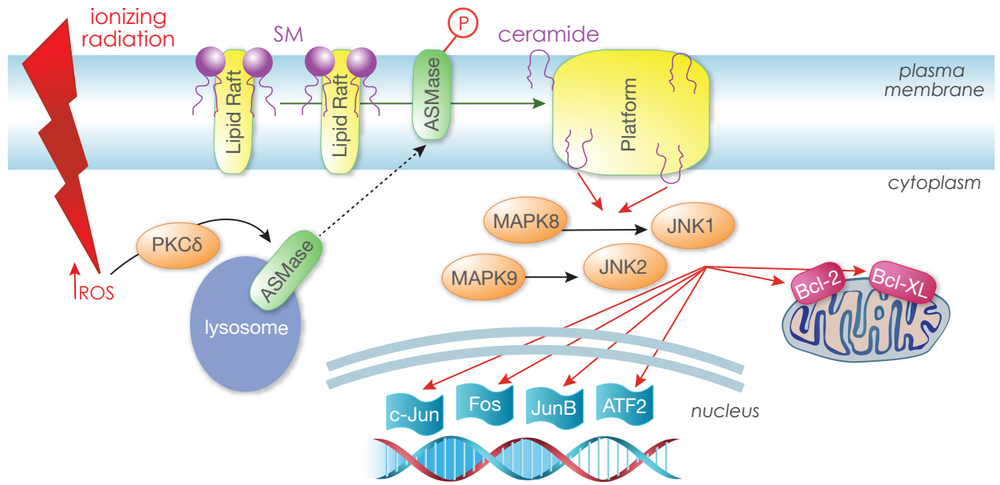


Figure 2. Ceramide signaling in response to ionizing radiation

membrane, the production of ceramide in lipid rafts drives the coalescence of multiple small rafts into ceramide-enriched membrane platforms.[7] Within these platforms, ceramide may slowly flip between the inner and outer leaflets of the lipid bilayer and be accessible to intracellular molecules. Ionizing radiation, as well as other forms of stress, activate the SAPK/JNK pathways.[8] Specifically, both JNK1 and JNK2 are activated by MAPK8 and MAPK9, which phosphorylate nuclear transcription factors, including c-Jun, Fos, JunB, and ATF2. Also, the JNKs target Bcl-2 family members associated with mitochrondria, driving apoptosis. In addition, ceramide, induced by stresses including radiation, inactivates the PI3K/Akt/Bad pathway, which also facilitates apoptosis.[9]

Sphingosine 1-Phosphate Effects

S1P was first thought to have its effects intracellularly, acting as a second messenger, interacting with and modulating the activities of specific target proteins. While this certainly happens,[10] most current research focuses on the signaling of S1P as a secreted ligand, activating G-protein coupled receptors in an autocrine or paracrine fashion. These receptors were initially identified as EDG (endothelial differentiation gene) receptors and were orphan receptors. With the identification of S1P as a ligand for five of the EDG receptors, these have been renamed: $S1P_1$ (EDG1), $S1P_2$ (EDG5), $S1P_3$ (EDG3), $S1P_4$ (EDG6), and $S1P_5$ (EDG8). $S1P_1$ and $S1P_3$ were first isolated from endothelial cells, while $S1P_2$ was first found on rat brain and vascular smooth muscle cells, $S1P_4$ was found on dendritic cells and $S1P_5$ on rat PC12 (prostate cancer) cells. The five S1P receptors share high sequence identity with the cannabinoid and lysophosphatidic receptors, which are also G-protein coupled receptors for lipid ligands. Through these receptors, S1P regulates cell proliferation, differentiation, stress fiber formation, cell motility and migration, and cell survival.[11]

Perhaps one of the most exciting effects of S1P relates to its action on lymphocyte trafficking. The concentration of S1P in lymphoid tissues is normally low compared with that of the lymph. Lymphocytes within lymphoid tissues respond to this gradient, through the $S1P_1$ receptor, by migrating from the tissue into the lymph. If the S1P levels within lymphoid nodes are elevated, by inhibition of S1P lyase, inflammation, or by the addition of stable S1P analogs, then lymphocyte egress is blocked. This greatly reduces the number of circulating lymphocytes and diminishes their ability to participate in the immune response. S1P analogs include SEW2871 (Item No. 10006440), FTY720 (Item No. 10006292), and (S)-FTY720-phosphonate. Because of its ability to reduce lymphocytic trafficking, FTY720 is effective in the treatment of multiple sclerosis.

S1P *vs.* Ceramide

Since ceramide is readily converted to sphingosine, which in turn can give rise to the potent mediator S1P, one might ask if S1P mediates any of the pro-apoptotic actions of ceramide. In fact, ionizing radiation initially downregulates sphingosine kinase 1, impairing the production of S1P.[12] Moreover, added S1P has been shown to be a radioprotectant, preventing oocyte apoptosis and male sterility in irradiated mice.[13-15] Isolated, proliferating endothelial cells, when irradiated, undergo an early premitotic apoptosis that is dependent on ceramide production in many cells, followed by a delayed death resulting from DNA damage in other cells. S1P protects cells from ceramide-dependent apoptosis but not from DNA damage-induced mitotic death.[16] Also, mice maintained on S1P analogs are significantly protected against radiation-induced lung injury.[17] It should be noted that these effects are seen over a 6 week period and appear to rely on altered gene expression in response to S1P analogs. Signaling *via* $S1P_1$, $S1P_2$, and $S1P_3$, the analogs decrease vascular leak through several effects on the cytoskeletal and adhesive properties of endothelial cells.[17] In addition, over this prolonged period, radiation increases the expression of both sphingosine kinase isoforms, perhaps suggesting the existence of a delayed protective feedback loop. Taken together, these studies suggest that intervention through S1P is an attractive approach to ameliorating the ceramide-dependent effects of ionizing radiation.

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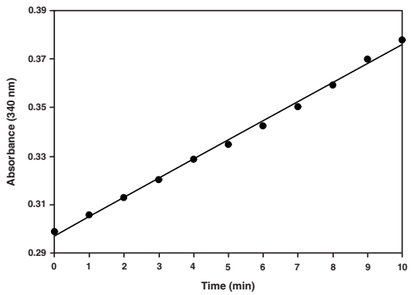
Assay Kits

Aconitase Assay Kit 705502

Stability: ≥6 months at -20°C
Summary: Aconitase is an iron-sulfur protein containing a $[Fe_4S_4]^{2+}$ cluster that catalyzes the stereospecific isomerization of citrate to isocitrate *via cis*-aconitate. Whereas exposure of aconitase to oxidants renders the enzyme inactive, loss of aconitase activity in cells or in biological samples treated with pro-oxidants has been interpreted as a measure of oxidative damage. Cayman's Aconitase Assay provides a simple, reproducible, and sensitive tool for assaying aconitase from tissue homogenates or cell lysates.

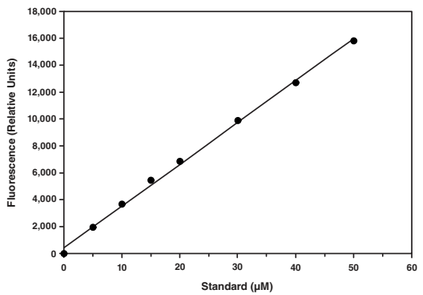
96 wells



Aconitase Fluorometric Assay Kit 700600

Stability: ≥6 months at -20°C
Summary: Aconitase is an iron-sulfur protein containing a $[Fe_4S_4]^{2+}$ cluster that catalyzes the stereo-specific isomerization of citrate to isocitrate *via cis*-aconitate. Exposure of aconitase to oxidants renders the enzyme inactive and loss of aconitase activity in cells or in biological samples treated with pro-oxidants has been interpreted as a measure of oxidative damage. Cayman's Fluorometric Aconitase Activity Assay provides a fluorescence-based method for detecting aconitase activity from tissue homogenates or cell lysates. In this assay, citrate is isomerized by aconitase into isocitrate, which is then converted to α-ketoglutarate in a reaction catalyzed by isocitric dehydrogenase. These reactions are monitored by measuring the formation of NADPH in a reaction with a substrate that yields a highly fluorescent product. Under appropriate conditions, the rate of NADPH production is proportional to aconitase activity.

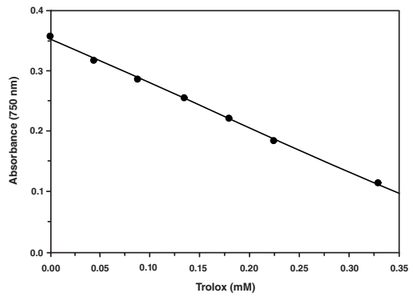
96 wells



Antioxidant Assay Kit 709001

Stability: ≥1 year at 4°C
Summary: Cayman's Antioxidant Assay measures the total antioxidant capacity of plasma, serum, urine, saliva, or cell lysates. The assay relies on the ability of antioxidants in the sample to inhibit the oxidation of ABTS to $ABTS^{\bullet+}$ by metmyoglobin. The capacity of the antioxidants in the sample to prevent ABTS oxidation is compared with that of Trolox, a water-soluble tocopherol analog, and is quantified as molar Trolox equivalents.

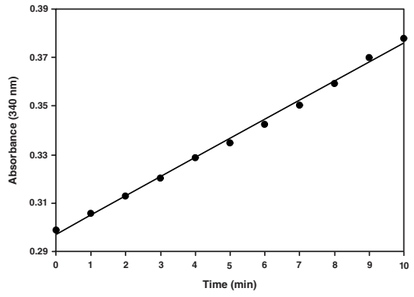
96 wells



Ascorbate Assay Kit 700420

L-Ascorbate Acid, Vitamin C
Stability: ≥6 months at -20°C
Summary: Ascorbate (L-Ascorbic acid or Vitamin C) is a six-carbon lactone that is synthesized from glucose in the liver of most mammalian species, but not by humans. Therefore, humans must obtain ascorbate in their diet in order to survive. In humans, ascorbate acts as an electron donor for eight different enzymes. It also serves as an antioxidant and may be beneficial for reducing the risk of developing chronic diseases such as cancer, cardiovascular disease, and cataracts. Cayman's Ascorbate Assay provides a reproducible, sensitive fluorescence-based tool for quantifying ascorbate from plasma, serum, urine, and fruit juices.

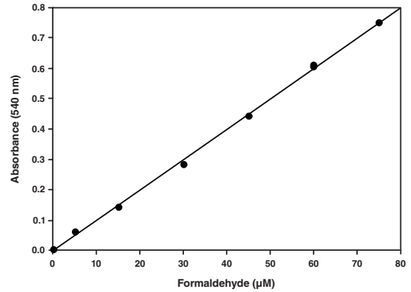
96 wells



Catalase Assay Kit 707002

CAT
Stability: ≥1 year at 4°C
Summary: Catalase is a ubiquitous antioxidant enzyme that is responsible for the detoxification of H_2O_2. Cayman's Catalase Assay utilizes the peroxidatic function of catalase for determination of enzyme activity. The assay can be used to measure catalase activity in plasma, serum, erythrocyte lysates, tissue homogenates, and cell lysates.

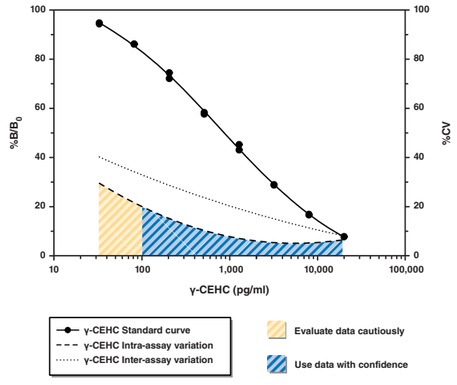
96 wells
480 wells



γ-CEHC EIA Kit (plasma and serum) 10010621

Stability: ≥6 months at -20°C
Summary: γ-Tocopherol is the most abundant form of vitamin E in the diet. It's metabolite, γ-CEHC, is produced in the liver by the action of CYP450 enzymes and excreted in urine at levels that exceed all other tocopherol metabolites. Cayman's γ-CEHC EIA can be used for efficient quantification of γ-CEHC in plasma and serum.

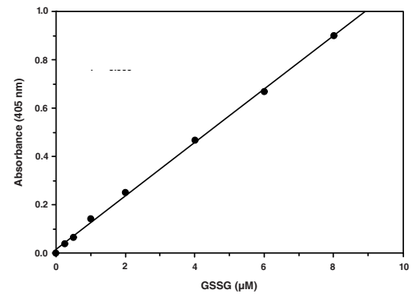
96 strip/solid wells
480 strip/solid wells



Glutathione Assay Kit 703002

GSH
Stability: ≥1 year at 4°C
Summary: Cayman's GSH Assay utilizes a carefully optimized enzymatic recycling method for the quantification of GSH in a 96-well microplate format. It measures both GSH and GSSG to reflect total glutathione in a sample. The kit can also be used to measure only GSSG by following an alternative protocol. The GSH Assay can be used for plasma, tissue samples, and cultured cells with minimal sample processing.

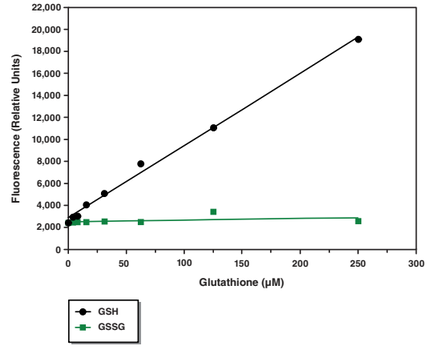
96 wells
480 wells



Glutathione Cell-Based Detection Kit (Blue Fluorescence) 600360

GSH
Stability: ≥6 months at -20°C
Summary: Glutathione (GSH) is the most prevalent low molecular-weight tripeptide thiol in animal cells. It serves as a primary cellular anti-oxidant and plays a fundamental role in the elimination of environmental toxins. During early apoptosis, cells may exclude GSH, causing a decrease in intracellular GSH levels. The intracellular level of GSH is thus used as an indicator of cell health. Cayman's Cell-Based Glutathione Assay Kit (Blue Fluorescence) employs a cell-permeable dye, monochlorobimane (MCB), which reacts with GSH to generate a highly fluorescent product that can be measured using excitation and emission wavelengths of 380 and 460 nm, respectively. The kit can be easily adapted to screening programs for therapeutic compounds regulating intracellular GSH levels.

100 tests



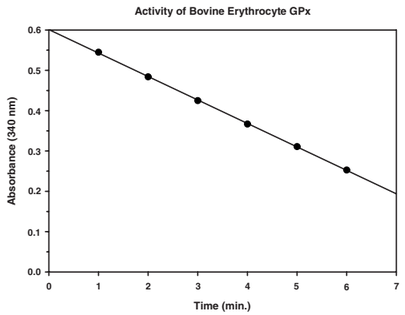
Glutathione Peroxidase Assay Kit 703102

GPx

Stability: ≥6 months at -20°C

Summary: GPx catalyzes the reduction of hydroperoxides, including H_2O_2, using reduced glutathione and thereby functions to protect the cell from oxidative damage. Cayman's Glutathione Peroxidase Assay measures GPx activity indirectly by a coupled reaction with glutathione reductase (GR). Cayman's GPx Assay can be used to measure all of the glutathione-dependent peroxidases in plasma, erythrocyte lysates, tissue homogenates, and cell lysates.

96 wells
480 wells



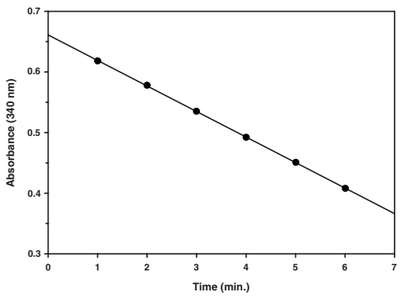
Glutathione Reductase Assay Kit 703202

GR

Stability: ≥6 months at -20°C

Summary: GR is a flavoprotein that catalyzes the NADPH-dependent reduction of oxidized GSSG to GSH. This enzyme is essential for the GSH redox cycle which maintains adequate levels of reduced cellular GSH, which is essential for protection against oxidative stress. Cayman's Glutathione Reductase Assay Kit measures GR activity by measuring the rate of NADPH oxidation.

96 wells



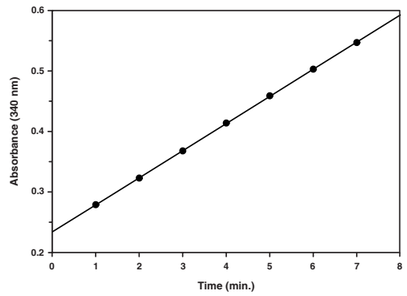
Glutathione S-Transferase Assay Kit 703302

GST

Stability: ≥1 year at -20°C

Summary: GSTs are ubiquitous multifunctional enzymes, which play a key role in cellular detoxification. Cayman's GST Assay measures total GST activity (cytosolic and microsomal) by measuring the conjugation of 1-chloro-2,4-dinitrobenzene (CDNB) with reduced glutathione. Cayman's GST Assay can be used to measure GST activity in plasma, erythrocyte lysates, tissue homogenates, and cell lysates. Cytosolic and microsomal GST activity can also be individually assayed.

96 wells



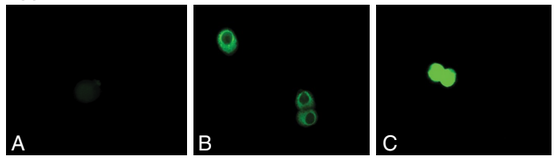
S-Glutathionylated Protein Detection Kit 10010721

PSSG

Stability: ≥1 year at -20°C

Summary: Cayman's PSSG Assay provides a method for the direct visualization of S-glutathionylated proteins in whole (permeabilized) cells by flow cytometry and microscopy as well as avidin overlay analysis. This assay starts with the modification of protein free-thiols groups followed by enzymatic cleavage of any PSSG adducts present in the sample. Biotinylation of the newly-formed protein free-thiols provides the basis for visualization using streptavidin-based colorimetric or fluorescence detection.

1 ea



Typical fluorescence images using 10,000 mouse monocytes per sample. *Panel A:* Cells stained by the standard method with omission of Reduction reagent generated no fluorescence. *Panel B:* Cells stained by the method as written reveal S-glutathionylated proteins. *Panel C:* Cells treated by the method with omission of free-thiol Blocking reagent reveals labeling of all accessible protein thiols.

8-hydroxy-2-deoxy Guanosine EIA Kit 589320

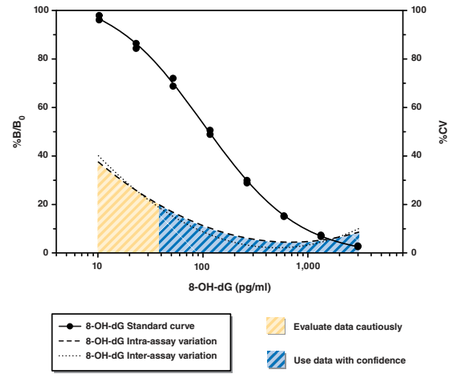
8-OH-dG

Stability: ≥1 year at -20°C

Sensitivity: 50% B/B_0: 115 pg/ml • 80% B/B_0: 33 pg/ml

Summary: 8-OH-dG is a product of oxidative damage of DNA by reactive oxygen and nitrogen species and serves as an established marker of oxidative stress. Cayman's 8-OH-dG EIA is a competitive assay that can be used for the quantification of 8-OH-dG in urine, cell culture, plasma, and other sample matrices. The EIA utilizes an anti-mouse IgG-coated plate and a tracer consisting of an 8-OH-dG AChE conjugate. This format has the advantage of providing low variability and increased sensitivity compared to assays that utilize an antigen-coated plate.

96 strip/solid wells
480 strip/solid wells



•Also Available: **8-hydroxy Guanine (89290)**
8-hydroxy Guanosine (89300)
8-hydroxy-2-deoxy Guanosine (89320)
Hydroxymethyl Uracil (89360)

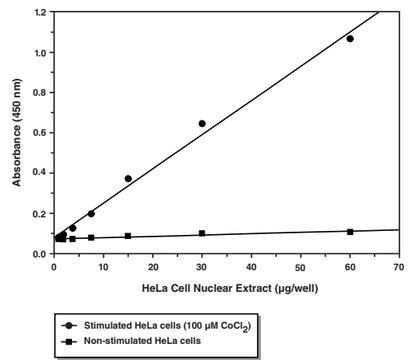
HIF-1α Transcription Factor Assay Kit 10006910

Hypoxia-inducible Factor-1α

Stability: ≥6 months at -80°C

Summary: The HIF-1α transcription factor is a member of the basic-helix-loop-helix (bHLH) family of transcription factors and plays an important role in maintaining cellular oxygen homeostasis. HIF-1α has emerged as an important drug target in breast and prostate cancer, cardiovascular disease, and ischemia. Cayman's HIF-1α Transcription Factor Assay is a sensitive ELISA-based method for detecting HIF-1α DNA binding activity in nuclear extracts and whole cell lysates.

96 wells



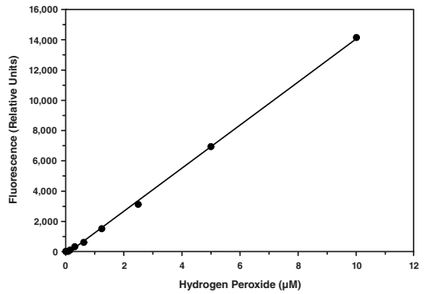
Hydrogen Peroxide Cell-Based Assay Kit 600050

H_2O_2

Stability: ≥1 year at 4°C

Summary: It is well established that H_2O_2 is a cytotoxic agent but evidence also suggests that H_2O_2 may be an important regulator of eukaryotic signal transduction. Cayman's H_2O_2 Cell-Based Assay provides a simple fluorometric method for the sensitive quantitation of H_2O_2 in cultured cells. H_2O_2 is detected using 10-acetyl-3,7-dihydroxyphenoxazine (ADHP), a highly sensitive and stable probe for H_2O_2. In the presence of horseradish peroxidase, ADHP reacts with H_2O_2 with a 1:1 stoichiometry to produce highly fluorescent resorufin (excitation = 530-560 nm; emission = 590 nm). Catalase, an H_2O_2 scavenger, is included in the kit for checking specificity of the assay.

96 wells
480 wells



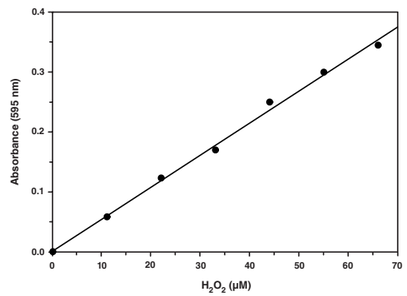
Hydrogen Peroxide (urinary) Assay Kit 706011

H_2O_2

Stability: ≥6 months at 4°C

Summary: H_2O_2 is a ubiquitous, toxic, metabolic by-product of aerobic respiration. Cayman's H_2O_2 Assay utilizes the well established xylenol orange detection method for quantifying the oxidation of ferrous ions (Fe^{2+}) to ferric ions (Fe^{3+}) by H_2O_2. A unique feature of Cayman's assay is the inclusion of catalase as an H_2O_2 scavenger for the purpose of confirming the specificity of the reaction for H_2O_2. The sensitivity and the specificity of the assay make it well suited to accurately measure urinary levels of H_2O_2.

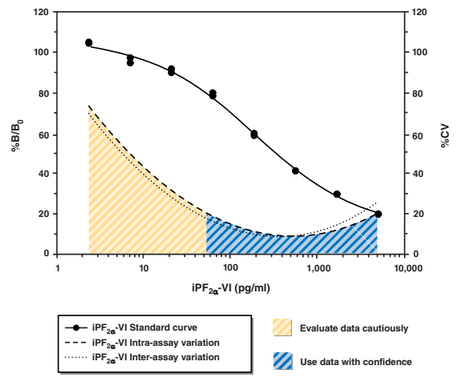
96 wells



iPF$_{2\alpha}$-VI EIA Kit 516301

Stability: ≥6 months at -20°C
Sensitivity: 50% B/B$_0$: 250 pg/ml • 80% B/B$_0$: 50 pg/ml
Summary: This assay is the first EIA method for the measurement of the more abundant iPF$_{2\alpha}$-VI isoprostane. Normal urinary levels of iPF$_{2\alpha}$-VI are 500-700 pg/mg creatinine. Cayman's iPF$_{2\alpha}$-VI EIA is a competitive assay that can be used for the quantification of iPF$_{2\alpha}$-VI from plasma, urine, cultured cells, and tissues.

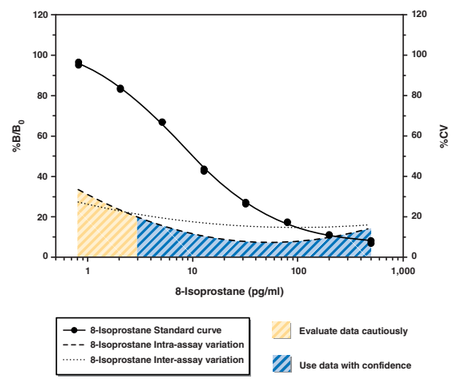
96 strip/solid wells
480 strip/solid wells



8-Isoprostane EIA Kit 516351

iPF$_{2\alpha}$-III, 8-epi PGF$_{2\alpha}$, 8-iso PGF$_{2\alpha}$
Stability: ≥1 year at -20°C
Sensitivity: 50% B/B$_0$: 10 pg/ml • 80% B/B$_0$: 2.7 pg/ml
Summary: The isoprostanes are a family of eicosanoids of non-enzymatic origin produced by the random oxidation of tissue phospholipids by oxygen radicals. 8-Isoprostane has been proposed to be a marker of antioxidant deficiency and oxidative stress. Plasma from healthy volunteers contains modest amounts of 8-isoprostane (40-100 pg/ml) that increase with the age of the test subject. Normal human urinary levels range from 10-50 ng/mmol creatinine.

96 strip/solid wells
480 strip/solid wells

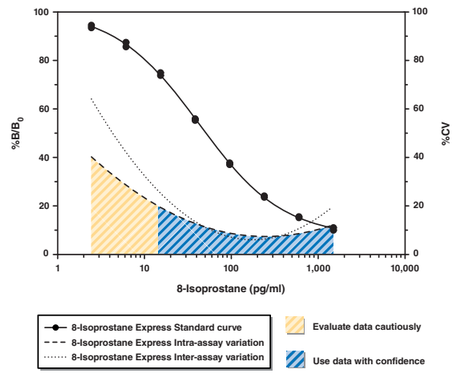


•Also Available: **8-Isoprostane Affinity Purification Kit (4 ml) (10367)**

8-Isoprostane Express EIA Kit 516360

iPF$_{2\alpha}$-III, 8-epi PGF$_{2\alpha}$, 8-iso PGF$_{2\alpha}$
Stability: ≥1 year at -20°C
Sensitivity: 50% B/B$_0$: 50 pg/ml • 80% B/B$_0$: 10 pg/ml
Summary: This assay offers the convenience of a fast assay (2 hour incubation; 1 hour development) while still achieving a detection limit (80% B/B$_0$) of 10 pg/ml.

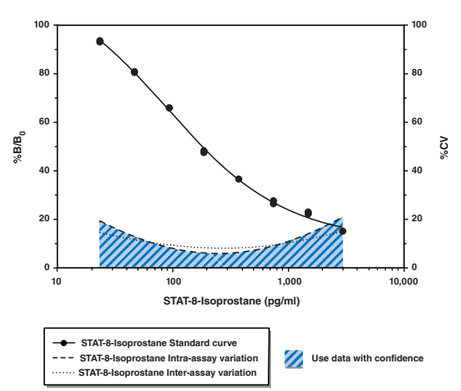
96 strip/solid wells
480 strip/solid wells



STAT-8-Isoprostane EIA Kit 500431

iPF$_{2\alpha}$-III, 8-epi PGF$_{2\alpha}$, 8-iso PGF$_{2\alpha}$
Stability: ≥1 year at -20°C
Sensitivity: 50% B/B$_0$: 180 pg/ml • 80% B/B$_0$: 45 pg/ml
Summary: Cayman's STAT-8-isoprostane EIA is a competitive assay that permits the rapid measurement of 8-iso PGF$_{2\alpha}$ from biological samples, requiring only 1 hour incubation and development times for each step. This assay format is similar to that employed in Cayman's original 8-isoprostane EIA (Item No. 516351) with the only change being the use of an alkaline phosphatase tracer in place of an AChE tracer. While Item No. 516351 offers superior sensitivity (IC$_{50}$ = ~35 pg/ml), the STAT-8-isoprostane assay offers the convenience of a fast assay while still achieving an IC$_{50}$ value of 180 pg/ml and a detection limit (80% B/B$_0$) of approximately 45 pg/ml.

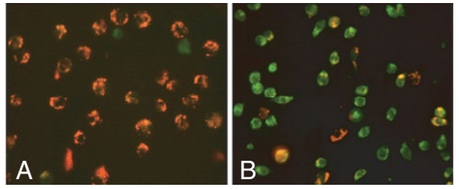
96 strip/solid wells
480 strip/solid wells



JC-1 Mitochrondrial Membrane Potential Assay Kit 10009172

Stability: ≥6 months at -20°C
Summary: Mitochondrial membrane potential, Δψm, is an important parameter of mitochondrial function that is used as an indicator of cell health. JC-1 is a lipophilic, cationic dye that can selectively enter into mitochondria and reversibly change color from green to red as the membrane potential increases. In healthy cells with high mitochondrial Δψm, JC-1 spontaneously forms complexes known as J-aggregates with intense red fluorescence. On the other hand, in apoptotic or unhealthy cells with low Δψm, JC-1 remains in the monomeric form, which shows only green fluorescence. Cayman's JC-1 Mitochondrial Membrane Potential Assay provides all the necessary reagents, as well as complete instructions, for analysis of mitochondrial integrity in whole cells.

100 tests

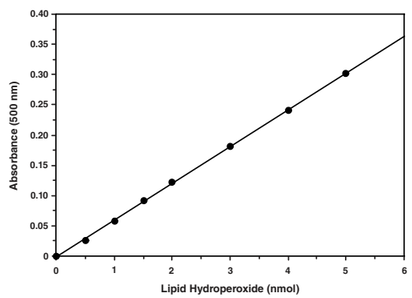


Effect of staurosporine on mitochondrial potential in Jurkat cells. *Panel A:* untreated cells show most of cells had strong J-aggregation (red). *Panel B:* staurosporine-treated cells show a majority of cells stained green due to low ΔΨm.

Lipid Hydroperoxide (LPO) Assay Kit 705002

Stability: ≥1 year at 4°C
Summary: Lipid peroxidation results in the formation of highly reactive, unstable hydroperoxides of both saturated and unsaturated lipids. Cayman's Lipid Hydroperoxide Assay measures the hydroperoxides utilizing the redox reactions with ferrous ions. An easy to use quantitative extraction method is used to extract lipid hydroperoxides into chloroform and then the extract is used directly in the assay. This kit is designed for use with either a single-tube spectrophotometer or with a 96-well microplate reader. The microplate assay requires a reusable glass plate that is supplied with the LPO Assay Kit (96 well) (Item No. 705003).

100 dtn



•Also Available: **Lipid Hydroperoxide (LPO) Assay Kit (96 well) (705003)**

Methionine Sulfoxide Immunoblotting Kit 600160

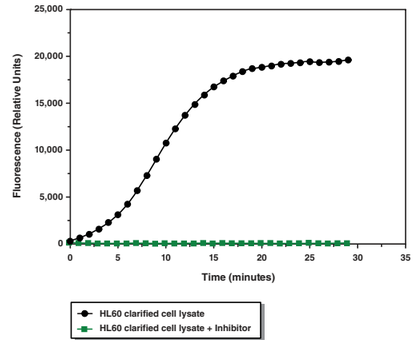
MetO
Stability: ≥1 year at -20°C
Summary: Protein MetO is a reversible oxidative modification that occurs by exposure of protein(s) methionine residues to reactive oxygen species (ROS). Cayman's MetO Immunoblotting Kit contains reagents needed for the immunochemical detection of proteins containing MetO residues by western blotting. MetO-containing samples of interest include those from cell or tissue lysates as well as semi-pure or purified proteins.

10 blots

Myeloperoxidase Chlorination Assay Kit 10006438

MPO
Stability: ≥6 months at 4°C
Summary: Cayman's Myeloperoxidase Chlorination Assay provides a convenient fluorescence-based method for detecting the MPO chlorination activity in both crude cell lysates and purified enzyme preparations. The assay utilizes the non-fluorescent probe, APF, which is selectively cleaved by hypochlorite to yield the highly fluorescent compound fluorescein. The kit includes an MPO-specific inhibitor for distinguishing MPO activity from MPO-independent fluorescence.

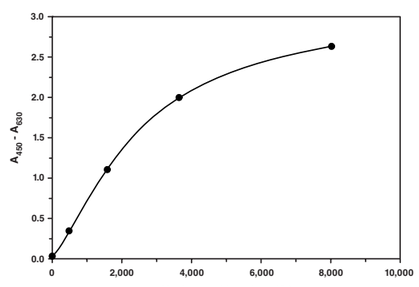
2 x 96 wells



Myeloperoxidase (human) EIA Kit 585001

MPO
Stability: ≥6 months at 4°C **Limit of Detection:** 14 pmol/L
Summary: Cayman's MPO (human) EIA is an immunometric assay (*i.e.* 'sandwich') which can be used to measure MPO in plasma without prior sample purification. This assay has been tested using plasma from healthy volunteers and the results were shown to be consistent with published data.

96 wells



vol. 14 Ox

Thomas G. Brock, Ph.D.

Isoprostanes

Reactive oxygen species (ROS) are a necessary evil. They are essential for normal cell signaling and for immune defense against many types of pathogens. However, when produced at high levels, they damage cellular components and contribute to disease. Natural mechanisms are in place to keep ROS levels in check, but, if those fail, then oxidative damage accumulates. An established biomarker of oxidative damage is 8-*epi* prostaglandin $F_{2\alpha}$, known informally as 8-isoprostane. This article touches on isoprostane production, measurement, and activity.

Isoprostane Production

The isoprostanes are a family of lipids derived from arachidonic acid (AA), produced by the random oxidation of this polyunsaturated acyl group *in situ* in membrane phospholipids by oxygen radicals. Following oxidative damage, the acyl group is excised and exported, accumulating in the extracellular milieu. Many different isoprostanes appear in the plasma and urine under normal conditions and are elevated by oxidative stress. They also appear as artifacts in tissue and plasma samples which have undergone oxidative degradation during prolonged or improper storage. Related to the isoprostanes are the neuroprostanes, derived from the most abundant polyunsaturated fatty acid in the brain, docosahexaenoic acid, and the phytoprostanes, which are produced by oxidation of α-linolenic acid in plants.

Mechanistically, isoprostane generation begins with the abstraction of a hydrogen atom from a carbon positioned between two unsaturated sites (Figure 1). On AA, this would occur at C-7, C-10, or C-13. Reaction of the resulting radical with molecular oxygen leads to the formation of a cyclopentane ring that is characteristic of the PGs as well as the isoprostanes. In fact, some isoprostanes are diastereomers of PGs that differ in configuration at only one stereogenic site. Thus, 8-*epi* prostaglandin $F_{2\alpha}$, an isoprostane produced by the non-enzymatic peroxidation of AA, differs from $PGF_{2\alpha}$, a PG biosynthesized through the COX pathway, by the bond orientation at C-8 (Figure 2). The nomenclature systems that have been applied to the isoprostanes and phytoprostanes are quite confusing and the interested reader may find a recent review to be useful.[1]

Isoprostane Measurement

There are several different methods for measuring isoprostanes. A relatively simple, reproducible, and cost-effective approach is Cayman's 8-Isoprostane EIA Kit (Item No. 516351; see page 22). This assay has been used to quantify 8-isoprostane levels in hundreds of peer-reviewed studies, including those listed in the Table at right. This competitive EIA has been used to measure 8-isoprostane in plasma, serum, urine, exhaled breath condensate, bronchoalveolar lavage fluid, induced sputum, and cell

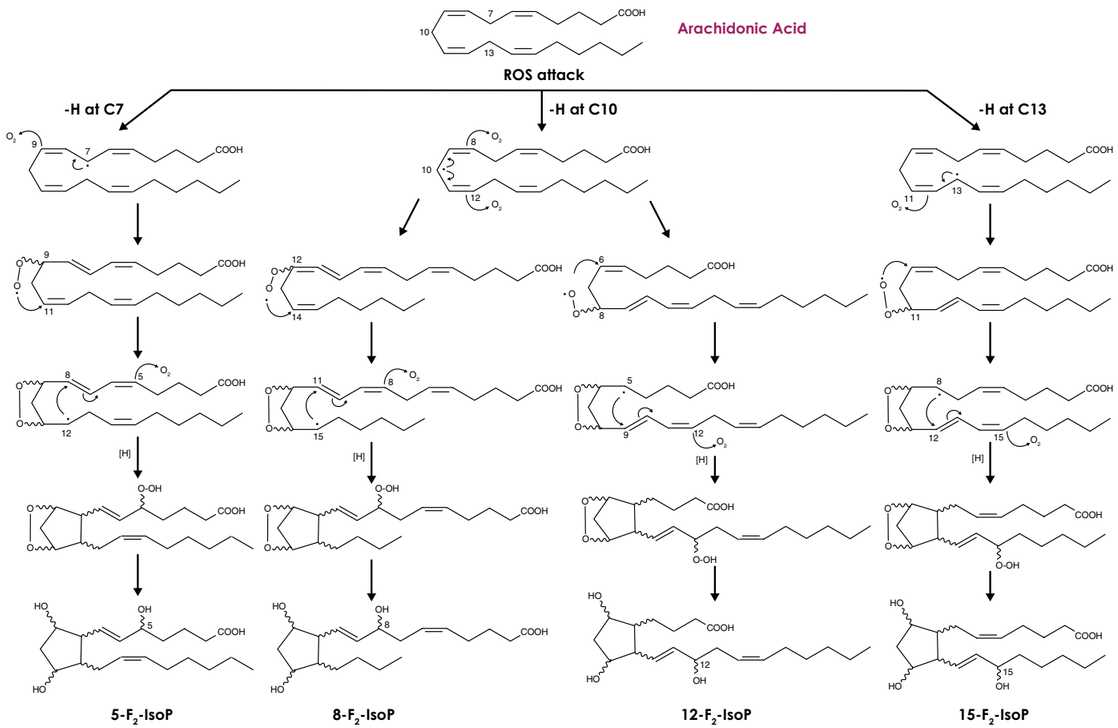


Figure 1. Pathways of isoprostane production from arachidonic acid

Recent Studies Citing the Cayman 8-Isoprostane EIA Kit (Cat. No. 516351)

Chow, S., Campbell, C., Sandrini, A., *et al.* Exhaled breath condensate biomarkers in asbestos-related lung disorders. *Respir. Med.* **103,** 1091-1097 (2009).

Cruz, M.J., Sánchez-Vidaurre, S., Romero, P.V., *et al.* Impact of age on pH, 8-isoprostane, and nitrogen oxides in exhaled breath condensate. *Chest* **135,** 462-467 (2009).

Dalaveris, E., Kerenidi, T., Katsabeki-Katsafli, A., *et al.*. VEGF, TNF-α and 8-isoprostane levels in exhaled breath condensate and serum of patients with lung cancer. *Lung Cancer* **64,** 219-225 (2009).

Elmarakby, A.A., Quigley, J.E., Imig, J.D., *et al.* TNF-α inhibition reduces renal injury in DOCA-salt hypertensive rats. *Am. J. Physiol. Regul. Integr. Comp. Physiol.* **294,** R76-R83 (2008).

Fitzpatrick, A.M., Teague, W.G., Holguin, F. , *et al.*. Airway glutathione homeostasis is altered in children with severe asthma: Evidence for oxidant stress. *J. Allergy Clin. Immunol.* **123,** 146-152 (2009).

Gong, Y., Yi, M., Fediuk, J.,*et al.* Hypoxic neonatal pulmonary arterial myocytes are sensitized to ROS-generated 8-isoprostane. *Free Radic. Biol. Med.* **48,** 882-894 (2010).

Kane, B., Borrill, Z., Southworth, T., *et al.* Reduced exhaled breath condensate pH in asthmatic smokers using inhaled corticosteroids. *Respirology* **14,** 419-423 (2009).

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Klusackova, P., Lebedova, J., Kacer, P., *et al.* Leukotrienes and 8-isoprostane in exhaled breath condensate in bronchoprovocation tests with occupational allergens. *Prostaglandins Leukot. Essent. Fatty Acids* **78,** 281-292 (2008).

Louhelainen, N., Rytilä, P., Obase, Y., *et al.* The value of sputum 8-isoprostane in detecting oxidative stress in mild asthma. *J. Asthma* **45,** 149-154 (2008).

Mannarino, E., Pirro, M., Cortese, C., *et al.* Effects of a phytosterol-enriched dairy product on lipids, sterols and 8-isoprostane in hypercholesterolemic patients: A multicenter Italian study. *Nutr. Metab. Cardiovasc. Dis.* **19,** 84-90 (2009).

Petrosyan, M., Perraki, E., Simoes, D., *et al.* Exhaled breath markers in patients with obstructive sleep apnoea. *Sleep Breath* **12,** 207-215 (2008).

Piotrowski, W.J., Kurmanowska, Z., Antczak, A., *et al.*. Exhaled 8-isoprostane as a prognostic marker in sarcoidosis. A short term follow-up. *BMC Pulm. Med.* **10,** 1-7 (2010).

Sakano, N., Takahashi, N., Wang, D.-H., *et al.* Plasma 3-nitrotyrosine, urinary 8-isoprostane and 8-OHdG among healthy Japanese people. *Free Radic. Res.* **43,** 183-192 (2009).

Samitas, K., Chorianopoulos, D., Vittorakis, S., *et al.* Exhaled cysteinyl-leukotrienes and 8-isoprostane in patients with asthma and their relation to clinical severity. *Respir. Med.* **103,** 750-756 (2009).

Virdis, A., Colucci, R., Versari, D., *et al.* Atorvastatin prevents endothelial dysfunction in mesenteric arteries from spontaneously hypertensive rats: Role of cyclooxygenase 2-derived contracting prostanoids. *Hypertension* **53,** 1008-1016 (2009).

Wood, L.G., Simpson, J.L., Hansbro, P.M.,*et al.* Potentially pathogenic bacteria cultured from the sputum of stable asthmatics are associated with increased 8-isoprostane and airway neutrophilia. *Free Radic. Res.* **44,** 146-154 (2010).

Xie, J., Zhang, Q., Zhong, N., *et al.* BAL fluid 8-isoprostane concentrations in eosinophilic bronchitis and asthma. *J. Asthma* **46,** 712-715 (2009).

Zinelli, C., Caffarelli, C., Strid, J., *et al.* Measurement of nitric oxide and 8-isoprostane in exhaled breath of children with atopic eczema. *Clin. Exp. Dermatol.* **34,** 607-612 (2009).

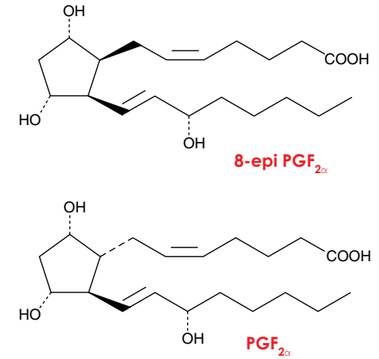

Figure 2. An isoprostane, 8-*epi* $PGF_{2\alpha}$, and a prostaglandin, $PGF_{2\alpha}$

supernatants. While the majority of these studies involve human subjects, samples from mice and rats have also been successfully assayed. These studies provide examples of 8-isoprostane measurement in diverse conditions, including asthma, hypertension, lung cancer, aging, hypercholesterolemia, chronic obstructive pulmonary disease, sclerosis, sarcoidosis, sleep apnea, and eczema.

Isoprostane Actions

Certain isoprostanes have powerful effects on the vascular system. Several studies have demonstrated that F_2-isoprostanes cause vasoconstriction.[2-6] Of these isoprostanes, the 15-, 12-, and 8-series are potent (EC_{50} values from 12.8 to 54.1 nM), while the 5-series are without effect.[4,5] 8-iso-$PGF_{2\alpha}$ also inhibits angiogenesis by blocking VEGF-induced endothelial cell migration, tube formation, and cardiac vessel sprouting.[7] In addition, 8-iso-$PGF_{2\alpha}$ stimulates the production of TGF-β in mouse mesangial cells and this may contribute to nephropathy associated with the development of type I diabetes.[8]

The actions of F_2-isoprostanes typically can be blocked by antagonists of the thromboxane A_2 (TXA_2) receptor, TP.[3,6,9,10] Treatment of smooth muscle cells or endothelial cells with 8-iso-$PGF_{2\alpha}$ stimulates the production of inositol 1,4,5-trisphophate, a second messenger of TP.[9-11] However, various F_2-series isoprostanes can increase the synthesis of TXA_2, suggesting that some of the effects of isoprostanes require the production of TXA_2.[4,5,12] On the other hand, both endothelial cells and smooth muscle cells appear to have two distinct binding sites for 8-iso-$PGF_{2\alpha}$, a high affinity site that is presumably an isoprostane receptor, which has thus far eluded isolation, and a lower affinity site, recognized as the TXA_2 receptor.[10] Taken together, these results indicate that, in some cases, isoprostanes stimulate TXA_2 biosynthesis, leading to TP-mediated signaling.

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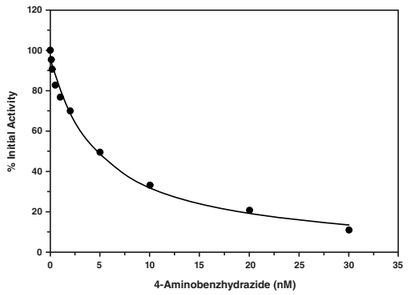
Myeloperoxidase Inhibitor Screening Assay Kit 700170

MPO

Stability: ≥6 months at 4°C

Summary: Cayman's MPO Inhibitor Screening Assay provides fluorescence-based methods for screening inhibitors to both the chlorination and peroxidation activities of MPO. Sufficient reagents are provided for a full 96-well plate assay of each type of activity.

2 x 96 wells



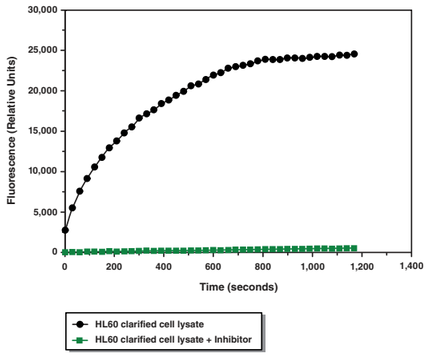
Myeloperoxidase Peroxidation Assay Kit 700160

MPO

Stability: ≥6 months at 4°C

Summary: Cayman's MPO Peroxidation Assay provides a fluorescence-based method for detecting MPO peroxidase activity in both crude cell lysates and purified enzyme preparations. The MPO-catalyzed reaction between hydrogen peroxide and ADHP produces the highly fluorescent compound resorufin. The kit includes an MPO-specific inhibitor for distinguishing MPO activity from MPO-independent fluorescence.

2 x 96 wells



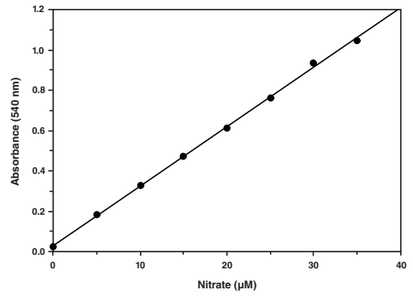
Nitrate/Nitrite Colorimetric Assay Kit 780001

Nitric Oxide Metabolite Detection Kit

Stability: ≥1 year at -20°C

Summary: Cayman's Nitrate/Nitrite Assay provides an accurate and convenient method for measurement of total nitrate/nitrite concentrations. This kit can be used to measure nitrate and nitrite in plasma, serum, urine, tissue culture media, and tissue homogenates.

2 x 96 wells



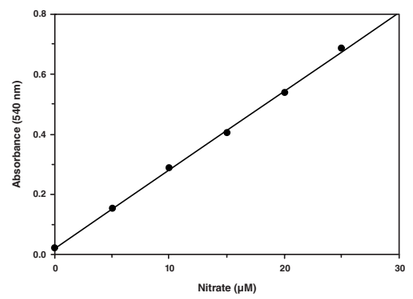
Nitrate/Nitrite Colorimetric Assay Kit (LDH method) 760871

Nitric Oxide Metabolite Detection Kit

Stability: ≥1 year at -20°C

Summary: NADPH is an essential cofactor for the function of the NOS enzyme. Unfortunately, NADPH interferes with the chemistry of the Griess reagents, which are the most commonly used reagents for nitrite detection. This kit uses Lactate Dehydrogenase (LDH) to oxidize the excess NADPH used in a NOS-catalyzed reaction, thereby making the assay particularly well suited to measurements of NOS activity *in vitro*.

96 wells



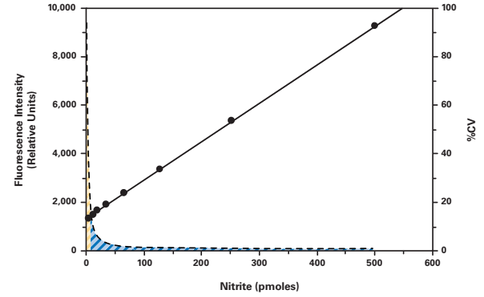
Nitrate/Nitrite Fluorometric Assay Kit 780051

Nitric Oxide Metabolite Detection Kit

Stability: ≥1 year at -20°C

Summary: Cayman's Nitrate/Nitrite Fluorometric Assay provides a convenient method for the quantitation of low levels of nitrate and nitrite in biological samples (particularly tissue culture medium). The minimum detectable quantity of NO_2/NO_3 is ~50 nM.

2 x 96 wells



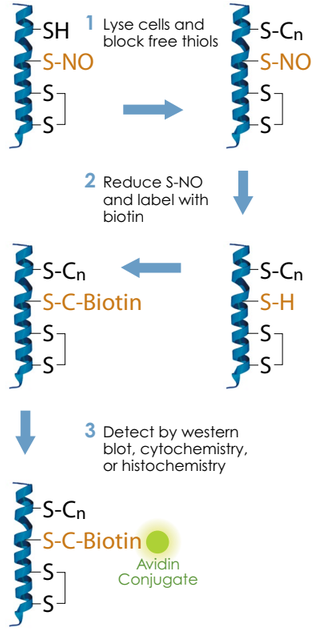
S-Nitrosylated Protein Detection Kit 10006518

SNO

Stability: ≥1 year at -20°C

Summary: Cayman's S-Nitrosylated Protein Detection Assay employs a modification of the Jaffrey *et al.* 'Biotin-switch' method to allow for the direct visualization of S-nitrosylated proteins in whole cells or tissues, as well as by WB analysis. Using this method, free SH groups are first blocked and any S-NO bonds present in the sample are then cleaved. Biotinylation of the newly formed SH groups provides the basis for visualization using streptavidin-based colorimetric or fluorescence detection.

1 ea



NOS Activity Assay Kit 781001

Stability: ≥1 year at -80°C

Summary: The NOS Activity Assay measures NOS activity by monitoring the conversion of radiolabeled arginine to citrulline. This assay is simple, sensitive, and specific for NOS activity and can be used with both crude and purified enzyme preparations. The kit includes sufficient materials and reagents for 50 total reactions. Radiolabeled arginine and NADPH are not included with the kit.

1 ea

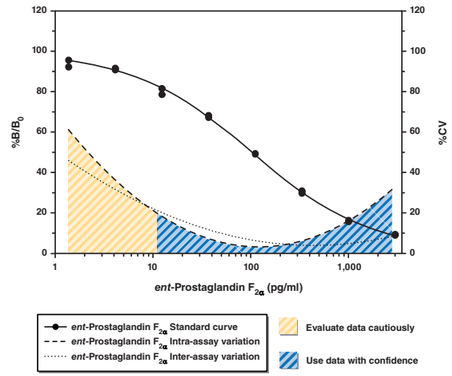
ent-Prostaglandin $F_{2\alpha}$ EIA Kit 10010382

Stability: ≥1 year at -20°C

Sensitivity: 50% B/B_0: 110 pg/ml • 80% B/B_0: 20 pg/ml

Summary: The majority of $PGF_{2\alpha}$ found in urine is formed non-enzymatically, as its formation cannot be blocked by inhibitors of COX activity. Chiral LC and GC-MS demonstrated that much of the urinary $PGF_{2\alpha}$ is the enantiomer of $PGF_{2\alpha}$, *ent*-$PGF_{2\alpha}$. Under conditions of oxidant stress, *ent*-$PGF_{2\alpha}$ increases disproportionately in relation to $PGF_{2\alpha}$. Cayman's *ent*-$PGF_{2\alpha}$ Assay is a competitive EIA that can be used for quantification of *ent*-$PGF_{2\alpha}$ in urine and other sample matrices.

96 wells
480 wells

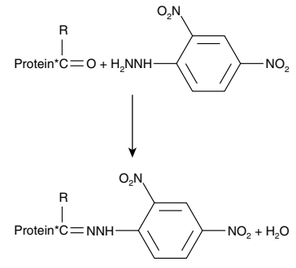


Protein Carbonyl Assay Kit 10005020

Stability: ≥1 year at 4°C

Summary: Cayman's Protein Carbonyl Assay is a colorimetric assay for the measurement of oxidized proteins. The carbonyls of protein samples are derivatized using 2,4-dinitrophenylhydrazine (DNPH). Formation of a Schiff base produces the corresponding hydrazone which can be analyzed spectrophotometrically at 360-385nm.This assay can be used to measure oxidized protein in plasma, serum, cell lysates, and tissue homogenates.

96 wells

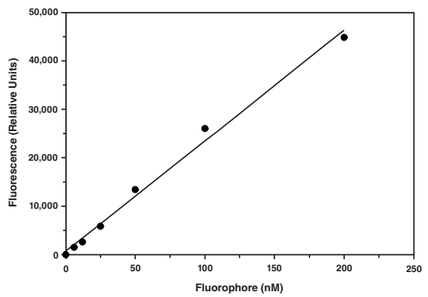


Protein Carbonyl Fluorometric Assay Kit 700490

Stability: ≥1 year at -20°C

Summary: The most general indicator, and the most commonly used marker, of protein oxidation is protein carbonyl content. Redox cycling cations such as Fe^{2+} or Cu^{2+} can bind to cation binding locations on proteins and with the aid of further attack by H_2O_2 or O_2 can transform side-chain amine groups on several amino acids (*i.e.*, lysine, arginine, proline, or histidine) into carbonyls. Cayman's Protein Carbonyl Fluorometric Assay Kit provides a reliable and sensitive method for determining protein carbonyl concentration in plasma, serum, cell lysate, and tissue homogenate samples. The assay relies on the 1:1 binding of a fluorophore to the protein carbonyl. Once bound, excess fluorophore is washed away. Any remaining fluorescence is directly proportional to protein carbonyl concentration.

96 wells



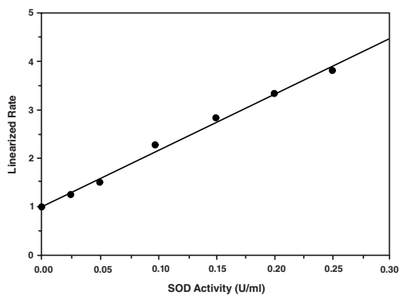
Superoxide Dismutase Assay Kit 706002

SOD

Stability: ≥1 year at -20°C

Summary: Cayman's SOD Assay is a fast and reliable assay for the measurement of SOD activity from plasma, serum, tissue homogenates, and cell lysates. SOD activity is assessed by measuring the dismutation of superoxide radicals generated by xanthine oxidase and hypoxanthine in a convenient 96-well format. A key feature of the kit is the inclusion of a quality-controlled SOD standard. The standard curve generated using this enzyme provides a means to accurately quantify the activity of all three types of SOD (Cu/Zn-, Mn-, and Fe-SOD).

96 wells
480 wells



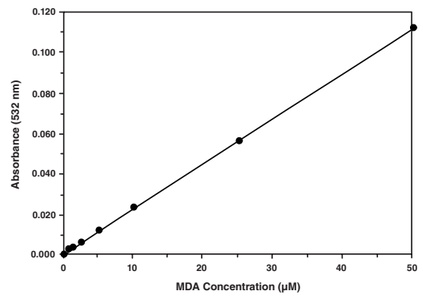
TBARS Assay Kit 10009055

Thiobarbituric Acid Reactive Substances

Stability: ≥1 year at 4°C

Summary: Decomposition of the unstable peroxides derived from oxidation of polyunsaturated fatty acids results in the formation of malondialdehyde (MDA), which can be quantified colorimetrically following its controlled reaction with thiobarbituric acid. The measurement of these TBARS is a well-established method for screening and monitoring lipid peroxidation. Cayman's TBARS Assay provides a simple, reproducible, and standardized tool for assaying lipid peroxidation in plasma, serum, urine, tissue homogenates, and cell lysates.

96 wells



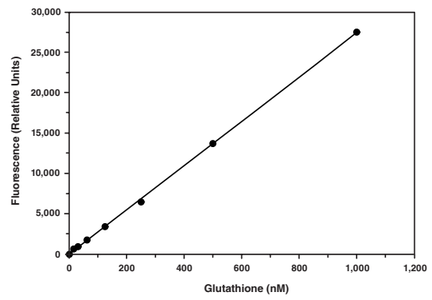
Thiol Detection Assay Kit 700340

Stability: ≥1 year at -20°C

Limit of Detection: 15 nM

Summary: The detection and measurement of free thiols (*i.e.*, free cysteine, glutathione, and cysteine residues on proteins) is one of the essential tasks for investigating biological processes and events in many biological systems. Cayman's Thiol Detection Assay provides a simple, sensitive fluorometric method for assaying free thiol content in samples (*i.e.*, plasma, serum, tissue homogenates, cell lysates, and urine), using a proprietary fluorometric detector.

96 wells
480 wells



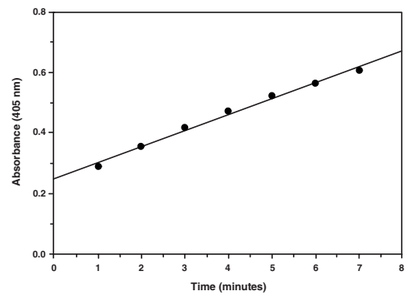
Thioredoxin Reductase Assay Kit 10007892

TrxR

Stability: ≥1 year at -20°C

Summary: Cayman's TrxR Assay provides a method for quantifying mammalian TrxR activity from tissue homogenates and cell lysates in a colorimetric 96-well plate format. In this assay, TrxR uses NADPH to reduce DTNB to 5-thio-2-nitrobenzoic acid (TNB) which absorbs strongly at 405-414 nm. Measurement of TrxR activity in the absence and in the presence of aurothiomalate, a specific TrxR inhibitor included in the kit, allows for correction of non-thioredoxin reductase-independent DTNB reduction.

96 wells



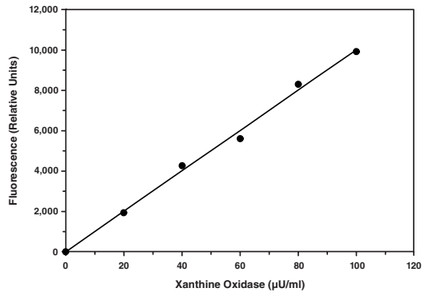
Xanthine Oxidase Assay Kit 10010895

Xanthine Oxidoreductase, XO

Stability: ≥1 year at -20°C

Summary: XO catalyzes the hydroxylation of hypoxanthine to xanthine and then further catalyzes the oxidation of xanthine to uric acid. When oxidizing NADH, XO generates superoxide, a powerful ROS. Cayman's XO Assay provides a simple and accurate method for quantifying xanthine oxidase activity. The assay is based on a multistep enzymatic reaction resulting in generation of the highly fluorescent product resorufin.

96 wells

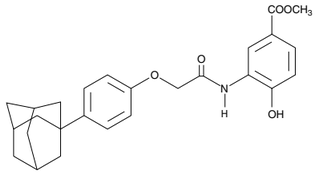


Hypoxia Inducible Factor

CAY10585 — 10012682

[934593-90-5] Hypoxia Inducible Factor-1α Inhibitor
MF: $C_{26}H_{29}NO_5$ **FW:** 435.5 **Purity:** ≥97% **Supplied as:** A crystalline solid
Summary: A novel inhibitor of HIF-1α accumulation and gene transcriptional activity; inhibits HIF-1 transcriptional activity with IC_{50} values of 2.6 and 0.7 µM in human Hep3b and AGS cells, respectively

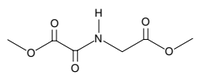
1 mg
5 mg
10 mg
25 mg



DMOG — 71210

[89464-63-1] Dimethyloxallyl Glycine
MF: $C_6H_9NO_5$ **FW:** 175.1 **Purity:** ≥98% **Supplied as:** A crystalline solid
Summary: A cell permeable, competitive inhibitor of HIF-α prolyl hydroxylase; stabilizes HIF-1α expression at normal oxygen tensions in cultured cells at concentrations between 0.1 and 1 mM

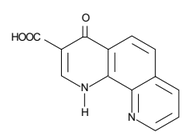
10 mg
50 mg
100 mg
500 mg



1,4-DPCA — 71220

[331830-20-7] 1,4-dihydrophenonthrolin-4-one-3-Carboxylic Acid
MF: $C_{13}H_8N_2O_3$ **FW:** 240.2 **Purity:** ≥98% **Supplied as:** A crystalline solid
Summary: A competitive inhibitor of HIF prolyl 4-hydroxylase (IC_{50} = 2.4-3.6 µM)

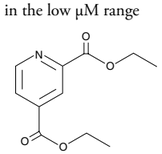
5 mg
10 mg
25 mg
50 mg



2,4-DPD — 71200

[41438-38-4] 2,4-Diethylpyridine dicarboxylate
MF: $C_{11}H_{13}NO_4$ **FW:** 223.2 **Purity:** ≥98% **Supplied as:** A solution in ethanol
Summary: A cell permeable, competitive inhibitor of HIF-α prolyl hydroxylase (HIF-PH) with effective concentrations in the low µM range

10 mg
25 mg
50 mg
100 mg



HIF-1α Monoclonal Antibody (Clone H1α67) — 10347

See the Antibodies Section on page 7 for a full lising of this product

HIF-1α (C-Term) Polyclonal Antibody — 10006421

See the Antibodies Section on page 7 for a full lising of this product

HIF-1α Transcription Factor Assay Kit — 10006910

See the Kit Section on page 21 for a full lising of this product

HIF-2α Polyclonal Antibody — 13505

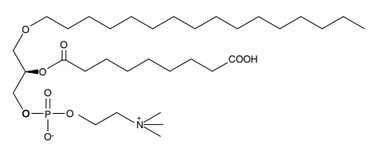
See the Antibodies Section on page 7 for a full lising of this product

Lipids

Azelaoyl PAF — 60924

MF: $C_{33}H_{66}NO_9P$ **FW:** 651.9 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: A PAF analog isolated and purified from oxLDL; acts as a potent PPARγ agonist

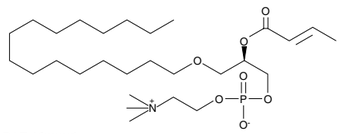
500 µg
1 mg
5 mg
10 mg



Butenoyl PAF — 60929

MF: $C_{28}H_{56}NO_7P$ **FW:** 549.7 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: A PAF analog isolated from oxLDL; retains at least 10% of the agonist potency of PAF itself but is present in oxLDL in amounts more than 100 times greater than PAF

1 mg
5 mg
10 mg
50 mg

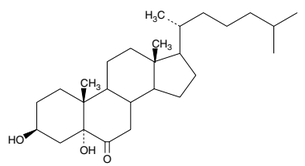


- Also Available: **Butanoyl PAF (60928)**

5α-hydroxy-6-keto Cholesterol — 10007601

[13027-33-3] Cholestane-6-oxo-3β,5α-diol, 6-Oxo-3,5-diol
MF: $C_{27}H_{46}O_3$ **FW:** 418.7 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A major metabolite of cholesterol formed during exposure of lung epithelial cells to ozone; potent inhibitor of cholesterol synthesis in human bronchial epithelial cells (IC_{50} = 350 nM); exhibits significant cytotoxicity in the low µM range

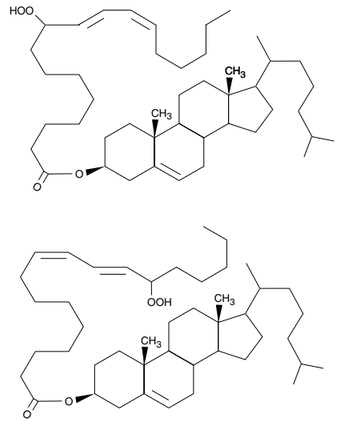
1 mg
5 mg
10 mg
50 mg



Cholesteryl Linoleate Hydroperoxides — 48001

MF: $C_{45}H_{76}O_4$ **FW:** 681.1 **Purity:** ≥98% hydroperoxide content
A solution in ethanol **Stability:** ≥6 months at -80°C
Summary: A product derived from the autoxidation of cholesteryl linoleate containing a mixture of racemic 9- and 13-HpODE cholesteryl esters

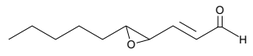
100 µg
500 µg
1 mg
5 mg



trans-4,5-epoxy-2(E)-Decenal — 10004257

[134454-31-2] 3-(3-pentyloxiranyl)-2E-propenal
MF: $C_{10}H_{16}O_2$ **FW:** 168.2 **Purity:** ≥95%
A solution in methyl acetate **Stability:** ≥1 year at -20°C
Summary: A prominent autoxidation product of either trilinolein or arachidonic acid

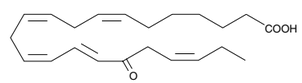
1 mg
5 mg
10 mg



17-keto-7(Z),10(Z),13(Z),15(E),19(Z)-Docosapentaenoic Acid — 9000347

MF: $C_{22}H_{32}O_3$ **FW:** 344.5 **Purity:** ≥95%
A solution in ethanol **Stability:** ≥6 months at -80°C
Summary: A metabolite of lipoxygenase-mediated oxidation of DPA; activates Nrf2-dependent antioxidant gene expression, acts as a PPARγ agonist (EC_{50} ~200nM), and inhibits pro-inflammatory cytokine and nitric oxide production at biological concentration ranges (5-25 µM)

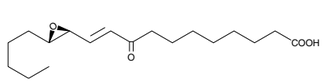
100 µg
250 µg
500 µg
1 mg



trans-EKODE-(E)-Ib — 10004224

[478931-82-7] 12,13-epoxy-9-keto-10(trans)-Octadecenoic Acid
MF: $C_{18}H_{30}O_4$ **FW:** 310.2 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: A biologically active peroxidation product of linoleic acid; activates an antioxidant response element (ARE) in neuronal cells and induces the expression of ARE-regulated cytoprotective genes; also stimulates the synthesis of aldosterone and corticosterone in adrenal cells when supplied at 1-5 µM

25 µg
50 µg
100 µg
500 µg



(±)-HETE HPLC Mixture — 34002

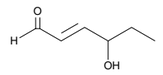
Purity: ≥98% for each compound
A solution in ethanol **Stability:** ≥2 years at -20°C
Summary: Contains 5 µg of the following HETEs: (±)5-HETE, (±)8-HETE, (±)11-HETE, (±)12-HETE, and (±)15-HETE

1 ea

4-hydroxy Hexenal — 32060

[160708-91-8] 4-HHE
MF: $C_6H_{10}O_2$ **FW:** 114.1 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥6 months at -80°C
Summary: A lipid peroxidation product derived from oxidized ω-3 fatty acids such as DHA

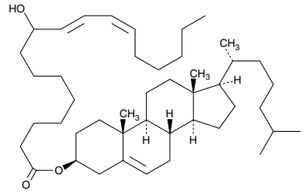
1 mg
5 mg
10 mg
25 mg



(±)9-HODE cholesteryl ester — 38401

[33783-76-5]
MF: $C_{45}H_{76}O_3$ **FW:** 665.1 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: A racemic monohydroxy fatty acid cholesteryl ester found in atherosclerotic lesions

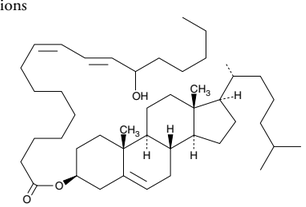
25 µg
50 µg
100 µg
250 µg



(±)13-HODE cholesteryl ester — 38601

[167354-91-8]
MF: $C_{45}H_{76}O_3$ **FW:** 665.1 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: A racemic monohydroxy fatty acid cholesteryl ester found in atherosclerotic lesions

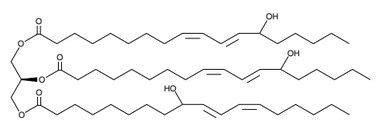
25 µg
50 µg
100 µg
500 µg



Hydroxy Linoleins — 89420

Purity: ≥98% (A mixture of 132 isomers)
A solution in ethanol **Stability:** ≥2 years at -20°C
Summary: A mixture of 132 possible isomers of mono-, di-, and tri-hydroxy compounds produced by the autoxidation of trilinolein and subsequent reduction of the hydroperoxides

500 µg
1 mg
5 mg
50 mg



vol. 14 Ox

Olivia L. May, Ph.D.

Nrf2 Antioxidant Stress Response: Managing its 'Dark Side'

There is a longstanding principle that antioxidants reduce risk of certain pathological conditions, such as cancer, diabetes, atherosclerosis, aging, and neurodegeneration. Antioxidant supplements are popularly consumed and certain dietary choices are made with the belief that externally ramping up antioxidant capacity improves the ability to ward off potential oxidative damage caused by reactive oxygen species (ROS). Recent advances made in understanding redox homeostasis maintained *via* the Keap1/Nrf2 signaling pathway may challenge this concept of artificially supplying the body with antioxidants. The feedback nature of the redox system must be considered fully, as chronic ingestion of antioxidants may actually diminish the body's endogenous, defensive antioxidant capability and could provide a favorable environment for pathological conditions to propagate.

Keap1-Nrf2 Stress Response Pathway

When confronted with oxidative stressors, cells must quickly augment their antioxidant capacity to counteract increased ROS production and maintain homeostasis. The nuclear factor erythroid 2-related factor (Nrf2) is a transcription factor that functions as the key controller of the redox homeostatic gene regulatory network (Figure 1). Under oxidative and electrophilic stresses, the Nrf2 signaling pathway is activated to enhance the expression of a multitude of antioxidant and phase II enzymes that restore redox homeostasis. Kelch-like ECH-associated protein 1 (Keap1), a cysteine-rich protein that is anchored to actin in the cytosol, interacts with Nrf2, acting as an adaptor protein for the Cul3-dependent E3 (Cul3) ubiquitin ligase complex. Under normal conditions, Keap1 promotes ubiquitination and eventual degradation of Nrf2. This is a relatively rapid event, with Nrf2 exhibiting a short half-life of 13-21 minutes.[1,2] Such rapid turnover maintains a low, basal level of Nrf2. The many cysteine residues in the amino acid sequence of Keap1 enable it to act as a sensor, detecting changes in cellular redox state. An increase in intracellular ROS or electrophiles yields an increase in the oxidation or conjugation of key Keap1 cysteines (C^{151}, C^{273}, C^{288}, C^{613}), which weakens its activity as an E3 ligase adaptor. Thus, during cellular stress, Keap1 is less effective at promoting Nrf2 degradation. As Nrf2 is stabilized (half-life is extended 100-200 minutes under high levels of oxidative stress)[1,3] it enters the nucleus where it activates transcription of a host of cytoprotective genes, including the components of an antioxidant system that can balance high ROS levels.[4]

The nuclear export signal (NES), located in the transactivation domain of Nrf2 and which functions to shuffle Nrf2 out of the nucleus, is also redox sensitive. It contains a cysteine residue at position 183 that is modified under oxidative stress, which weakens the NES activity, leading to increased retention of Nrf2 in the nucleus.[5] Accumulating Nrf2 in the nucleus associates with its transcriptional partner, Maf proteins, forming a heterodimer that binds to antioxidant response elements (ARE) on the DNA of target cytoprotective genes.

The Keap1-Nrf2 pathway regulates over 600 cytoprotective genes (see table for a brief list of examples) that confer upon the cell multiple layers of protection. In short this includes: antioxidant enzymes, conjugating enzymes, proteins that enhance the export of xenobiotics and their metabolites, enzymes that participate in the synthesis and regeneration of glutathione, enzymes that promote the synthesis of reducing equivalents, enzymes that inhibit inflammation, proteins that protect against heavy metal toxicity, proteins that function to repair and remove damaged proteins, and proteins that regulate the expression of other transcription factors and growth factors.

Redox Regulation in Cancer

High levels of ROS are harmful to normal cells and lead to tumor development by inducing DNA damage, increasing cancer-causing mutations, and activating inflammatory pathways. Because of these cancer promoting activities of ROS, antioxidants are thought to reduce cancer risk. Malignant transformation further increases cellular stress, leading to even more enhanced levels of ROS. Because the Keap1-Nrf2 system protects cells from the harmful effects of oxidants and electrophiles by regulating the expression of cytoprotective proteins, it has been considered useful to exploit this pathway as a cancer therapeutic. Nrf2 has been demonstrated to be protective against tumor formation in mouse models of stomach, bladder, and skin cancer[6-10] and has been shown to be down-regulated in skin tumors in mice and in prostate cancer in humans.[10,11] The mechanism through which Nrf2 is protective against tumorigenesis has been attributed to its ability to reduce the amount of ROS and DNA damage in cells. Conversely, it has also been suggested that constitutive Nrf2 activity can be beneficial for tumor survival. Recent work indicates Nrf2 overexpression in head and neck squamous cell carcinomas[12] and there is a correlation of aggressive, chemoresistant endometrial tumors with high Nrf2 expression.[13]

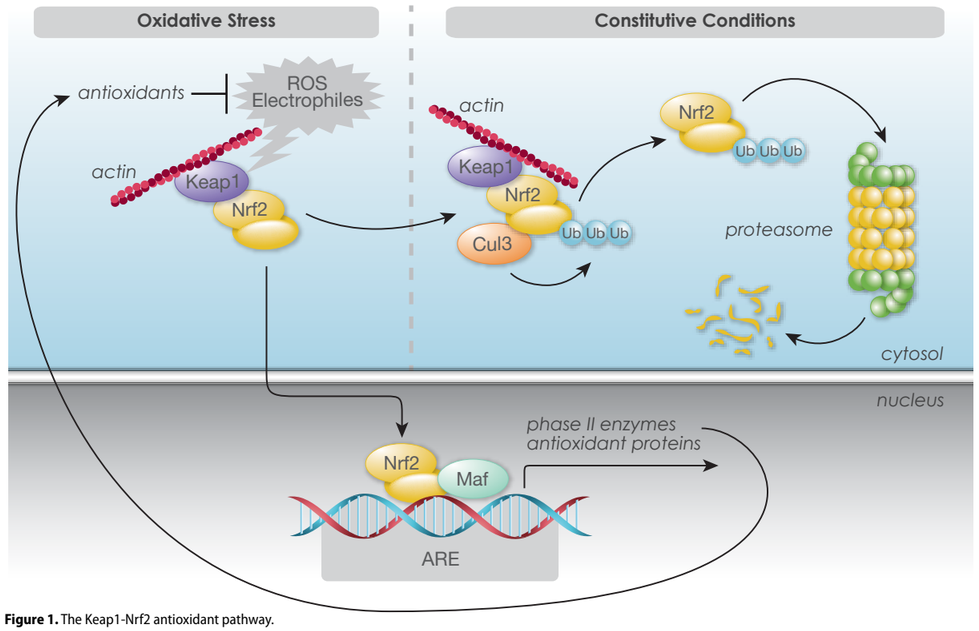


Figure 1. The Keap1-Nrf2 antioxidant pathway.

Nrf2-dependent genes	Function
NQO1	FAD-dependent flavoprotein that catalyzes 2-electron reductions of quinones, quinoneimines, nitroaromatics, and azo dyes
Aldo-Keto Reductases (AKRs)	Catalyze NAD(P)H-dependent reductions of the carbonyl groups of aliphatic and aromatic aldehydes and ketones, retinals, ketoprostaglandins, and ketosteroids
Sulfotransferases (SULFs)	Catalyze sulfation of various xenobiotics
Uridine Diphosphoglucuronosyltransferases (UGTs)	Catalyze glucuronidation of steroids, bile acids, bilirubin, dietary substances, environmental pollutants
Glutathione S-transferases (GSTs)	Catalyze the conjugation of various substrates to glutathione
Multi-Drug Resistance Associated Protein (MRP)	Exports nucleosides and prostaglandins
γ-Glutamylcysteine Ligase (GCL)	Catalyzes rate-limiting step in glutathione biosynthesis
χ-CT	Core subunit of cystine/glutamate membrane transporter, aiding in the synthesis of glutathione
Glutathione Reductase	Catalyzes reduction of oxidized glutathione and regeneration of reduced glutathione
Glucose 6-Phosphate Dehydrogenase	Provides NADPH to glutathione reductase
Malic Enzyme	NADPH-generating enzyme
Phosphogluconate Dehydrogenase	NADPH-generating enzyme
Selenocysteine-containing thioredoxin reductases/thioredoxins	Direct antioxidants and also moderate signaling pathways
Heme Oxygenase 1	Generates the antioxidants carbon monoxide and bilirubin
Ferritin	Sequesters free iron
Metallothioneins	Metal binding proteins that protect against toxicity of heavy metals and oxidative damage

This suggests that the beneficial activity of Nrf2, which protects normal cells from basal levels of ROS, can be subverted by cancer cells to protect themselves from the cellular stress-inducing conditions of the tumor microenvironment. In order to survive, even cancer cells must adapt to this toxic environment, moderating ROS levels below a certain threshold and within a range that permits their growth and survival. In such a situation, an active Nrf2 pathway could maintain a favorable redox balance and upregulate ARE-dependent genes to generate antioxidants in cancer cells to promote their survival. This tumor-protective role of Nrf2 has been referred to as its "dark side".[14]

In mice, several oncogenes have been shown to actively induce transcription of Nrf2, promoting a ROS detoxification program that creates a permissive environment for tumor formation. DeNicola *et al.*, 2011 have shown that a stress-response program is triggered early in tumor development and that the K-Ras, B-Raf, and Myc oncogenes can increase Nrf2 transcription, creating a reducing environment that enables tumor formation.[15] Furthermore they demonstrated that genetic deletion of Nrf2 in early stage cancer cells results in high ROS levels and senescence-like growth arrest. However, treatment of these Nrf2-lacking cells with antioxidants resumed tumor proliferation. Thus it seems the Nrf2 antioxidant/detoxification program can potentially be hijacked to the advantage of cancer cell survival.

Feedback, Antioxidants, and Potential Therapy

While supplementation with antioxidants is not altogether a bad idea, it's interesting to consider the broader significance of "tweaking" the stress response pathway in the context of cancer. Increased antioxidant levels lower ROS and free radical levels in cells, eventually creating a reducing intracellular environment, keeping Keap 1 in a reduced configuration. With less oxidized Keap1 present, ubiquitination and degradation of Nrf2 increases, leading to a lower basal steady-state Nrf2 level and, subsequently, lower basal levels of endogenous antioxidant and phase II enzymes. If cancer cells have adapted this ROS stress-response pathway to their advantage, then disrupting redox and ROS homeostasis is a promising strategy to treat cancer with careful, targeted selection. Raj *et al.*, 2011 have identified the small molecule, piperlongumine, a natural product isolated from the Long pepper (*Piper longum*), a plant indigenous to southern India and southeast Asia, which selectively blocks the Nrf2 program in cancer cells, sparing normal cells from toxicity.[16] These investigators hypothesize that compared to basal conditions for normal cells, malignantly transformed cells have a higher capacity to generate ROS, creating a greater dependence on the Keap1-Nrf2 antioxidant pathway to maintain a permissive growth environment. This dependency of cancer cells on ROS homeostasis seems to underlie the selectivity of piperlongumine. As such, with the rapid progress made in understanding the Keap1-Nrf2 antioxidant pathway, targeted approaches such as this provide novel strategies for cancer treatment. Piperlongumine is available from Cayman to aid in this research (see page 15).

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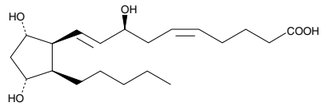
iPF$_{2\alpha}$-IV 16230

[331962-00-6]
MF: $C_{20}H_{34}O_5$ **FW:** 354.5 **Purity:** ≥98%*
A solution in acetonitrile **Stability:** ≥1 year at -20°C
Summary: An isoprostane from the relatively unexplored Type IV isoprostane family

25 µg
50 µg
100 µg
1 mg

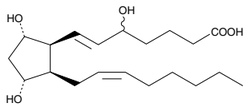


•Also Available: **iPF$_{2\alpha}$-IV-d$_4$ (316230)**

5-iPF$_{2\alpha}$-VI 16300

[180469-63-0] iPF$_{2\alpha}$-I
MF: $C_{20}H_{34}O_5$ **FW:** 354.5 **Purity:** ≥95%
A solution in acetonitrile **Stability:** ≥1 year at -20°C
Summary: An isoprostane from the unique Type VI class of isoprostanes; produced in higher concentrations compared to 8-isoprostane

25 µg
50 µg
100 µg
1 mg

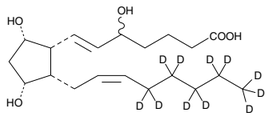


•Also Available: **5-iPF$_{2\alpha}$-IV-d$_{11}$ (10006654)**

8,12-*iso*-iPF$_{2\alpha}$-VI-d$_{11}$ 10006878

MF: $C_{20}H_{23}D_{11}O_5$ **FW:** 365.6 **Chemical Purity:** ≥95%
Deuterium Incorporation: ≤1% d_0
A solution in acetonitrile **Stability:** ≥1 year at -80°C
Summary: An internal standard for the quantification of 8,12-*iso*-iPF$_{2\alpha}$-VI by GC- or LC-MS

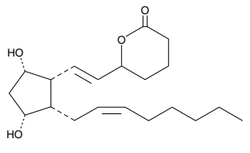
10 µg
25 µg
50 µg
100 µg



8,12-*iso*-iPF$_{2\alpha}$-VI 1,5-lactone 10312

MF: $C_{20}H_{32}O_4$ **FW:** 336.2 **Purity:** ≥98%
A solution in methyl acetate **Stability:** ≥1 year at -80°C
Summary: A racemic mixture of the lactone form of the free acid, 8,12-*iso*- iPF$_{2\alpha}$-VI; the free acid is the most abundant F$_2$-iP regioisomer measured in the urine of rats treated to induce lipid peroxidation; used as a biomarker for oxidative stress

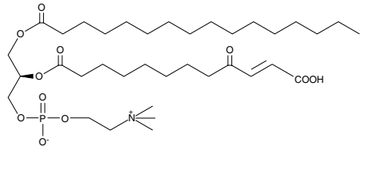
25 µg
50 µg
100 µg
1 mg



KDdiA-PC 62935

[439904-34-4]
MF: $C_{36}H_{66}NO_{11}P$ **FW:** 719.9 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: A phosphatidylcholine species containing a fragmented, oxidized short-chain fatty acid remnant at the *sn*-2 position; acts as a potent CD36 ligand

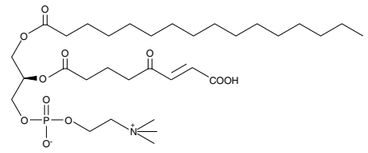
500 µg
1 mg
5 mg
10 mg



KOdiA-PC 62945

[439904-33-3]
MF: $C_{32}H_{58}O_{11}P$ **FW:** 663.8 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: A phosphatidylcholine species containing a fragmented, oxidized short-chain fatty acid remnant at the *sn*-2 position; acts as a potent CD36 ligand

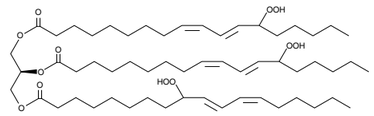
500 µg
1 mg
5 mg
10 mg



Linolein Hydroperoxides 89430

Purity: ≥98% (A mixture of 132 isomers)
A solution in ethanol **Stability:** ≥2 years at -80°C
Summary: A mixture of 132 possible isomers of mono-, di-, and tri-hydroperoxides produced from the autoxidation of trilinolein

500 µg
1 mg
5 mg
50 mg



9-Nitrooleate 10008042

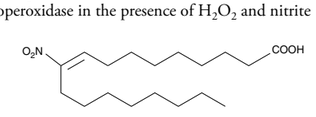
[875685-44-2] 9-nitro-9-trans-Octadecenoic Acid
MF: $C_{18}H_{33}NO_4$ **FW:** 327.5 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: Nitration product of oleic acid *in vivo* mediated by peroxynitrite, acidified nitrite, and myeloperoxidase in the presence of H_2O_2 and nitrite

50 µg
100 µg
500 µg
1 mg

10-Nitrooleate 10008043

[88127-53-1] 10-Nitro-9-trans-Octadecenoic Acid
MF: $C_{18}H_{33}NO_4$ **FW:** 327.5 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: Nitration product of oleic acid *in vivo* mediated by peroxynitrite, acidified nitrite, and myeloperoxidase in the presence of H_2O_2 and nitrite

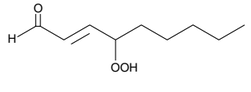
50 µg
100 µg
500 µg
1 mg



4-hydroperoxy 2-Nonenal 10004413

[7439-43-2]
MF: $C_9H_{16}O_3$ **FW:** 172.2 **Purity:** ≥95%
A solution in acetone **Stability:** ≥1 year at -80°C
Summary: Immediate precursor of 4-HNE formed from ω-6 hydroperoxides such as linoleic acid and arachidonic acid

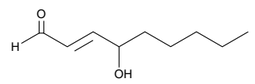
500 µg
1 mg
5 mg
10 mg



4-hydroxy Nonenal 32100

[75899-68-2] 4-HNE
MF: $C_9H_{16}O_2$ **FW:** 156.2 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥6 months at -80°C
Summary: A lipid peroxidation product derived from oxidized ω-6 PUFAs such as linoleic acid and arachidonic acid which is widely used as a marker of lipid peroxidation

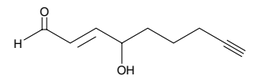
1 mg
5 mg
10 mg
50 mg



4-hydroxy Nonenal Alkyne 13265

[1011268-23-7] Click Tag ™4-HNE alkyne
MF: $C_9H_{12}O_2$ **FW:** 152.2 **Purity:** ≥98%
A solution in methyl acetate **Stability:** ≥6 months at -80°C
Summary: A form of 4-HNE with a terminal alkyne; for use in linking reactions (click chemistry) for detection of 4-HNE-modified DNA and proteins

100 µg
500 µg
1 mg
5 mg

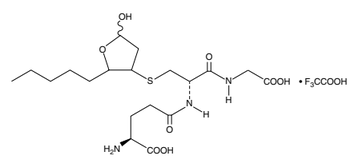


•Also Available: **4-hydroxy Nonenal-d3 (332101)**

4-hydroxy Nonenal Glutathione 10627

4-HNE-GSH
MF: $C_{19}H_{33}N_3O_8S$ **FW:** 463.6 **Purity:** ≥95%
A crystalline solid **Stability:** ≥1 year at -80°C
Summary: A major adduct formed by the reaction of HNE with GSH; HNE-GSH levels in liver, plasma, or isolated cells can serve as biomarkers for oxidative stress

1 mg
5 mg
10 mg
25 mg

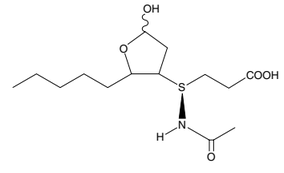


•Also Available: **4-hydroxy Nonenal Glutathione-d$_3$ (9000876)**

4-hydroxy Nonenal Mercapturic Acid 32110

[146764-24-1]
MF: $C_{14}H_{25}NO_5S$ **FW:** 319.4 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: Primary urinary metabolite of 4-HNE

1 mg
5 mg
10 mg
25 mg

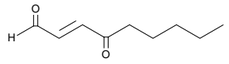


•Also Available: **4-hydroxy Nonenal Mercapturic Acid-d$_3$ (9000348)**

4-oxo-2-Nonenal 10185

[103560-62-9] 4-ONE
MF: $C_9H_{14}O_2$ **FW:** 154.2 **Purity:** ≥98%
A solution in methyl acetate **Stability:** ≥6 months at -80°C
Summary: A lipid peroxidation product; actively modifies histidine and lysine residues on proteins and causes protein cross-linking

500 µg
1 mg
5 mg
10 mg



•Also Available: **4-oxo 2-Nonenal-d$_3$ (10004174)**

Oxidized Lipid HPLC Mixture 34004

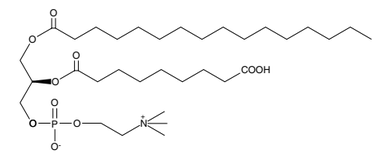
Purity: ≥98% for each compound
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: Contains the free acid forms of racemic 15-HETE, 9-HODE, and 13-HODE, as well as racemic 9-HODE and 13-HODE cholesteryl esters (5 µg each)

1 ea

PAz-PC 62924

[117746-89-1] Azelaoyl PC, 1-Palmitoyl-2-Azelaoyl PC
MF: $C_{33}H_{64}NO_{10}P$ **FW:** 665.8 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: A predominant low molecular weight component of oxidized LDL with cytotoxic and pro-atherogenic properties

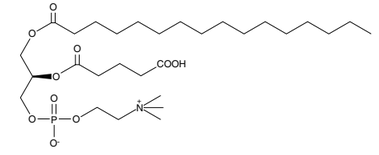
1 mg
5 mg
10 mg
25 mg



PGPC 10044

[89947-79-5]
MF: $C_{29}H_{56}NO_{10}P$ **FW:** 609.7 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: A predominant low molecular weight species of oxidized LDL; induces the expression of both E-selectin and VCAM-1, and increases endothelial cell binding by both neutrophils and monocytes

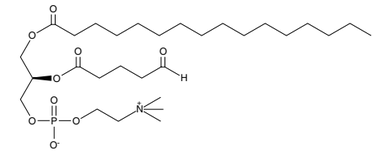
500 µg
1 mg
5 mg
10 mg



POV-PC 10031

[121324-31-0] 2-(5-oxovaleryl) Phosphatidylcholine
MF: $C_{29}H_{56}NO_9P$ **FW:** 593.7 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: One of the oxLDL species derived from 2-arachidonoyl or eicosapentanoyl phospholipids; confers CD36 scavenger receptor binding affinity of oxLDL

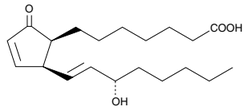
1 mg
5 mg
10 mg
25 mg



8-*iso* Prostaglandin A_1 10035

[211186-29-7] 8-epi PGA_2
MF: $C_{20}H_{32}O_4$ **FW:** 334.5 **Purity:** ≥97%*
A solution in methyl acetate **Stability:** ≥2 years at -20°C
Summary: One of several isoprostanes produced from peroxidation of arachidonic acid esterified in phospholipids

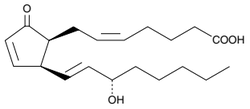
1 mg
5 mg
10 mg
50 mg



8-*iso* Prostaglandin A_2 10235

8-epi PGA_2
MF: $C_{20}H_{30}O_4$ **FW:** 334.5 **Purity:** ≥98%*
A solution in methyl acetate **Stability:** ≥1 year at -20°C
Summary: One of several isoprostanes produced from peroxidation of arachidonic acid esterified in phospholipids

1 mg
5 mg
10 mg
50 mg

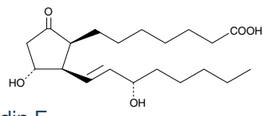


•Also Available: **8-iso Prostaglandin A_2-biotin (10010500)**

8-*iso* Prostaglandin E_1 13360

[21003-46-3] 8-epi PGE_1, Ovinonic Acid
MF: $C_{20}H_{34}O_5$ **FW:** 354.5 **Purity:** ≥98%
A light yellow crystalline solid **Stability:** ≥2 years at -20°C
Summary: An isoprostane which is found in human semen at levels of 7 µg/ml; constricts pulmonary vessels with a potency similar to $PGF_{2\alpha}$

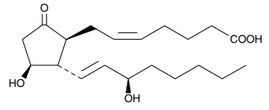
500 µg
1 mg
5 mg
10 mg



ent-Prostaglandin E_2 10008294

[65085-69-0]
MF: $C_{20}H_{32}O_5$ **FW:** 352.5 **Purity:** ≥98%*
A solution in methyl acetate **Stability:** ≥1 year at -20°C
Summary: The opposite enantiomer of PGE_2 that is generated *in vitro* and *in vivo* in settings of oxidative stress

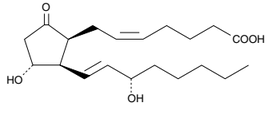
1 mg
5 mg
10 mg
50 mg



8-*iso* Prostaglandin E_2 14350

[27415-25-4] 8-epi PGE_2
MF: $C_{20}H_{32}O_5$ **FW:** 352.5 **Purity:** ≥99%*
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: One of several isoprostanes produced from arachidonic acid during lipid peroxidation; acts as a potent renal vasoconstrictor

500 µg
1 mg
5 mg
10 mg

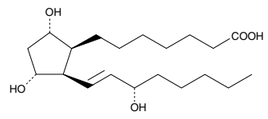


•Also Available: **8-*iso* Prostaglandin E_2-d_4 (10011321)**
8-*iso* Prostaglandin E_2 isopropyl ester (14352)
8-*iso*-16-cyclohexyl-tetranor Prostaglandin E_2 (10009278)
8-*iso*-15-keto Prostaglandin E_2 (14390)

8-*iso* Prostaglandin $F_{1\alpha}$ 15350

[26771-96-0] 8-epi $PGF_{1\alpha}$
MF: $C_{20}H_{36}O_5$ **FW:** 356.5 **Purity:** ≥99%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: An isoprostane that was first identified in human semen where it is present along with its 19-hydroxy congener at 5-10 µg/ml of seminal plasma

1 mg
5 mg
10 mg
50 mg

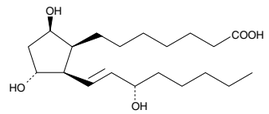


•Also Available: **8-iso Prostaglandin $F_{1\alpha}$-d_9 (10008935)**

8-*iso* Prostaglandin $F_{1\beta}$ 15370

8-epi-9β-$PGF_{1\alpha}$
MF: $C_{20}H_{36}O_5$ **FW:** 356.5 **Purity:** ≥99%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A potential autoxidation product of DGLA

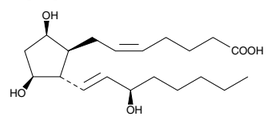
1 mg
5 mg
10 mg
50 mg



ent-Prostaglandin $F_{2\alpha}$ 10008122

[54483-31-7] (-)-$PGF_{2\alpha}$
MF: $C_{20}H_{34}O_5$ **FW:** 354.5 **Purity:** ≥98%*
A solution in methyl acetate **Stability:** ≥1 year at -20°C
Supplied as: A solution in methyl acetate
Summary: The opposite enantiomer of $PGF_{2\alpha}$ generated *via* the isoprostane pathway of free radical-catalyzed lipid peroxidation

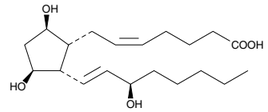
1 mg
5 mg
10 mg
50 mg



ent-8-*iso* Prostaglandin $F_{2\alpha}$ 10011545

ent-15-F_{2t}-Isoprostane, ent-8-epi $PGF_{2\alpha}$
MF: $C_{20}H_{34}O_5$ **FW:** 354.5 **Purity:** ≥98%*
A solution in acetonitrile **Stability:** ≥1 year at -20°C
Summary: A non-enzymatic, free radical peroxidation product of arachidonic acid; acts as a potent vasoconstrictor of porcine retinal and brain microvessels with EC_{50} values of 31 and 54 nM, respectively

25 µg
50 µg
100 µg
1 mg

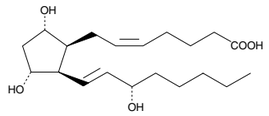


•Also Available: ***ent*-8-*iso* Prostaglandin $F_{2\alpha}$-d_9 (10011721)**
***ent*-8-*iso*-15(S)-Prostaglandin $F_{2\alpha}$ (10010380)**
***ent*-8-*iso*-15(S)-Prostaglandin $F_{2\alpha}$-d_9 (10011720)**

8-*iso* Prostaglandin $F_{2\alpha}$ 16350

[27415-26-5] $iPF_{2\alpha}$-III, 8-Isoprostane, 15-F_{2t}-Isoprostane, 8-epi $PGF_{2\alpha}$
MF: $C_{20}H_{34}O_5$ **FW:** 354.5 **Purity:** ≥99%*
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: An isoprostane produced by the non-enzymatic peroxidation of arachidonic acid in membrane phospholipids and the most frequently studied member of the isoprostane family

1 mg
5 mg
10 mg
50 mg

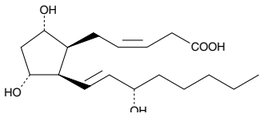


•Also Available: **8-*iso* Prostaglandin $F_{2\alpha}$-d_4 (316350)**
8-*iso* Prostaglandin $F_{2\alpha}$ Ethanolamide (10005764)
8-*iso* Prostaglandin $F_{2\alpha}$ Quant-PAK (10007652)
8-*iso*-15(R)-Prostaglandin $F_{2\alpha}$ (16395)
8-*iso*-13,14-dihydro-15-keto Prostaglandin $F_{2\alpha}$ (16380)
8-*iso*-15-keto Prostaglandin $F_{2\alpha}$ (16390)

2,3-dinor-8-*iso* Prostaglandin $F_{2\alpha}$ 16290

[221664-05-7] 2,3-dinor-$iPF_{2\alpha}$-III, 2,3-dinor-8-iso $PGF_{2\alpha}$
MF: $C_{18}H_{30}O_5$ **FW:** 326.4 **Purity:** ≥98%
A solution in methyl acetate **Stability:** ≥2 years at -20°C
Summary: An isomer of $PGF_{2\alpha}$ of non-enzymatic origin produced by free radical peroxidation of arachidonic acid

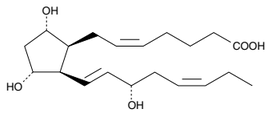
25 µg
50 µg
100 µg
1 mg



8-*iso* Prostaglandin $F_{3\alpha}$ 16992

[7045-31-0] 8-epi $PGF_{3\alpha}$, 8-iso $PGF_{3\alpha}$
MF: $C_{20}H_{32}O_5$ **FW:** 352.5 **Purity:** ≥98%*
A solution in methyl acetate **Stability:** ≥1 year at -20°C
Summary: An isoprostane produced from the free-radical peroxidation of EPA

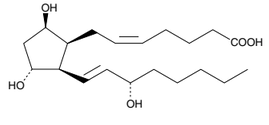
50 µg
100 µg
500 µg
1 mg



8-*iso* Prostaglandin $F_{2\beta}$ 16370

[177020-26-7] 8-epi-$PGF_{2\beta}$, 8-iso-$PGF_{2\beta}$, 8-epi-9β-$PGF_{2\alpha}$, 8-iso-9β-$PGF_{2\alpha}$
MF: $C_{20}H_{34}O_5$ **FW:** 354.5 **Purity:** ≥98%*
A solution in methyl acetate **Stability:** ≥2 years at -20°C
Summary: An isomer of $PGF_{2\alpha}$ of non-enzymatic origin produced by free radical peroxidation of arachidonic acid

1 mg
5 mg
10 mg
50 mg



•Also Available: **8-*iso*-15-keto Prostaglandin $F_{2\beta}$ (10008539)**

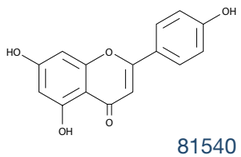
Mono-Oxidized Racemic Fatty Acids	
Item. No.	Item Name
33200	(±)4-HDoHE
33300	(±)7-HDoHE
33350	(±)8-HDoHE
33400	(±)10-HDoHE
33450	(±)11-HDoHE
33500	(±)13-HDoHE
33550	(±)14-HDoHE
33600	(±)16-HDoHE
33650	(±)17-HDoHE
33750	(±)20-HDoHE
37500	(±)11-HEDE
37505	11(R)-HEDE
37700	(±)15-HEDE
32200	(±)5-HEPE
32340	(±)8-HEPE
32400	(±)9-HEPE
32500	(±)11-HEPE
32540	(±)12-HEPE
32840	(±)18-HEPE
34210	(±)5-HETE
34340	(±)8-HETE
34400	(±)9-HETE
34500	(±)11-HETE
34550	(±)12-HETE
34700	(±)15-HETE
38400	(±)9-HODE
38600	(±)13-HODE
10138	(±)12-HpETE
10705	(±)9-HpODE
10704	(±)13-HpODE

Nitric Oxide

Apigenin 10010275

[520-36-5] Chamomile, Flavone, NSC 83244, Versulin
MF: $C_{15}H_{10}O_5$ **FW:** 270.2 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: Inhibits CK2 activity in the renal cortex with an IC_{50} value of 30 µM; potent inhibitor of NO and PGE_2 biosynthesis by reducing iNOS and COX-2 expression

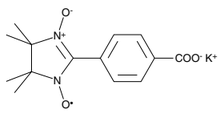
25 mg
50 mg
100 mg
500 mg



Carboxy-PTIO (potassium salt) 81540

[148819-94-7]
MF: $C_{14}H_{16}N_2O_4$ • K **FW:** 315.4 **Purity:** ≥99%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A NO scavenger, reacting stoichiometrically with NO; can be used for electron paramagnetic resonance (EPR) detection of NO

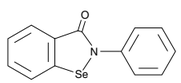
5 mg
10 mg
50 mg
100 mg



Ebselen 70530

[60940-34-3]
MF: $C_{13}H_9NOSe$ **FW:** 274.2 **Purity:** ≥99%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A glutathione peroxidase mimic and excellent scavenger of peroxynitrite with a rate constant of 2 x 10^6 $M^{-1}s^{-1}$

5 mg
10 mg
50 mg
100 mg

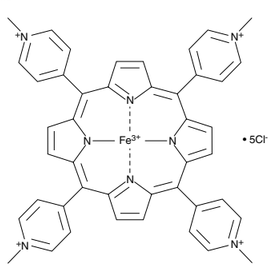


•Also Available: **Ebselen Oxide (10012298)**

FeTMPyP 75854

[133314-07-5]
MF: $C_{44}H_{36}Cl_5N_8Fe$ **FW:** 909.9 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A synthetic porphyrin complexed with iron which acts as a peroxynitrite decomposition catalyst

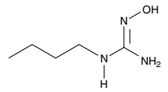
10 mg
25 mg
50 mg
100 mg



N-HBG 10006859

[140215-98-1]
MF: $C_5H_{13}N_3O$ **FW:** 131.2 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: An ω-hydroxy-L-arginine analog that serves as an efficient substrate for all three NOS isoforms

1 mg
5 mg
10 mg
25 mg



Nitrate/Nitrite Colorimetric Assay Kit 780001

See the Kit Section on page 26 for a full lising of this product

Nitrate/Nitrite Colorimetric Assay Kit (LDH method) 760871

See the Kit Section on page 26 for a full lising of this product

Nitrate/Nitrite Fluorometric Assay Kit 780051

See the Kit Section on page 27 for a full lising of this product

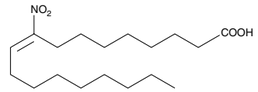
S-Nitrosylated Protein Detection Kit 10006518

See the Kit Section on page 27 for a full lising of this product

9-Nitrooleate 10008042

[875685-44-2] 9-nitro-9-trans-Octadecenoic Acid
MF: $C_{18}H_{33}NO_4$ **FW:** 327.5 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: Nitration product of oleic acid *in vivo* mediated by peroxynitrite, acidified nitrite, and myeloperoxidase in the presence of H_2O_2 and nitrite

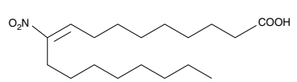
50 µg
100 µg
500 µg
1 mg



10-Nitrooleate 10008043

[88127-53-1] 10-Nitro-9-trans-Octadecenoic Acid
MF: $C_{18}H_{33}NO_4$ **FW:** 327.5 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: Nitration product of oleic acid *in vivo* mediated by peroxynitrite, acidified nitrite, and myeloperoxidase in the presence of H_2O_2 and nitrite

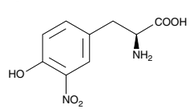
50 µg
100 µg
500 µg
1 mg



Nitrotyrosine 89540

[621-44-3]
MF: $C_9H_{10}N_2O_5$ **FW:** 226.2 **Purity:** ≥99%
A crystalline solid **Stability:** ≥2 years at room temperature
Summary: A marker of peroxynitrite-mediated nitration of protein tyrosine residues

1 g
5 g
10 g
25 g



Nitrotyrosine Affinity Sorbent 389549

Summary: The nitrotyrosine affinity sorbent consists of Cayman's nitrotyrosine monoclonal antibody conjugated to Sepharose 4B. • Application(s): IP and WB • The sorbent is designed for immunoprecipitation of nitrated proteins from biological samples. This is an effective way to concentrate nitrated proteins for subsequent detection using a different nitrotyrosine antibody, such as Cayman's Nitrotyrosine Polyclonal Antibody (Item No. 189540)

200 µg

Nitrotyrosine BSA 89542

Peroxynitrite-treated BSA
Summary: Nitrotyrosine BSA is a positive control for detection of protein tyrosine nitration by WB using nitrotyrosine antibodies.

200 µg

Nitrotyrosine Monoclonal Antibody 189542

See the Antibody Section on page 8 for a full lising of this product

Nitrotyrosine Monoclonal Antibody - Biotinylated 10006966

See the Antibody Section on page 8 for a full lising of this product

Nitrotyrosine Polyclonal Antibody 10189540

See the Antibody Section on page 8 for a full lising of this product

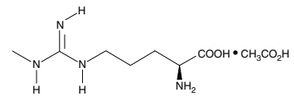
Nitrotyrosine (Peptide) Polyclonal Antibody 10006778

See the Antibody Section on page 8 for a full lising of this product

L-NMMA (acetate) 10005031

[53308-83-1]
MF: $C_7H_{16}N_4O_2$ • $C_2H_4O_2$ **FW:** 248.3 **Purity:** ≥99%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A relatively non-selective inhibitor of all NOS isoforms with K_i values of 0.18, 0.4, and 6 µM, for nNOS (rat), eNOS (human), and iNOS (mouse), respectively

5 mg
25 mg
50 g
100 mg



•Also Available: **L-NMMA (citrate) (80200)**

NOS Activity Assay Kit 781001

See the Kit Section on page 27 for a full lising of this product

eNOS (bovine recombinant) 60880

NOS III, ecNOS
MF: Homodimer M_r: 135 kDa/subunit **Purity:** cell lysate 100,000 x g supernatant
Source: Recombinant enzyme isolated from a Baculovirus overexpression system in *Sf*21 cells

10 units

•Also Available: **eNOS Electrophoresis Standard (360880)**

eNOS Polyclonal Antiserum 160880

See the Antibody Section on page 8 for a full lising of this product

iNOS (mouse recombinant) 60864

NOS II
MF: Homodimer M_r: 130 kDa/subunit **Purity:** cell lysate 100,000 x g supernatant
Source: Recombinant enzyme expressed in *E. coli*

50 units
100 units
250 units

•Also Available: **iNOS Electrophoresis Standard (360862)**

iNOS Polyclonal Antibody 160862

See the Antibody Section on page 8 for a full lising of this product

nNOS Polyclonal Antibody 160870

See the Antibody Section on page 8 for a full lising of this product

nNOS (rat recombinant) 60870

NOS I, ncNOS
MF: Homodimer M_r: 150 kDa/subunit **Purity:** cell lysate 100,000 x g supernatant
Source: Recombinant enzyme expressed in *Sf*9 cells

50 units
100 units
250 units
500 units

•Also Available: **nNOS Electrophoresis Standard (360870)**

nNOS (rat recombinant) - Purified 60875

NOS I, ncNOS
MF: Homodimer M_r: 150 kDa/subunit **Purity:** ≥95%
Source: Recombinant enzyme expressed in *Sf*9 cells • Specific activity: >500 units/mg

10 units
50 units

•Also Available: **nNOS Western Ready Control (10009632)**

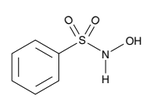
Peroxynitrite 81565

See the Antioxidant and Prooxidant Section on page 13 for a full lising of this product

Piloty's Acid 10006995

[599-71-3] Benzenesulphonydroxamic Acid
MF: $C_6H_7NO_3S$ **FW:** 173.2 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: One of the best known and most widely used nitroxyl donors

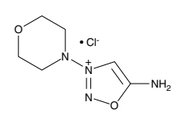
500 mg
1 g
5 g
10 g



SIN-1 Chloride 82220

[16142-27-1] Linsidomine, 3-Morpholino-sydnonimine
MF: $C_6H_{11}N_4O_2$ • Cl **FW:** 206.6 **Purity:** ≥99%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: Active metabolite of molsidomine that acts as a potent vasorelaxant and inhibitor of platelet aggregation; produces both NO and superoxide to generate peroxynitrite under physiological conditions

5 mg
10 mg
50 mg
100 mg



Nitric Oxide Donors (physiochemical data)

Item No.	Item Name	Half-life ($t_{1/2}$) (pH 7.4; 37°C)	Half-life ($t_{1/2}$) (pH 7.4; 22-25°C)	Stable Stock Solution	Miscellaneous
82230	**Angeli's Salt**	2 minutes	17-25 minutes	10 nM NaOH *(i.e.*, pH~12)	0.54 moles NO generated per mole donor; Nitroxyl donor
10010502	**CAY10562**	6 minutes (pH 5.0)			
10010526	**CAY10563**	1 minute (pH 5.0)			
10010527	**CAY10564**	1 minute (pH 5.0)			
10010528	**CAY10565**	130 minute (pH 5.0)			
82100	**DEA NONOate**	2 minutes	16 minutes	10 mM NaOH (*(i.e*, pH~12)	1.5 moles NO generated per mole donor
82120	**DETA NONOate**	20 hours	57 hours	10 mM NaOH (*(i.e*, pH~12)	2 moles NO generated per mole donor
82110	**DPTA NONOate**	3 hours	5 hours	10 mM NaOH (*(i.e.*, pH~12)	2 moles NO generated per mole donor
82290	**FK-409**	40 minutes		DMSO or pH 3-4	
10009137	**b-Gal-NONOate**	6 minutes (pH 5.0)			
82130	**MAHMA NONOate**	1 minute	3 minutes	10 mM NaOH (*(i.e.*, pH~12)	2 moles NO generated per mole donor
82200	**Molsidomine**	Requires hepatic metabolism (half-life in plasma is 1-2 hours)		Deoxygenated buffer at pH 5; DMSO or SMF	Coverted to active metabolite SIN-1; by liver esterases
82240	**S-Nitroso-L-glutathione**	Varies depending on nature of buffers; enhanced by thiols, metals, and light		Deoxygenated buffer at pH 1-2 (protect from light); use metal chelators to increase stability	
10005705	**NO-Indomethacin**				
10006456	**NO-Losartan A**				
82140	**PAPA NONOate**	15 mintues	77 minutes	10 mM NaOH (*(i.e*, pH~12)	2 moles NO genterated per mole donor
82145	**PROLI NONOate**	1.8 seconds		10 mM NaOH (*(i.e*, pH~12)	2 moles NO generated per mole donor
82340	**SE 175**	Prodrug which requires biotransformation *in vivo* prior to NO release		Neutral pH buffers (pH 7.4)	
82250	**SNAP**	6 hours at pH 7.0; varies depending on nature of buffer; enhanced by thiols, metals, and light		Deoxygenated buffer at pH 1-2 (protect from light); use metal chelators to increase stability	
82150	**Spermine NONOate**	39 minutes	230 minutes	10 mM NaOH *(i.e.*, pH~12)	2 moles NO generated per mole donor
83300	**Sulpho NONOate**	7 minutes (but does not produce NO)	24 minutes (but does not produce NO)	10 mM NaOH (*(i.e*, pH~12)	0 moles NO generated per mole donor
82160	**V-PYRRO/NO**	3 seconds following hepatic metabolism		Ethanol, aqueous solubility less than 5 mg/ml	

NOS Inhibitors

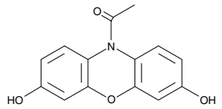
Item No.	Item Name	nNOS	eNOS	iNOS
81520	1400W (hydrochloride)	K_i = 2 µM (human)	K_i = 50 µM (human)	K_i = 7 nM (human)
81530	Aminoguanidine (hydrochloride)	IC_{50} = 160 µM (rat)		IC_{50} = 5.4 µM (mouse)
81010	AMT (hydrochloride)	IC_{50} = 34 nM (rat)	IC_{50} = 150 nM (bovine)	IC_{50} = 4.2, 3.6 nM (mouse)
10554	N^6-amino-L-Arginine (hydrochloride)	K_i = 0.3 µM	K_i = 2.5 µM	K_i = 3 µM
80230	N^6,N^6-dimethyl-L-Arginine (dihydrochloride)			IC_{50} = ~30 µM (mouse)
80587	N^ω-propyl-L-Arginine	K_i = 57 nM (bovine)	K_i = 8.5 µM (bovine)	K_i = 180 µM (mouse)
13570	N-Benzylacetamidine (hydrobromide)		IC_{50} = 350 µM	IC_{50} = 0.20 µM
81050	Diphenyleneiodonium Chloride		IC_{50} = 0.3 µM (porcine)	IC_{50} = 50 nM (mouse)
10012088	Ethyl-L-NIO (hydrochloride)	K_i =5.3 µM	K_i = 18 µM	K_i = 12 µM
80340	α-Guanidinoglutaric Acid	K_i = 2.7 µM (rat)		
81015	2-Imino-4-methylpiperidine (acetate)	IC_{50} = 0.2 µM	IC_{50} = 1.1 µM	IC_{50} = 0.1 µM (human)
81005	S-(2-aminoethyl) Isothiourea (dihydrobromide)	K_i = 1.8 µM (human)	K_i = 2.1 µM (human)	K_i = 0.59 µM (human)
81275	S-ethyl Isothiourea (hydrobromide)	K_i = 29 nM (human) IC_{50} = 250 nM (rat)	K_i = 39 nM (human) IC_{50} = 370 nM (bovine)	K_i = 19 nM (human), K_i = 5.2 nM (mouse) K_i = 14.7 nM (mouse), IC_{50} = 13 nM (mouse)
81280	S-ethyl N-[4-(trifluoromethyl)phenyl] Isothiourea (hydrochloride)	K_i = 0.32 µM (human)	K_i = 9.4 µM (human)	K_i = 37 µM (human)
81290	S-isopropyl Isothiourea (hydrobromide)	K_i = 37 nM (human)	K_i = 22 nM (human)	K_i = 9.8 nM (human)
81300	S-methyl Isothiourea (hemisulfate)	K_i = 0.16 µM (human)	K_i = 0.2 µM (human)	K_i = 0.12 µM (human)
81020	MEG (sulfate)	EC_{50} = 60 µM (rat)	EC_{50} = 110 µM (bovine)	EC_{50} = 11.5 µM (rat)
80210	L-NAME (hydrochloride)	IC_{50} = 60 µM (rat)	IC_{50} = 110 µM (bovine)	IC_{50} = 11.5 µM (rat)
80310	L-NIL (hydrochloride)	IC_{50} = 92 µM (rat)		IC_{50} = 33 µM (mouse)
80320	L-NIO (hydrochloride)	K_i = 1.7 µM (rat)	K_i = 3.9 µM (bovine) K_i = 0.5 µM (porcine)	K_i = 3.9 µM (mouse) IC_{50} = 3.0 µM (mouse)
10010252	Methyl-L-NIO (hydrochloride)	K_i = 3.0 µM	K_i = 100 µM	K_i = 9.5 µM
81340	7-Nitroindazole	IC_{50} = 0.7 µM (rat)	IC_{50} = 0.78 µM (bovine)	IC_{50} = 5.8 µM (rat)
81345	3-bromo-7-Nitroindazole	IC_{50} = 0.17 µM (rat)	IC_{50} = 0.86 µM (bovine)	IC_{50} = 0.29 µM (rat)
80220	L-NNA	K_i = 15 µM (bovine)	K_i = 39 nM (human)	K_i = 4.4 µM (mouse)
81500	1,3-PBIT (dihydrobromide)	K_i = 0.25 µM (human)	K_i = 9 µM (human)	K_i = 0.047 µM (human)
81510	1,4-PBIT (dihydrobromide)	K_i = 16 nM (human)	K_i = 360 nM (human)	K_i = 7.4 nM (human)
10011724	Propenyl-L-NIO (hydrochloride)	K_i = 10.3 µM	K_i = 58.2 µM	K_i = 17 µM
80580	L-Thiocitrulline (dihydrochloride)	K_i = 0.06 µM (rat)		K_i = 3.6 µM (rat)
80585	S-methyl-L-Thiocitrulline (hydrochloride)	K_i = 50 nM (rat) K_i = 1.2 nM (human)	K_i = 11 nM (human)	K_i = 840 nM (rat) K_i = 40 nM (human)
81310	TRIM	IC_{50} = 28.2 µM (mouse)	IC_{50} = 1,057 µM (bovine)	IC_{50} = 27 µM (rat)
80330	Vinyl-L-NIO (hydrochloride)	IC_{50} = 100 nM (rat)	IC_{50} = 12 µM (bovine)	IC_{50} = 60 µM (mouse)

Probes & Spin Traps

10-Acetyl-3,7-dihydroxyphenoxazine 10010469

[119171-73-2] A 6550, ADHP, Amplex Red®
MF: $C_{14}H_{11}NO_4$ **FW:** 257.2 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A highly sensitive, stable substrate for HRP that reacts with H_2O_2 to produce the fluorescent compound resorufin; enables detection of H_2O_2 at a concentration as low as 5 pmol per 100 µl samples

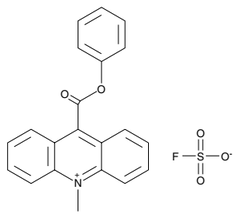
1 mg
5 mg
10 mg
25 mg



10-methyl-9-(phenoxycarbonyl) Acridinium fluorosulfonate 10007464

[149300-54-9] PMAC
MF: $C_{21}H_{16}FNO_5S$ **FW:** 413.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A sensitive tool for detection of reactive oxygen species (ROS); can be phagocytized by cells and used as an internal ROS detector when immobilized onto polymer microspheres; hypoxanthine/xanthine oxidase or hydrogen peroxide at physiological pH initiates chemiluminescence

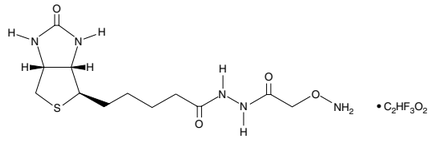
1 mg
5 mg
10 mg
50 mg



Aldehyde Reactive Probe (trifluoroacetate salt) 10009350

[627090-10-2] ARP, O-(Biotinylcarbazoylmethyl) Hydroxylamine
MF: $C_{12}H_{21}N_5O_4S \bullet C_2HF_3O_2$ **FW:** 445.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A biotinylated reagent used for the detection and quantification of apurinic/apyrimidinic (AP) sites in damaged DNA; reacts with aldehyde groups formed when reactive oxygen species depurinate DNA, thereby covalently linking biotin to these AP sites

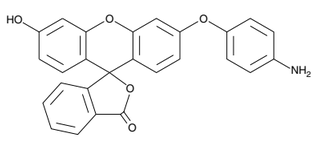
5 mg
10 mg
25 mg
50 mg



APF 10157

MF: $C_{26}H_{17}NO_5$ **FW:** 423.4 **Purity:** ≥98%
A solution in methyl acetate **Stability:** ≥1 year at -20°C
Summary: A fluorogenic fluorescein derivative that is oxidized and converted to fluorescein by the hydroxyl radical, hypochlorite ion, and certain peroxidase intermediates; inert to NO, H_2O_2, superoxide, and other oxidants

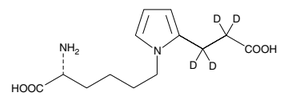
500 µg
1 mg
5 mg
10 mg



CEP-Lysine-d_4 9000595

MF: $C_{13}H_{16}D_4N_2O_4$ **FW:** 272.3 **Chemical Purity:** ≥98%
Deuterium Incorporation: ≤1% d_0
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: An internal standard for the quantification of CEP-Lysine by GC- or LC-MS

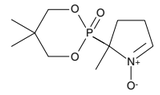
500 µg
1 mg
5 mg
10 mg



CYPMPO 10009660

MF: $C_{10}H_{18}NO_2P$ **FW:** 247.2 **Purity:** ≥95%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A free radical spin trap with excellent trapping capabilities toward hydroxyl and superoxide radicals in biological and chemical systems

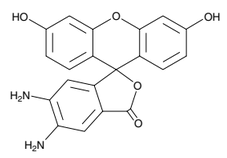
1 mg
5 mg
10 mg
50 mg



DAF-2 85160

[205391-01-1] 4,5-Diaminofluorescein
MF: $C_{20}H_{14}N_2O_5$ **FW:** 362.3 **Purity:** ≥98%
A solution in DMSO **Stability:** ≥1 year at -20°C
Summary: A sensitive fluorescent indicator commonly used for the detection of NO

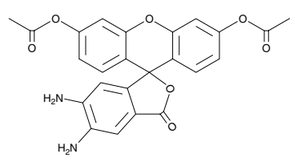
100 µg
250 µg
500 µg
1 mg



DAF-2 diacetate 85165

[205391-02-2] 4,5-Diaminofluorescein diacetate
MF: $C_{24}H_{18}N_2O_7$ **FW:** 446.4 **Purity:** ≥95%
A solution in DMSO **Stability:** ≥1 year at -20°C
Summary: A cell-permeable derivative of DAF-2 that acts as a sensitive fluorescent indicator for the detection and bioimaging of NO

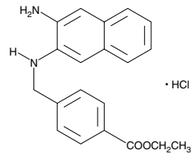
100 µg
250 µg
500 µg
1 mg



DAN-1 EE (hydrochloride) 85070

MF: $C_{20}H_{20}N_2O_2 \bullet HCl$ **FW:** 356.9 **Purity:** ≥95%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: A fluorescent indicator for the bioimaging of NO

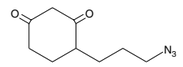
1 mg
5 mg
10 mg
50 mg



DAz-2 13382

MF: $C_9H_{13}N_3O_2$ **FW:** 195.2 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A cell-permeable chemical probe that reacts specifically with sulfenic acid-modified proteins; azido group of DAz-2 provides a method for the selective conjugation to phosphine- or alkynyl-derivatized reagents, such as biotin or various fluorophores, for subsequent analysis of the labeled proteins

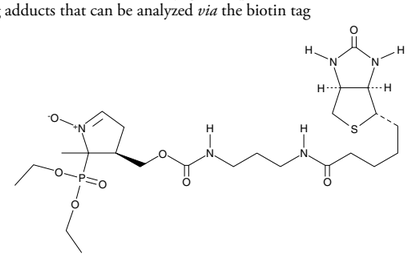
1 mg
5 mg
10 mg
25 mg



DEPMPO-biotin 13251

[936224-52-1] 4-BioS1DEPMPO, bt-DEPMPO
MF: $C_{24}H_{42}N_5O_8PS$ **FW:** 591.7 **Purity:** ≥95%
A solution in ethanol **Stability:** ≥1 year at -80°C
Summary: A biotinylated form of DEPMPO, which is used to spin trap reactive O-, N-, S-, and C-centered radicals; offers monitored biodistribution in cells, tissues and organs when used with an avidin-conjugated reporter; binds free radicals on proteins, producing adducts that can be analyzed *via* the biotin tag

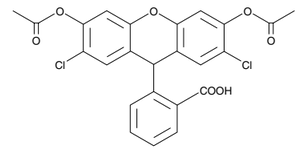
25 µg
50 µg
100 µg
250 µg



2,7-Dichlorodihydrofluorescein diacetate 85155

[4091-99-0] DCDHF diacetate, DCF
MF: $C_{24}H_{16}Cl_2O_7$ **FW:** 487.3 **Purity:** ≥95%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: A fluorescent indicator of peroxynitrite formation; neither NO, superoxide, nor hydrogen peroxide alone appear to oxidize DCDHF

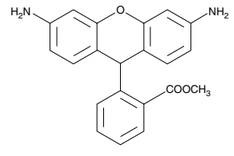
50 mg
100 mg
250 mg
500 mg



Dihydrorhodamine 123 85100

[109244-58-8] DHR
MF: $C_{21}H_{18}N_2O_3$ **FW:** 346.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A fluorophore that can be used as an indicator of peroxynitrite formation; neither NO, superoxide, nor hydrogen peroxide alone appear to oxidize DHR; used to investigate reactive oxygen intermediates produced by endothelial cells, eosinophils, and reactive microglia

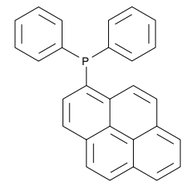
1 mg
5 mg
10 mg
25 mg



Diphenyl-1-pyrenylphosphine 62237

[110231-30-6] DPPP
MF: $C_{28}H_{19}P$ **FW:** 386.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A probe that reacts stoichiometrically with hydroperoxides to yield the fluorescent molecule diphenyl-1-pyrenylphosphine oxide (DPPP-O); also a fluorescent probe for the detection of LDL and cellular oxidation

5 mg
10 mg
25 mg
50 mg



DMPO 10006436

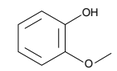
[3317-61-1] 5,5-Dimethyl-1-Pyrroline N-Oxide
MF: $C_6H_{11}NO$ **FW:** 113.2 **Purity:** ≥98%
A neat oil **Stability:** ≥1 year at room temperature
Summary: A commonly-used spin trap that reacts with O-, N-, S-, and C-centered radicals, allowing their characterization by electron spin resonance and immuno-spin trapping; is water-soluble, rapidly penetrates lipid bilayers, has low toxicity, and can be used both *in vitro* and *in vivo*

500 mg
1 g
5 g

Guaiacol 70430

[90-05-1]
MF: $C_7H_8O_2$ **FW:** 124.1 **Purity:** ≥98%
A colorless liquid **Stability:** ≥1 year at room temperature
Summary: A phenolic natural product that serves as a reducing co-substrate for peroxidase enzymes

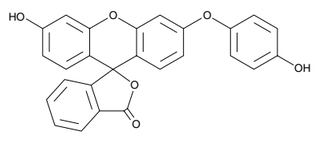
25 g
50 g
100 g
500 g



HPF 10159

MF: $C_{26}H_{16}O_6$ **FW:** 424.4 **Purity:** ≥98%
A solution in methyl acetate **Stability:** ≥1 year at -20°C
Summary: A cell-permeable aromatic amino-fluorescein derivative that can be oxidized and converted to fluorescein by ROS such as the hydroxyl radical, peroxynitrite, and ROS generated from a peroxidase/H_2O_2 system

500 µg
1 mg
5 mg
10 mg

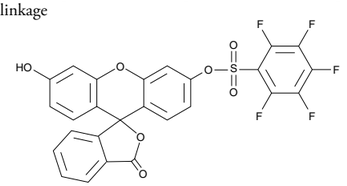


Pentafluorobenzenesulfonyl fluorescein 10005983

[728912-45-6]

MF: $C_{26}H_{11}F_7O_6S$ **FW:** 526.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A hydrogen peroxide-selective probe that fluoresces upon perhydrolysis of the sulfonyl linkage

1 mg
5 mg
10 mg
25 mg

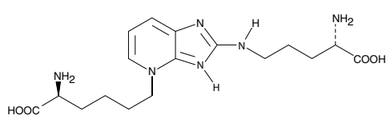


Pentosidine 10010254

[124505-87-9]

MF: $C_{17}H_{26}N_6O_4$ **FW:** 378.4 **Purity:** ≥98%
A crystalline solid **Stability:** ≥2 years at -20°C
Summary: A well-characterized natural advanced glycation end product (AGE) that is often used as a biomarker for the production of all AGEs

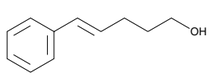
1 mg
5 mg
10 mg



PPA 75751

MF: $C_{11}H_{14}O$ **FW:** 162.2 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: Product of peroxidase-catalyzed reduction of PPHP that can be used as a reference standard for HPLC analysis of peroxidase assays

500 µg
1 mg
5 mg
10 mg

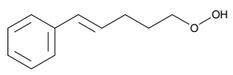


PPHP 75750

[87864-20-8]

MF: $C_{11}H_{14}O_2$ **FW:** 178.2 **Purity:** ≥98%
A solution in ethanol **Stability:** ≥1 year at -20°C
Summary: A substrate for the measurement of peroxidase enzymes

500 µg
1 mg
5 mg
10 mg

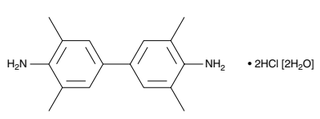


TMB (hydrochloride hydrate) 70450

[207738-08-7]

MF: $C_{16}H_{20}N_2$ • 2HCl [$2H_2O$] **FW:** 349.3 **Purity:** ≥98%
A crystalline solid **Stability:** ≥1 year at -20°C
Summary: An aromatic amine that undergoes oxidation by the higher oxidation states of heme peroxidases (compounds I and II) thereby serving as a reducing co-substrate

100 mg
250 mg
1 g
5 g



TMPD (hydrochloride) 70455

[637-01-4] Wurster's reagent, N,N,N',N'-tetramethyl-p-phenylenediamine

MF: $C_{10}H_{16}N_2$ • 2HCl **FW:** 237.2 **Purity:** ≥95%
A crystalline solid **Stability:** ≥2 years at room temperature
Summary: An easily oxidizable compound that serves as a reducing co-substrate for heme peroxidases

5 g
10 g
25 g
50 g

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