Characterization of human thioredoxin system and the potential cellular responses encoded to observe the Thioredoxin-Trx1 reversibly regulated redox sites.

Thioredoxin: human TXN, is a oxidoreductase enzyme in the status of a 12 kDa cellular redox-reductase reaction (70-kDa in bacteria, fungi and plants), a cellular defense mechanisms against oxidative stress of the cell, and numerous cytosolic processes in all cells. Txn1 is a pleiotropic cellular causative gene factor which has numerous functions. Chromosome 3p12-p11 shares homology with human thioredoxin gene Trx1, Trx80: 9q31.3; (§, ‡). Here the following reaction is the possible mechanisms of the thioredoxin-catalyzed reduction and re-oxidation of its characteristic cystine residues. The TXN gene, consists of the first of 5 exons separated by 4 introns and is located 22 bp downstream from the only known basal TATA box factor TBP-2/TXNIP vitamin D(3) up-regulated protein 1-VDUP1, negatively regulating TRX function, and exhibiting cellular growth and suppressive (cancer) activity. TRX inhibited Apoptosis signal-regulating kinase-ASK1 kinase (MAP3K5), activity, dependent on two cysteine residues in the N-terminal domain of ASK1 on the redox (regulation) forming intramolecular disulfide between the status of TXN. Two cysteine residues (N-terminal C32S or Trx C-terminal C35S and/or a Trx-CS double mutation) remaining trapped with the Ask1 as a inactive high-molecular-mass complex, blocking its reduction to release Trx from ASK1 depends on intramolecular disulfide to catalyze the reduction of the redox regulation of TRX. Trx and a thiol-specific antioxidant thioredoxin peroxidase-2 orthologue (Tpx) in various* biological phenomena is involved in redox regulation (NADPH-the thioredoxin system) of the dithiol-disulfide active site.

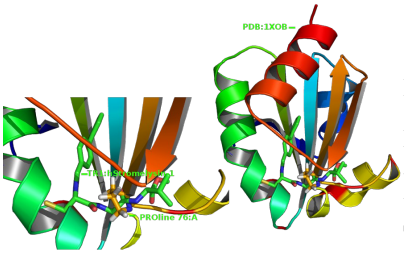
An apoptosis signal transduction pathway through stimulus-coupled S-nitrosation of cysteine, has two critical (almost identical) cysteine residues in the Trx redox-active center. Where a disulfide exchange reaction between oxidized Txnip [thioredoxin-interacting protein; mouse Vdup1] and reduced TXN occurs. Txnip (-when used to investigate cardiac hypertrophy) is a regulator of biomechanical signaling. Hydrogen peroxide downregulated expression is the only known function associated with an incomplete TRX response through stimulus-coupled S-nitrosation of cysteine residues. Peroxiredoxin PrxIII-'Tpx1 serves as' a tandem (dimer) thioredoxin (Trx2) and NADP-linked thioredoxin reductase (TRR2-TxnR1), are Trx mechanisms of the two electron donor system.

Cytosolic caspase-3 was maintained by S-nitrosation, consistent with cytosolic and

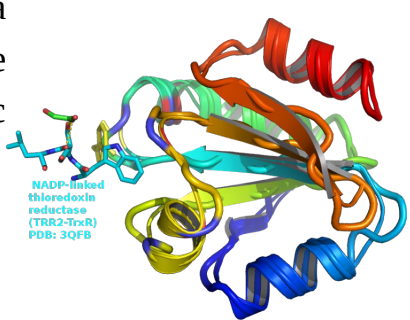
mitochondria, Trx-1 contain equivalent Trx systems, which enabled identification of caspase-3 substrates where TXN may regulate S-nitrosation with the redox center of TXN specific (C73S) to Nitric oxide-NO cellular signal transduction associated with inhibition of apoptosis or mutant Trx neurotoxicity. EGCG° (epigallocatechin-3-gallate) may be useful in cell survival on caspase-(3_dependent)-neuronal apoptosis where a membrane reaction, a reduced hormesis consequently triggers the apoptosis effect and direct or indirectly numerous protein-protein interactions and basal cofactor substrates which occur between caspase-3 and Trx. The effect of exercise training via activation of caspase-3 has a decrease in superoxide, and increase of Trx-1 levels in brain. Protection from mechanical stress identified, NSF- N-ethylmaleimide transduced into a TRX peroxidase response via mechanical force of a typical transnitrosylated Casp3, attenuated Trx1 2-cysteines which directly transnitrosylates Peroxiredoxins. C32S (redox potential) was identified as thiol-reducing system, which lacks reducing activitiy (non-active C69S and Cys(73) both monomeric) or a reversible regulating function in the presence of caspase 3 activity is a process found in the presence of NADP and TrxR. There are at least two thioredoxin reductive or oxidative** (reductases / peroxiredoxin) regulated systems. The mutant 32CXXC35' motif of thioredoxin nitrosation sites, where two cysteines are separated by two other amino acids, and codes for an additional three cysteines where the Cys 62/C73S (not monomers) sidechain the active site of Cys 62 also can form several disulphides and be modified by the carbon-bonded sulfhydryl, where the thiol reducing system, was evident. Intracellular TRX/ADF (Adult T cell leukemia-derived factor HTLV-I) can regulate cell nuclei, protein-nucleic acid interactions. Transnitrosylation and denitrosylation is a reversible Post-translational (PTM) altered by redox modification of different cysteine residues (C32-73S) in Trx1, S-nitrosation or its interactions with other proteins and DNA-dependent nuclear processes. NFKappaB - REF-1 redox factor 1 involving Cys62, in the two complexes, are correlated as N ⇔ C-terminal responses with TRX-1 nuclear migration through the reduction of a pleiotropic cellular factor. TRX redox activities of protein-protein cysteine residues is identical to a DNA repair enzyme through various cytoplasmic aspects mediating cellular responses in the 'nucleus'. The DNA binding activity and transactivation of 'AP-1' activator proteins (JUN-proto* oncogen) depends on the reduction between the sulfhydryl of cysteines to keep Trx1 reduced, is demonstrated in cells. Selenium-dependent seleneocysteine based peroxidase reductants, reduce Lipoic acid stereoselectively under the same TRX rather than GSH-PX1-glutathione peroxidase oxidative stress conditions. Sense-antisense (TRX)

antiapoptoitic interactions nitrosylated at Cys73 are attenuated and integrated into the host cell under oxidative conditions, in which thioredoxin (TRX), and a cellular TRX reducing catalyst agent (DTT-redox reagent) to S-nitrosoglutathione (GSNO) intermediate via cysteine residues 'influences'-catalyst mediated (post-translational modifications) PTMs; and possibly 1,25D(3)-Calcitriol; NADPH:oxygen oxidoreductases correlated with (Trx-1) a protein disulfide oxidoreductase. Peroxynitrite** converts superoxide to hydrogen peroxide (H2O2)-induced Trx degradation, in concentrations that detoxify reactive oxygen species (ROS), demonstrated by superoxide dismutases (SOD)-catalase: ↩ and peroxidases, converting superoxide to hydrogen peroxide which is decomposed to water plus oxidized thioredoxin to maintain the anti-apoptotic (C62) function of thioredoxins additional five sulfhydryl group thiols in the fully reduced state, in a Trx-dependent manner. Reactive oxygen species (ROS) can cause DNA damage, and uncontrolled cellular proliferation or apoptotic death of cancer cells.The NADPH (Trx system) oxidizing substrate-dependent reduction of Thioredoxin reductase-TrxR has a reversibly modulated role in restoration of GR (glucocorticoid receptor) function, and DNA binding domain.

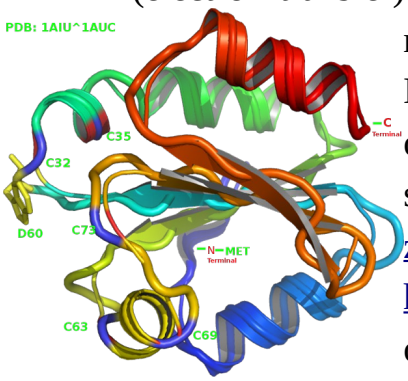
(Click on image to Zoom)



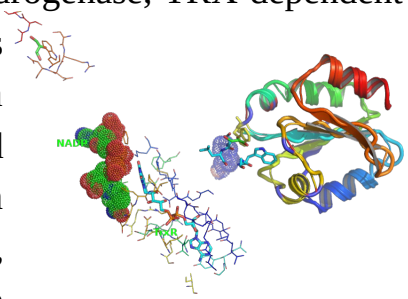
Secreted Trx may participate in removing inhibitors of collagen-degrading metalloproteinases. PMID: 14503974 the molecular mechanisms underlying functional the TR1-Trx1 redox pair and structure determination of an active site of the ligand mini-stromelysin-1 TR-1 augmentation composed of TR (Trx reductase activities) the main function of TR1 here is to reduce Trx1 also validated as a ligand PMID; 23105116, have been characterized between ligand bound and free structures PMID; 20661909, for specific isolation of C35S selenocysteine (SeCys)-containing protein shows the best docking position found, consists of one strand at position [PROline]76:A.side chain: from the four-stranded antiparallel beta sheet was with wild-type TrxA C32-35S located in the Thioredoxin_fold (PDB accession code 1XOB: PMID: 15987909) , TR1 as a single hybrid PDB (Cys32 and Cys35 for Trx1, and for TR1) pubmed/20536427 investigate the possible mechanism. {{{During this reduction, the thiol-disulfide oxidoreductase thioredoxin-1 (Trx1) linked thioredoxin reductase (TRR2) a working model suggesting that deregulation of the thioredoxin reductase TXNRD1 and|}}} its characteristic



substrate thioredoxin (TR [1]), concomitant with diminution of their Trx reductase cellular contents is highly related to glutamate excitotoxicity PMID: 20620191; TR1: hStromelysin-1



An ET (electron transfer) mechanism from NADPH and another enzyme thioredoxin reductase pubmed/17369362 the charged residue aspartate D60 (Fig.2) pubmed/9369469/ plays a role in the degradation of proteins and in apoptotic processes induced by oxidative stress PMID: 16263712 to determine the effect of zerumbone ZSD1 (from shampoo ginger; Name: Alpha-humulene) on NADP-malate dehydrogenase, TRX dependent oxidoreductase, that NADPH does not contain. Monomeric Thioredoxin is present across phyla from humans to plants PMID: 20661909, 11012661 mediated in vivo by thioredoxin-catalyzed reduction and re-oxidation of cystine residues PubMed id: 10196131 (Fig.3-PDB: 1CIV, NADP). Trx is able to activate vegetal NADP-malate dehydrogenase PMID: 3170595 (excluding the initial methionine) Met is located at the N-terminal - PMID: 11807942, 2684271. A relatively rigid local configuration for the TRX-aspartate residue D60 is found but which implies that the (NADP-TrxR) protein fluctuates among the numerous protein models and mutations over the time scales fluctuations.



- Trx (thioredoxin) a redox-regulating protein also controls the antioxidant enzyme activity of the main cellular antioxidant enzymes (AOE) superoxide dismutase (SOD) and catalase.[↩]

(Reference: 1-189)

Solution structure of human thioredoxin in a mixed disulfide intermediate complex with its target peptide from the transcription factor NF kappa B.Qin J, Clore GM, Kennedy WM, Huth JR, Gronenborn AM.Structure. 1995 Mar 15;3(3):289-97.PMID:7788295

Thioredoxin: a redox-regulating cellular cofactor for glucocorticoid hormone action. Cross talk between endocrine control of stress response and cellular antioxidant defense system.Makino Y, Okamoto K, Yoshikawa N, Aoshima M, Hirota K, Yodoi J, Umesono K, Makino I, Tanaka H., J Clin

Invest. 1996 Dec 1;98(11):2469-77.PMID:8958209
Physiological functions of thioredoxin and thioredoxin reductase.Arnér ES, Holmgren A.,Eur J Biochem. 2000 Oct;267(20):6102-9. Review.PMID:11012661
Thioredoxin in the endocrine response to stress.Tanaka H, Makino Y, Okamoto K.Vitam Horm. 1999;57:153-75. Review.,PMID:10232049
Human thioredoxin homodimers: regulation by pH, role of aspartate 60, and crystal structure of the aspartate 60 --> asparagine mutant.Andersen JF, Sanders DA, Gasdaska JR, Weichsel A, Powis G, Montfort WR.Biochemistry. 1997 Nov 18;36(46):13979-88.PMID:9369469
AP-1 transcriptional activity is regulated by a direct association between thioredoxin and Ref-1.Hirota K, Matsui M, Iwata S, Nishiyama A, Mori K, Yodoi J.Proc Natl Acad Sci U S A. 1997 Apr 15;94(8):3633-8.PMID:9108029
Thioredoxin 1 is inactivated due to oxidation induced by peroxiredoxin under oxidative stress and reactivated by the glutaredoxin system.Du Y, Zhang H, Zhang X, Lu J, Holmgren A.J Biol Chem. 2013 Nov 8;288(45):32241-7. doi: 10.1074/jbc.M113.495150. Epub 2013 Sep 23.PMID:24062305
Thioredoxin, a mediator of growth inhibition, maps to 9q31.Heppell-Parton A, Cahn A, Bench A, Lowe N, Lehrach H, Zehetner G, Rabbitts P.Genomics. 1995 Mar 20;26(2):379-81.PMID:7601465
Truncated thioredoxin is a mitogenic cytokine for resting human peripheral blood mononuclear cells and is present in human plasma.Pekkari K, Gurunath R, Arner ES, Holmgren A.J Biol Chem. 2000 Dec 1;275(48):37474-80.PMID:10982790
Isolation and characterization of human thioredoxin-encoding genes.Tonissen KF, Wells JR.Gene. 1991 Jun 30;102(2):221-8.PMID:1874447
Genomic cloning of human thioredoxin-encoding gene: mapping of the transcription start point and analysis of the promoter.Kaghad M, Dessarps F, Jacquemin-Sablon H, Caput D, Fradelizi D, Wollman EE.Gene. 1994 Mar 25;140(2):273-8.PMID:8144037
The tert-butylhydroquinone-mediated activation of the human thioredoxin gene reveals a novel promoter structure.Osborne SA, Hawkes HJ, Baldwin BL, Alexander KA, Svingen T, Clarke FM, Tonissen KF.Biochem J. 2006 Sep 1;398(2):269-77.PMID:16712525
Involvement of thioredoxin-binding protein 2 in the antitumor activity of CD437.Matsuoka S, Tsuchiya H, Sakabe T, Watanabe Y, Hoshikawa Y, Kurimasa A, Itamochi H, Harada T, Terakawa N, Masutani H, Yodoi J, Shiota G.Cancer Sci. 2008 Dec;99(12):2485-90. doi: 10.1111/j.1349-7006.2008.00979.x. Epub 2008 Nov 17.PMID:19018770
Importin alpha1 (Rch1) mediates nuclear translocation of thioredoxin-binding protein-2/vitamin D(3)-up-regulated protein 1.Nishinaka Y, Masutani H, Oka S, Matsuo Y, Yamaguchi Y, Nishio K, Ishii Y, Yodoi J.J Biol Chem. 2004 Sep 3;279(36):37559-65. Epub 2004 Jul 2.PMID:15234975
The thioredoxin system in retroviral infection and apoptosis.Masutani H, Ueda S, Yodoi J.Cell Death Differ. 2005 Aug;12 Suppl 1:991-8. Review.PMID:15818395
Regulatory roles of thioredoxin in oxidative stress-induced cellular responses.Nishinaka Y, Masutani H, Nakamura H, Yodoi J.Redox Rep. 2001;6(5):289-95. Review.PMID:11778846
Thioredoxin-binding protein-2 (TBP-2): its potential roles in the aging process.Yoshida T, Kondo N, Oka S, Ahsan MK, Hara T, Masutani H, Nakamura H, Yodoi J.Biofactors. 2006;27(1-4):47-51. Review.PMID:17012763

Regulation of the bioavailability of thioredoxin in the lens by a specific thioredoxin-binding protein (TBP-2).Liyanage NP, Fernando MR, Lou MF.Exp Eye Res. 2007 Aug;85(2):270-9. Epub 2007 May 21.PMID:17603038

Identification of thioredoxin-binding protein-2/vitamin D(3) up-regulated protein 1 as a negative regulator of thioredoxin function and expression.Nishiyama A, Matsui M, Iwata S, Hirota K, Masutani H, Nakamura H, Takagi Y, Sono H, Gon Y, Yodoi J.J Biol Chem. 1999 Jul 30;274(31):21645-50.PMID:10419473

The histone deacetylase inhibitor SAHA arrests cancer cell growth, up-regulates thioredoxin-binding protein-2, and down-regulates thioredoxin.Butler LM, Zhou X, Xu WS, Scher HI, Rifkind RA, Marks PA, Richon VM.Proc Natl Acad Sci U S A. 2002 Sep 3;99(18):11700-5. Epub 2002 Aug 20.PMID:12189205

Vitamin D3 up-regulated protein 1 mediates oxidative stress via suppressing the thioredoxin function.Junn E, Han SH, Im JY, Yang Y, Cho EW, Um HD, Kim DK, Lee KW, Han PL, Rhee SG, Choi I.J Immunol. 2000 Jun 15;164(12):6287-95.PMID:10843682

Differential role of glutaredoxin and thioredoxin in metabolic oxidative stress-induced activation of apoptosis signal-regulating kinase 1.Song JJ, Lee YJ.Biochem J. 2003 Aug 1;373(Pt 3):845-53.PMID:12723971

A novel function of peroxiredoxin 1 (Prx-1) in apoptosis signal-regulating kinase 1 (ASK1)-mediated signaling pathway.Kim SY, Kim TJ, Lee KY.FEBS Lett. 2008 Jun 11;582(13):1913-8. doi: 10.1016/j.febslet.2008.05.015. Epub 2008 May 22.PMID:18501712

A novel class of antioxidants inhibit LPS induction of tissue factor by selective inhibition of the activation of ASK1 and MAP kinases.Luyendyk JP, Piper JD, Tencati M, Reddy KV, Holscher T, Zhang R, Luchoomun J, Chen X, Min W, Kunsch C, Mackman N.Arterioscler Thromb Vasc Biol. 2007 Aug;27(8):1857-63. Epub 2007 Jun 7.PMID:17561491

Mammalian thioredoxin is a direct inhibitor of apoptosis signal-regulating kinase (ASK) 1.Saitoh M, Nishitoh H, Fujii M, Takeda K, Tobiume K, Sawada Y, Kawabata M, Miyazono K, Ichijo H.EMBO J. 1998 May 1;17(9):2596-606.PMID:9564042

Involvement of glutaredoxin-1 and thioredoxin-1 in beta-amyloid toxicity and Alzheimer's disease.Akterin S, Cowburn RF, Miranda-Vizuete A, Jiménez A, Bogdanovic N, Winblad B, Cedazo-Minguez A.Cell Death Differ. 2006 Sep;13(9):1454-65. Epub 2005 Nov 25.PMID:16311508

The thioredoxin system in retroviral infection and apoptosis.Masutani H, Ueda S, Yodoi J.Cell Death Differ. 2005 Aug;12 Suppl 1:991-8. Review.PMID:15818395

Thioredoxin promotes ASK1 ubiquitination and degradation to inhibit ASK1-mediated apoptosis in a redox activity-independent manner.Liu Y, Min W.Circ Res. 2002 Jun 28;90(12):1259-66.PMID:12089063

Disulfide Bond-mediated multimerization of Ask1 and its reduction by thioredoxin-1 regulate H(2)O(2)-induced c-Jun NH(2)-terminal kinase activation and apoptosis.Nadeau PJ, Charette SJ, Toledano MB, Landry J.Mol Biol Cell. 2007 Oct;18(10):3903-13. Epub 2007 Jul 25.PMID:17652454

Identification of thioredoxin-binding protein-2/vitamin D(3) up-regulated protein 1 as a negative regulator of thioredoxin function and expression.Nishiyama A, Matsui M, Iwata S, Hirota K, Masutani H, Nakamura H, Takagi Y, Sono H, Gon Y, Yodoi J.J Biol Chem. 1999 Jul 30;274(31):21645-

50.PMID:10419473
Thioredoxin and TRAF family proteins regulate reactive oxygen species-dependent activation of ASK1 through reciprocal modulation of the N-terminal homophilic interaction of ASK1.Fujino G, Noguchi T, Matsuzawa A, Yamauchi S, Saitoh M, Takeda K, Ichijo H.Mol Cell Biol. 2007 Dec;27(23):8152-63. Epub 2007 Aug 27.PMID:17724081
Thioredoxin 1 is inactivated due to oxidation induced by peroxiredoxin under oxidative stress and reactivated by the glutaredoxin system.Du Y, Zhang H, Zhang X, Lu J, Holmgren A.J Biol Chem. 2013 Nov 8;288(45):32241-7. doi: 10.1074/jbc.M113.495150. Epub 2013 Sep 23.PMID:24062305
Granzyme B induction signalling pathway in acute myeloid leukemia cell lines stimulated by tumor necrosis factor alpha and Fas ligand.Guilloton F, Jean C, de Thonel A, Laurent G, Quillet-Mary A.Cell Signal. 2007 Jun;19(6):1132-40. Epub 2007 Jan 3.PMID:17258890
Effects of dietary selenium on post-ischemic expression of antioxidant mRNA.Venardos K, Ashton K, Headrick J, Perkins A.Mol Cell Biochem. 2005 Feb;270(1-2):131-8.PMID:15792362
Thioredoxin reductase - its role in epidermal redox status.Schallreuter KU, Wood JM.J Photochem Photobiol B. 2001 Nov 15;64(2-3):179-84. Review.PMID:1174440
Involvement of thioredoxin-binding protein 2 in the antitumor activity of CD437.Matsuoka S, Tsuchiya H, Sakabe T, Watanabe Y, Hoshikawa Y, Kurimasa A, Itamochi H, Harada T, Terakawa N, Masutani H, Yodoi J, Shiota G.Cancer Sci. 2008 Dec;99(12):2485-90. doi: 10.1111/j.1349-7006.2008.00979.x. Epub 2008 Nov 17.PMID:19018770
The logic of kinetic regulation in the thioredoxin system.Pillay CS, Hofmeyr JH, Rohwer JM.BMC Syst Biol. 2011 Jan 25;5:15. doi: 10.1186/1752-0509-5-15.PMID:21266044
Regulation of the catalytic activity and structure of human thioredoxin 1 via oxidation and S-nitrosylation of cysteine residues.Hashemy SI, Holmgren A.J Biol Chem. 2008 Aug 8;283(32):21890-8. doi: 10.1074/jbc.M801047200. Epub 2008 Jun 10.PMID:18544525
Mammalian thioredoxin reductase 1: roles in redox homoeostasis and characterization of cellular targets.Turanov AA, Kehr S, Marino SM, Yoo MH, Carlson BA, Hatfield DL, Gladyshev VN.Biochem J. 2010 Sep 1;430(2):285-93. doi: 10.1042/BJ20091378.PMID:20536427
Cloning and expression of a cDNA for human thioredoxin.Wollman EE, d'Auriol L, Rimsky L, Shaw A, Jacquot JP, Wingfield P, Graber P, Dessarps F, Robin P, Galibert F, et al.J Biol Chem. 1988 Oct 25;263(30):15506-12.PMID:3170595
Thioredoxin 1 delivery as new therapeutics.Nakamura H, Hoshino Y, Okuyama H, Matsuo Y, Yodoi J.Adv Drug Deliv Rev. 2009 Apr 28;61(4):303-9. Review.PMID:19385090
Physiological functions of thioredoxin and thioredoxin reductase.Arnér ES, Holmgren A.Eur J Biochem. 2000 Oct;267(20):6102-9. Review.PMID:11012661
Small changes huge impact: the role of thioredoxin 1 in the regulation of apoptosis by S-nitrosylation.Li H, Wan A, Xu G, Ye D.Acta Biochim Biophys Sin (Shanghai). 2013 Mar;45(3):153-61. doi: 10.1093/abbs/gms103. Epub 2012 Dec 4. Review.PMID:23212077
Distinction of thioredoxin transnitrosylation and denitrosylation target proteins by the ICAT quantitative approach.Wu C, Parrott AM, Liu T, Jain MR, Yang Y, Sadoshima J, Li H.J Proteomics. 2011 Oct 19;74(11):2498-509. doi: 10.1016/j.jprot.2011.06.001. Epub 2011 Jun 17.PMID:21704743
Mammalian thioredoxin reductase 1: roles in redox homoeostasis and characterization of cellular

targets.Turanov AA, Kehr S, Marino SM, Yoo MH, Carlson BA, Hatfield DL, Gladyshev VN.Biochem J. 2010 Sep 1;430(2):285-93. doi: 10.1042/BJ20091378.PMID:20536427
Selenium and the thioredoxin and glutaredoxin systems.Björnstedt M, Kumar S, Björkhem L, Spyrou G, Holmgren A.Biomed Environ Sci. 1997 Sep;10(2-3):271-9. Review.PMID:9315320
The interaction of thioredoxin with Txnip. Evidence for formation of a mixed disulfide by disulfide exchange.atwari P, Higgins LJ, Chutkow WA, Yoshioka J, Lee RT.J Biol Chem. 2006 Aug 4;281(31):21884-91. Epub 2006 Jun 9.PMID:16766796
Alterations of the thioredoxin system by hyperoxia: implications for alveolar development.Tipple TE, Welty SE, Nelin LD, Hansen JM, Rogers LK.Am J Respir Cell Mol Biol. 2009 Nov;41(5):612-9. doi: 10.1165/rcmb.2008-0224OC. Epub 2009 Feb 24.PMID:19244202
A possible interaction of thioredoxin with VDUP1 in HeLa cells detected in a yeast two-hybrid system.Yamanaka H, Maehira F, Oshiro M, Asato T, Yanagawa Y, Takei H, Nakashima Y.Biochem Biophys Res Commun. 2000 May 19;271(3):796-800.PMID:10814541
The interaction of thioredoxin with Txnip. Evidence for formation of a mixed disulfide by disulfide exchange.Patwari P, Higgins LJ, Chutkow WA, Yoshioka J, Lee RT.J Biol Chem. 2006 Aug 4;281(31):21884-91. Epub 2006 Jun 9.PMID:16766796
Thioredoxin in the cardiovascular system.World CJ, Yamawaki H, Berk BC.J Mol Med (Berl). 2006 Dec;84(12):997-1003. Epub 2006 Oct 5. Review.PMID:17021908
Effects of dietary selenium on post-ischemic expression of antioxidant mRNA.Venardos K, Ashton K, Headrick J, Perkins A.Mol Cell Biochem. 2005 Feb;270(1-2):131-8.PMID:15792362
Targeted deletion of thioredoxin-interacting protein regulates cardiac dysfunction in response to pressure overload.Yoshioka J, Imahashi K, Gabel SA, Chutkow WA, Burds AA, Gannon J, Schulze PC, MacGillivray C, London RE, Murphy E, Lee RT.Circ Res. 2007 Dec 7;101(12):1328-38. Epub 2007 Oct 4.PMID:17916779
The interaction of thioredoxin with Txnip. Evidence for formation of a mixed disulfide by disulfide exchange.Patwari P, Higgins LJ, Chutkow WA, Yoshioka J, Lee RT.J Biol Chem. 2006 Aug 4;281(31):21884-91. Epub 2006 Jun 9.PMID:16766796
Diabetes impairs exercise training-associated thioredoxin response and glutathione status in rat brain.Lappalainen Z, Lappalainen J, Oksala NK, Laaksonen DE, Khanna S, Sen CK, Atalay M.J Appl Physiol (1985). 2009 Feb;106(2):461-7. doi:10.1152/japplphysiol.91252.2008. Epub 2008 Dec 12.PMID:19074570
Reconstitution of the mitochondrial PrxIII antioxidant defence pathway: general properties and factors affecting PrxIII activity and oligomeric state.Cao Z, Bhella D, Lindsay JG.J Mol Biol. 2007 Sep 28;372(4):1022-33. Epub 2007 Jul 21.PMID:17707404
The logic of kinetic regulation in the thioredoxin system.Pillay CS, Hofmeyr JH, Rohwer JM.BMC Syst Biol. 2011 Jan 25;5:15. doi: 10.1186/1752-0509-5-15.PMID:21266044
Cloning and expression of a cDNA for human thioredoxin.Wollman EE, d'Auriol L, Rimsky L, Shaw A, Jacquot JP, Wingfield P, Graber P, Dessarps F, Robin P, Galibert F, et al.J Biol Chem. 1988 Oct 25;263(30):15506-12.PMID:3170595
Reconstitution of the mitochondrial PrxIII antioxidant defence pathway: general properties and factors affecting PrxIII activity and oligomeric state.Cao Z, Bhella D, Lindsay JG.J Mol Biol. 2007 Sep

28;372(4):1022-33. Epub 2007 Jul 21.PMID:17707404
Balancing science and practice in indicator development: the Maryland Hospital Association Quality Indicator (QI) project.Kazandjian VA, Wood P, Lawthers J.Int J Qual Health Care. 1995 Mar;7(1):39-46.PMID:7640917
Regulated protein denitrosylation by cytosolic and mitochondrial thioredoxins.Benhar M, Forrester MT, Hess DT, Stamler JS.Science. 2008 May 23;320(5879):1050-4. doi: 10.1126/science.1158265.PMID:18497292
Regulation of the catalytic activity and structure of human thioredoxin 1 via oxidation and S-nitrosylation of cysteine residues.Hashemy SI, Holmgren A.J Biol Chem. 2008 Aug 8;283(32):21890-8. doi: 10.1074/jbc.M801047200. Epub 2008 Jun 10.PMID:18544525
Thioredoxin system inhibitors as mediators of apoptosis for cancer therapy.Tonissen KF, Di Trapani G.Mol Nutr Food Res. 2009 Jan;53(1):87-103. doi: 10.1002/mnfr.200700492. Review.PMID:18979503
The role of apoptosis signal-regulating kinase 1 in cardiomyocyte apoptosis.Nishida K, Otsu K.Antioxid Redox Signal. 2006 Sep-Oct;8(9-10):1729-36. Review.PMID:16987025
Regulation of the catalytic activity and structure of human thioredoxin 1 via oxidation and S-nitrosylation of cysteine residues.Hashemy SI, Holmgren A.J Biol Chem. 2008 Aug 8;283(32):21890-8. doi: 10.1074/jbc.M801047200. Epub 2008 Jun 10.PMID:1854452
Thioredoxin promotes ASK1 ubiquitination and degradation to inhibit ASK1-mediated apoptosis in a redox activity-independent manner.Liu Y, Min W.Circ Res. 2002 Jun 28;90(12):1259-66.PMID:12089063
Regulated protein denitrosylation by cytosolic and mitochondrial thioredoxins.Benhar M, Forrester MT, Hess DT, Stamler JS.Science. 2008 May 23;320(5879):1050-4. doi: 10.1126/science.1158265.PMID:18497292
Attenuation of neuronal degeneration in thioredoxin-1 overexpressing mice after mild focal ischemia.Zhou F, Gomi M, Fujimoto M, Hayase M, Marumo T, Masutani H, Yodoi J, Hashimoto N, Nozaki K, Takagi Y.Brain Res. 2009 May 26;1272:62-70. doi: 10.1016/j.brainres.2009.03.023. Epub 2009 Mar 25.PMID:19328186
Thioredoxin is required for S-nitrosation of procaspase-3 and the inhibition of apoptosis in Jurkat cells.Mitchell DA, Morton SU, Fernhoff NB, Marletta MA.Proc Natl Acad Sci U S A. 2007 Jul 10;104(28):11609-14. Epub 2007 Jul 2.PMID:17606900
Epigallocatechin-3-gallate exhibits anti-tumor effect by perturbing redox homeostasis, modulating the release of pro-inflammatory mediators and decreasing the invasiveness of glioblastoma cells.Agarwal A, Sharma V, Tewari R, Koul N, Joseph C, Sen E.Mol Med Rep. 2008 Jul-Aug;1(4):511-5.PMID:21479441
Attenuation of neuronal degeneration in thioredoxin-1 overexpressing mice after mild focal ischemia.Zhou F, Gomi M, Fujimoto M, Hayase M, Marumo T, Masutani H, Yodoi J, Hashimoto N, Nozaki K, Takagi Y.Brain Res. 2009 May 26;1272:62-70. doi: 10.1016/j.brainres.2009.03.023. Epub 2009 Mar 25.PMID:19328186
The roles of thioredoxin in protection against oxidative stress-induced apoptosis in SH-SY5Y cells.Andoh T, Chock PB, Chiueh CC.J Biol Chem. 2002 Mar 22;277(12):9655-60. Epub 2001 Dec 19.PMID:11751890

Thioredoxin is required for S-nitrosation of procaspase-3 and the inhibition of apoptosis in Jurkat cells.Mitchell DA, Morton SU, Fernhoff NB, Marletta MA.Proc Natl Acad Sci U S A. 2007 Jul 10;104(28):11609-14. Epub 2007 Jul 2.PMID:17606900

Methylglyoxal increases cardiomyocyte ischemia-reperfusion injury via glycative inhibition of thioredoxin activity.Wang XL, Lau WB, Yuan YX, Wang YJ, Yi W, Christopher TA, Lopez BL, Liu HR, Ma XL.Am J Physiol Endocrinol Metab. 2010 Aug;299(2):E207-14. doi: 10.1152/ajpendo.00215.2010. Epub 2010 May 11.PMID:20460580

Redox regulatory mechanism of transnitrosylation by thioredoxin.Wu C, Liu T, Chen W, Oka S, Fu C, Jain MR, Parrott AM, Baykal AT, Sadoshima J, Li H.Mol Cell Proteomics. 2010 Oct;9(10):2262-75. doi: 10.1074/mcp.M110.000034. Epub 2010 Jul 21.PMID:20660346

Diabetes impairs exercise training-associated thioredoxin response and glutathione status in rat brain.Lappalainen Z, Lappalainen J, Oksala NK, Laaksonen DE, Khanna S, Sen CK, Atalay M.J Appl Physiol (1985). 2009 Feb;106(2):461-7. doi: 10.1152/japplphysiol.91252.2008. Epub 2008 Dec 12.PMID:19074570

Zerumbone-loaded nanostructured lipid carrier induces G2/M cell cycle arrest and apoptosis via mitochondrial pathway in a human lymphoblastic leukemia cell line.Rahman HS, Rasedee A, Abdul AB, Zeenathul NA, Othman HH, Yeap SK, How CW, Hafiza WA.Int J Nanomedicine. 2014 Jan 16;9:527-38. doi: 10.2147/IJN.S54346. eCollection 2014.PMID:24549090

Zerumbone, a Southeast Asian ginger sesquiterpene, markedly suppresses free radical generation, proinflammatory protein production, and cancer cell proliferation accompanied by apoptosis: the alpha,beta-unsaturated carbonyl group is a prerequisite.Murakami A, Takahashi D, Kinoshita T, Koshimizu K, Kim HW, Yoshihiro A, Nakamura Y, Jiwajinda S, Terao J, Ohigashi H.Carcinogenesis. 2002 May;23(5):795-802.PMID:12016152

Diabetes impairs exercise training-associated thioredoxin response and glutathione status in rat brain.Lappalainen Z, Lappalainen J, Oksala NK, Laaksonen DE, Khanna S, Sen CK, Atalay M.J Appl Physiol (1985). 2009 Feb;106(2):461-7. doi: 10.1152/japplphysiol.91252.2008. Epub 2008 Dec 12.PMID:19074570

Probing the chemistry of thioredoxin catalysis with force.Wiita AP, Perez-Jimenez R, Walther KA, Gräter F, Berne BJ, Holmgren A, Sanchez-Ruiz JM, Fernandez JM.Nature. 2007 Nov 1;450(7166):124-7.PMID:17972886

Thioredoxin increases exocytosis by denitrosylating N-ethylmaleimide-sensitive factor.Ito T, Yamakuchi M, Lowenstein CJ.J Biol Chem. 2011 Apr 1;286(13):11179-84. doi: 10.1074/jbc.M110.201780. Epub 2011 Feb 15.PMID:21324905

The thiol-based redox networks of pathogens: unexploited targets in the search for new drugs.Jaeger T, Flohé L.Biofactors. 2006;27(1-4):109-20. Review.PMID:17012768

Redox regulatory mechanism of transnitrosylation by thioredoxin.Wu C, Liu T, Chen W, Oka S, Fu C, Jain MR, Parrott AM, Baykal AT, Sadoshima J, Li H.Mol Cell Proteomics. 2010 Oct;9(10):2262-75. doi: 10.1074/mcp.M110.000034. Epub 2010 Jul 21.PMID:20660346

Crystal structures of reduced, oxidized, and mutated human thioredoxins: evidence for a regulatory homodimer.Weichsel A, Gasdaska JR, Powis G, Montfort WR.Structure. 1996 Jun 15;4(6):735-51.PMID:8805557

The thioredoxin system in retroviral infection and apoptosis.Masutani H, Ueda S, Yodoi J.Cell Death Differ. 2005 Aug;12 Suppl 1:991-8. Review.PMID:15818395
Distinction of thioredoxin transnitrosylation and denitrosylation target proteins by the ICAT quantitative approach.Wu C, Parrott AM, Liu T, Jain MR, Yang Y, Sadoshima J, Li H.J Proteomics. 2011 Oct 19;74(11):2498-509. doi: 10.1016/j.jprot.2011.06.001. Epub 2011 Jun 17.PMID:21704743
Redox regulatory and anti-apoptotic functions of thioredoxin depend on S-nitrosylation at cysteine 69.Haendeler J, Hoffmann J, Tischler V, Berk BC, Zeiher AM, Dimmeler S.Nat Cell Biol. 2002 Oct;4(10):743-9.PMID:12244325
Regulation of the catalytic activity and structure of human thioredoxin 1 via oxidation and S-nitrosylation of cysteine residues.Hashemy SI, Holmgren A.J Biol Chem. 2008 Aug 8;283(32):21890-8. doi: 10.1074/jbc.M801047200. Epub 2008 Jun 10.PMID:18544525
Redox potential of human thioredoxin 1 and identification of a second dithiol/disulfide motif.Watson WH, Pohl J, Montfort WR, Stuchlik O, Reed MS, Powis G, Jones DP.J Biol Chem. 2003 Aug 29;278(35):33408-15. Epub 2003 Jun 19.PMID:1281694
Human thioredoxin homodimers: regulation by pH, role of aspartate 60, and crystal structure of the aspartate 60 --> asparagine mutant.Andersen JF, Sanders DA, Gasdaska JR, Weichsel A, Powis G, Montfort WR.Biochemistry. 1997 Nov 18;36(46):13979-88.PMID:9369469
Distinction of thioredoxin transnitrosylation and denitrosylation target proteins by the ICAT quantitative approach.Wu C, Parrott AM, Liu T, Jain MR, Yang Y, Sadoshima J, Li H.J Proteomics. 2011 Oct 19;74(11):2498-509. doi: 10.1016/j.jprot.2011.06.001. Epub 2011 Jun 17.PMID:21704743
Essential role for mitochondrial thioredoxin reductase in hematopoiesis, heart development, and heart function.Conrad M, Jakupoglu C, Moreno SG, Lippl S, Banjac A, Schneider M, Beck H, Hatzopoulos AK, Just U, Sinowatz F, Schmahl W, Chien KR, Wurst W, Bornkamm GW, Brielmeier M.Mol Cell Biol. 2004 Nov;24(21):9414-23.PMID:15485910
Thioredoxin 1-mediated post-translational modifications: reduction, transnitrosylation, denitrosylation, and related proteomics methodologies.Wu C, Parrott AM, Fu C, Liu T, Marino SM, Gladyshev VN, Jain MR, Baykal AT, Li Q, Oka S, Sadoshima J, Beuve A, Simmons WJ, Li H.Antioxid Redox Signal. 2011 Nov 1;15(9):2565-604. doi: 10.1089/ars.2010.3831. Epub 2011 Jun 8. Review.PMID:21453190
Physiological functions of thioredoxin and thioredoxin reductase.Arnér ES, Holmgren A.Eur J Biochem. 2000 Oct;267(20):6102-9. Review.PMID:11012661
Redox regulatory mechanism of transnitrosylation by thioredoxin.Wu C, Liu T, Chen W, Oka S, Fu C, Jain MR, Parrott AM, Baykal AT, Sadoshima J, Li H.Mol Cell Proteomics. 2010 Oct;9(10):2262-75. doi: 10.1074/mcp.M110.000034. Epub 2010 Jul 21.PMID:20660346
A genome-wide survey of human thioredoxin and glutaredoxin family pseudogenes.Spyrou G, Wilson W, Padilla CA, Holmgren A, Miranda-Vizuete A.Hum Genet. 2001 Oct;109(4):429-39.PMID:11702225
The origami of thioredoxin-like folds.Pan JL, Bardwell JC.Protein Sci. 2006 Oct;15(10):2217-27.PMID:17008712
Distinction of thioredoxin transnitrosylation and denitrosylation target proteins by the ICAT quantitative approach.Wu C, Parrott AM, Liu T, Jain MR, Yang Y, Sadoshima J, Li H.J Proteomics. 2011 Oct 19;74(11):2498-509. doi: 10.1016/j.jprot.2011.06.001. Epub 2011 Jun 17.PMID:21704743

Thioredoxin and peptide methionine sulfoxide reductase: convergence of similar structure and function in distinct structural folds.Gladyshev VN.Proteins. 2002 Feb 1;46(2):149-52.PMID:11807942
Glutathione and glutaredoxin act as a backup of human thioredoxin reductase 1 to reduce thioredoxin 1 preventing cell death by aurothioglucose.Du Y, Zhang H, Lu J, Holmgren A.J Biol Chem. 2012 Nov 2;287(45):38210-9. doi: 10.1074/jbc.M112.392225. Epub 2012 Sep 13.PMID:22977247
Crystal structure of human thioredoxin revealing an unraveled helix and exposed S-nitrosation site.Weichsel A, Kem M, Montfort WR.Protein Sci. 2010 Sep;19(9):1801-6. doi: 10.1002/pro.455.PMID:20662007
Structure of human thioredoxin exhibits a large conformational change.Hall G, Emsley J.Protein Sci. 2010 Sep;19(9):1807-11. doi: 10.1002/pro.466.PMID:20661909
Requirements for the different cysteines in the chemotactic and desensitizing activity of human thioredoxin.Bizzarri C, Holmgren A, Pekkari K, Chang G, Colotta F, Ghezzi P, Bertini R.Antioxid Redox Signal. 2005 Sep-Oct;7(9-10):1189-94.PMID:16115022
Human thioredoxin homodimers: regulation by pH, role of aspartate 60, and crystal structure of the aspartate 60 --> asparagine mutant.Andersen JF, Sanders DA, Gasdaska JR, Weichsel A, Powis G, Montfort WR.Biochemistry. 1997 Nov 18;36(46):13979-88.PMID:9369469
A proton nuclear magnetic resonance assignment and secondary structure determination of recombinant human thioredoxin.Forman-Kay JD, Clore GM, Driscoll PC, Wingfield P, Richards FM, Gronenborn AM.Biochemistry. 1989 Aug 22;28(17):7088-97.PMID:2684271
Crystal structures of reduced, oxidized, and mutated human thioredoxins: evidence for a regulatory homodimer.Weichsel A, Gasdaska JR, Powis G, Montfort WR.Structure. 1996 Jun 15;4(6):735-51.PMID:8805557
Secretion of thioredoxin by normal and neoplastic cells through a leaderless secretory pathway.Rubartelli A, Bajetto A, Allavena G, Wollman E, Sitia R.J Biol Chem. 1992 Dec 5;267(34):24161-4.PMID:1332947
The predicted amino acid sequence of human thioredoxin is identical to that of the autocrine growth factor human adult T-cell derived factor (ADF): thioredoxin mRNA is elevated in some human tumors.Gasdaska PY, Oblong JE, Cotgreave IA, Powis G.Biochim Biophys Acta. 1994 Aug 2;1218(3):292-6.PMID:8049254
The thioredoxin system in retroviral infection and apoptosis.Masutani H, Ueda S, Yodoi J.Cell Death Differ. 2005 Aug;12 Suppl 1:991-8. Review.PMID:15818395
Thioredoxin-mediated redox control of human T cell lymphotropic virus type I (HTLV-I) gene expression.Sasada T, Nakamura H, Masutani H, Ueda S, Sono H, Takabayashi A, Yodoi J.Mol Immunol. 2002 Feb;38(10):723-32.PMID:11841832
Increased inflammatory signaling and lethality of influenza H1N1 by nuclear thioredoxin-1.Go YM, Kang SM, Roede JR, Orr M, Jones DP.PLoS One. 2011 Apr 15;6(4):e18918. doi: 10.1371/journal.pone.0018918.PMID:21526215
Redox regulation of cellular activation.Nakamura H, Nakamura K, Yodoi J.Annu Rev Immunol. 1997;15:351-69. Review.PMID:9143692
Redox regulatory mechanism of transnitrosylation by thioredoxin.Wu C, Liu T, Chen W, Oka S, Fu C, Jain MR, Parrott AM, Baykal AT, Sadoshima J, Li H.Mol Cell Proteomics. 2010 Oct;9(10):2262-75.

doi: 10.1074/mcp.M110.000034. Epub 2010 Jul 21.PMID:20660346
Distinction of thioredoxin transnitrosylation and denitrosylation target proteins by the ICAT quantitative approach.Wu C, Parrott AM, Liu T, Jain MR, Yang Y, Sadoshima J, Li H.J Proteomics. 2011 Oct 19;74(11):2498-509. doi: 10.1016/j.jprot.2011.06.001. Epub 2011 Jun 17.PMID:21704743
Thioredoxin 1-mediated post-translational modifications: reduction, transnitrosylation, denitrosylation, and related proteomics methodologies.Wu C, Parrott AM, Fu C, Liu T, Marino SM, Gladyshev VN, Jain MR, Baykal AT, Li Q, Oka S, Sadoshima J, Beuve A, Simmons WJ, Li H.Antioxid Redox Signal. 2011 Nov 1;15(9):2565-604. doi: 10.1089/ars.2010.3831. Epub 2011 Jun 8. Review.PMID:21453190
AP-1 transcriptional activity is regulated by a direct association between thioredoxin and Ref-1.Hirota K, Matsui M, Iwata S, Nishiyama A, Mori K, Yodoi J.Proc Natl Acad Sci U S A. 1997 Apr 15;94(8):3633-8.PMID:9108029
Thioredoxin is required for S-nitrosation of procaspase-3 and the inhibition of apoptosis in Jurkat cells.Mitchell DA, Morton SU, Fernhoff NB, Marletta MA.Proc Natl Acad Sci U S A. 2007 Jul 10;104(28):11609-14. Epub 2007 Jul 2.PMID:17606900
Small changes huge impact: the role of thioredoxin 1 in the regulation of apoptosis by S-nitrosylation.Li H, Wan A, Xu G, Ye D.Acta Biochim Biophys Sin (Shanghai). 2013 Mar;45(3):153-61. doi: 10.1093/abbs/gms103. Epub 2012 Dec 4. Review.PMID:23212077
Crystal structure of human thioredoxin revealing an unraveled helix and exposed S-nitrosation site.Weichsel A, Kem M, Montfort WR.Protein Sci. 2010 Sep;19(9):1801-6. doi: 10.1002/pro.455.PMID:20662007
Thioredoxin 1-mediated post-translational modifications: reduction, transnitrosylation, denitrosylation, and related proteomics methodologies.Wu C, Parrott AM, Fu C, Liu T, Marino SM, Gladyshev VN, Jain MR, Baykal AT, Li Q, Oka S, Sadoshima J, Beuve A, Simmons WJ, Li H.Antioxid Redox Signal. 2011 Nov 1;15(9):2565-604. doi: 10.1089/ars.2010.3831. Epub 2011 Jun 8. Review.PMID:21453190
Substrate and functional diversity of lysine acetylation revealed by a proteomics survey.Kim SC, Sprung R, Chen Y, Xu Y, Ball H, Pei J, Cheng T, Kho Y, Xiao H, Xiao L, Grishin NV, White M, Yang XJ, Zhao Y.Mol Cell. 2006 Aug;23(4):607-18.PMID:16916647
Thioredoxin-dependent redox regulation of p53-mediated p21 activation.Ueno M, Masutani H, Arai RJ, Yamauchi A, Hirota K, Sakai T, Inamoto T, Yamaoka Y, Yodoi J, Nikaido T.J Biol Chem. 1999 Dec 10;274(50):35809-15.PMID:10585464
Roles of thioredoxin reductase 1 and APE/Ref-1 in the control of basal p53 stability and activity.Seemann S, Hainaut P.Oncogene. 2005 Jun 2;24(24):3853-63.PMID:15824742
Solution structure of human thioredoxin in a mixed disulfide intermediate complex with its target peptide from the transcription factor NF kappa B.Qin J, Clore GM, Kennedy WM, Huth JR, Gronenborn AM.Structure. 1995 Mar 15;3(3):289-97.PMID:7788295
The solution structure of human thioredoxin complexed with its target from Ref-1 reveals peptide chain reversal.Qin J, Clore GM, Kennedy WP, Kuszewski J, Gronenborn AM.Structure. 1996 May 15;4(5):613-20.PMID:8736558
Redox regulation of cellular activation.Nakamura H, Nakamura K, Yodoi J.Annu Rev Immunol. 1997;15:351-69. Review.PMID:9143692
Contribution of thioredoxin reductase to T-cell mitogenesis and NF-kappaB DNA-binding promoted by

selenite.Ueno H, Kajihara H, Nakamura H, Yodoi J, Nakamuro K.Antioxid Redox Signal. 2007 Jan;9(1):115-21.PMID:17115890
Thioredoxin-related protein 14, a new member of the thioredoxin family with disulfide reductase activity: implication in the redox regulation of TNF-alpha signaling.Jeong W, Jung Y, Kim H, Park SJ, Rhee SG.Free Radic Biol Med. 2009 Nov 1;47(9):1294-303. doi: 10.1016/j.freeradbiomed.2009.07.021. Epub 2009 Jul 21. Review.PMID:19628032
Redox regulation of cellular activation.Nakamura H, Nakamura K, Yodoi J.Annu Rev Immunol. 1997;15:351-69. Review.PMID:9143692
AP-1 transcriptional activity is regulated by a direct association between thioredoxin and Ref-1.Hirota K, Matsui M, Iwata S, Nishiyama A, Mori K, Yodoi J.Proc Natl Acad Sci U S A. 1997 Apr 15;94(8):3633-8.PMID:9108029
Thioredoxin-dependent redox regulation of p53-mediated p21 activation.Ueno M, Masutani H, Arai RJ, Yamauchi A, Hirota K, Sakai T, Inamoto T, Yamaoka Y, Yodoi J, Nikaido T.J Biol Chem. 1999 Dec 10;274(50):35809-15.PMID:10585464
Thioredoxin nuclear translocation and interaction with redox factor-1 activates the activator protein-1 transcription factor in response to ionizing radiation.Wei SJ, Botero A, Hirota K, Bradbury CM, Markovina S, Laszlo A, Spitz DR, Goswami PC, Yodoi J, Gius D.Cancer Res. 2000 Dec 1;60(23):6688-95.PMID:11118054
Direct association with thioredoxin allows redox regulation of glucocorticoid receptor function.Makino Y, Yoshikawa N, Okamoto K, Hirota K, Yodoi J, Makino I, Tanaka H.J Biol Chem. 1999 Jan 29;274(5):3182-8.PMID:9915858
Thioredoxin facilitates the induction of heme oxygenase-1 in response to inflammatory mediators.Wiesel P, Foster LC, Pellacani A, Layne MD, Hsieh CM, Huggins GS, Strauss P, Yet SF, Perrella MA.J Biol Chem. 2000 Aug 11;275(32):24840-6.PMID:10823822
Physiological functions of thioredoxin and thioredoxin reductase.Arnér ES, Holmgren A.Eur J Biochem. 2000 Oct;267(20):6102-9. Review.PMID:11012661
c-Jun-NH2 terminal kinase (JNK)-mediates AP-1 activation by thioredoxin: phosphorylation of cJun, JunB, and Fra-1.Das KC, Muniyappa H.Mol Cell Biochem. 2010 Apr;337(1-2):53-63. doi: 10.1007/s11010-009-0285-0. Epub 2009 Oct 27.PMID:19859790
Thioredoxin reductase regulates AP-1 activity as well as thioredoxin nuclear localization via active cysteines in response to ionizing radiation.Karimpour S, Lou J, Lin LL, Rene LM, Lagunas L, Ma X, Karra S, Bradbury CM, Markovina S, Goswami PC, Spitz DR, Hirota K, Kalvakolanu DV, Yodoi J, Gius D.Oncogene. 2002 Sep 12;21(41):6317-27.PMID:12214272
Thioredoxin-dependent redox regulation of p53-mediated p21 activation.Ueno M, Masutani H, Arai RJ, Yamauchi A, Hirota K, Sakai T, Inamoto T, Yamaoka Y, Yodoi J, Nikaido T.J Biol Chem. 1999 Dec 10;274(50):35809-15.PMID:10585464
Disulfide Bond-mediated multimerization of Ask1 and its reduction by thioredoxin-1 regulate H(2)O(2)-induced c-Jun NH(2)-terminal kinase activation and apoptosis.Nadeau PJ, Charette SJ, Toledano MB, Landry J.Mol Biol Cell. 2007 Oct;18(10):3903-13. Epub 2007 Jul 25.PMID:17652454
Crystal structures of reduced, oxidized, and mutated human thioredoxins: evidence for a regulatory homodimer.Weichsel A, Gasdaska JR, Powis G, Montfort WR.Structure. 1996 Jun 15;4(6):735-

51.PMID:8805557
Thioredoxin reductase regulates AP-1 activity as well as thioredoxin nuclear localization via active cysteines in response to ionizing radiation.Karimpour S, Lou J, Lin LL, Rene LM, Lagunas L, Ma X, Karra S, Bradbury CM, Markovina S, Goswami PC, Spitz DR, Hirota K, Kalvakolanu DV, Yodoi J, Gius D.Oncogene. 2002 Sep 12;21(41):6317-27.PMID:12214272
Glutathione and glutaredoxin act as a backup of human thioredoxin reductase 1 to reduce thioredoxin 1 preventing cell death by aurothioglucose.Du Y, Zhang H, Lu J, Holmgren A.J Biol Chem. 2012 Nov 2;287(45):38210-9. doi: 10.1074/jbc.M112.392225. Epub 2012 Sep 13.PMID:22977247
Selenium and the thioredoxin and glutaredoxin systems.Björnstedt M, Kumar S, Björkhem L, Spyrou G, Holmgren A.Biomed Environ Sci. 1997 Sep;10(2-3):271-9. Review.PMID:9315320
Regulation of redox signaling by selenoproteins.Hawkes WC, Alkan Z.Biol Trace Elem Res. 2010 Jun;134(3):235-51. doi: 10.1007/s12011-010-8656-7. Epub 2010 Mar 20.PMID:20306235
Thioredoxin and dihydrolipoic acid inhibit elastase activity in cystic fibrosis sputum.Lee RL, Rancourt RC, del Val G, Pack K, Pardee C, Accurso FJ, White CW.Am J Physiol Lung Cell Mol Physiol. 2005 Nov;289(5):L875-82.PMID:16214824
The thioredoxin and glutaredoxin systems are efficient electron donors to human plasma glutathione peroxidase.Björnstedt M, Xue J, Huang W, Akesson B, Holmgren A.J Biol Chem. 1994 Nov 25;269(47):29382-4.PMID:7961915
S-nitrosoglutathione is cleaved by the thioredoxin system with liberation of glutathione and redox regulating nitric oxide.Nikitovic D, Holmgren A.J Biol Chem. 1996 Aug 9;271(32):19180-5.PMID:8702596
Antisense-thioredoxin inhibits angiogenesis via pVHL-mediated hypoxia-inducible factor-1alpha degradation.Kim WJ, Cho H, Lee SW, Kim YJ, Kim KW.Int J Oncol. 2005 Apr;26(4):1049-52.PMID:15754001
Thioredoxin in the endocrine response to stress.Tanaka H, Makino Y, Okamoto K.Vitam Horm. 1999;57:153-75. Review.PMID:10232049
Small changes huge impact: the role of thioredoxin 1 in the regulation of apoptosis by S-nitrosylation.Li H, Wan A, Xu G, Ye D.Acta Biochim Biophys Sin (Shanghai). 2013 Mar;45(3):153-61. doi: 10.1093/abbs/gms103. Epub 2012 Dec 4. Review.PMID:23212077
Distinction of thioredoxin transnitrosylation and denitrosylation target proteins by the ICAT quantitative approach.Wu C, Parrott AM, Liu T, Jain MR, Yang Y, Sadoshima J, Li H.J Proteomics. 2011 Oct 19;74(11):2498-509. doi: 10.1016/j.jprot.2011.06.001. Epub 2011 Jun 17.PMID:21704743
Redox regulatory mechanism of transnitrosylation by thioredoxin.Wu C, Liu T, Chen W, Oka S, Fu C, Jain MR, Parrott AM, Baykal AT, Sadoshima J, Li H.Mol Cell Proteomics. 2010 Oct;9(10):2262-75. doi: 10.1074/mcp.M110.000034. Epub 2010 Jul 21.PMID:20660346
Regulation of the catalytic activity and structure of human thioredoxin 1 via oxidation and S-nitrosylation of cysteine residues.Hashemy SI, Holmgren A.J Biol Chem. 2008 Aug 8;283(32):21890-8. doi: 10.1074/jbc.M801047200. Epub 2008 Jun 10.PMID:18544525
Redox regulation of thyroid-transcription factors, Pax-8 and TTF-1, is involved in their increased DNA-binding activities by thyrotropin in rat thyroid FRTL-5 cells.Kambe F, Nomura Y, Okamoto T, Seo H.Mol Endocrinol. 1996 Jul;10(7):801-12.PMID:8813721

S-nitrosoglutathione is cleaved by the thioredoxin system with liberation of glutathione and redox regulating nitric oxide.Nikitovic D, Holmgren A.J Biol Chem. 1996 Aug 9;271(32):19180-5.PMID:8702596
S-nitrosylation of thioredoxin mediates activation of apoptosis signal-regulating kinase 1.Sumbayev VV.Arch Biochem Biophys. 2003 Jul 1;415(1):133-6.PMID:12801522
Thioredoxin 1-mediated post-translational modifications: reduction, transnitrosylation, denitrosylation, and related proteomics methodologies.Wu C, Parrott AM, Fu C, Liu T, Marino SM, Gladyshev VN, Jain MR, Baykal AT, Li Q, Oka S, Sadoshima J, Beuve A, Simmons WJ, Li H.Antioxid Redox Signal. 2011 Nov 1;15(9):2565-604. doi: 10.1089/ars.2010.3831. Epub 2011 Jun 8. Review.PMID:21453190
The thioredoxin system in retroviral infection and apoptosis.Masutani H, Ueda S, Yodoi J.Cell Death Differ. 2005 Aug;12 Suppl 1:991-8. Review.PMID:15818395
Altered thioredoxin subcellular localization and redox status in MCF-7 cells following 1,25-dihydroxyvitamin D3 treatment.Byrne BM, Welsh J.J Steroid Biochem Mol Biol. 2005 Oct;97(1-2):57-64. Epub 2005 Aug 2.PMID:16061374
Glutathione and glutaredoxin act as a backup of human thioredoxin reductase 1 to reduce thioredoxin 1 preventing cell death by aurothioglucose.Du Y, Zhang H, Lu J, Holmgren A.J Biol Chem. 2012 Nov 2;287(45):38210-9. doi: 10.1074/jbc.M112.392225. Epub 2012 Sep 13.PMID:22977247
Cloning and expression of a cDNA for human thioredoxin.Wollman EE, d'Auriol L, Rimsky L, Shaw A, Jacquot JP, Wingfield P, Graber P, Dessarps F, Robin P, Galibert F, et al.J Biol Chem. 1988 Oct 25;263(30):15506-12.PMID:3170595
Thioredoxin 1-mediated post-translational modifications: reduction, transnitrosylation, denitrosylation, and related proteomics methodologies.Wu C, Parrott AM, Fu C, Liu T, Marino SM, Gladyshev VN, Jain MR, Baykal AT, Li Q, Oka S, Sadoshima J, Beuve A, Simmons WJ, Li H.Antioxid Redox Signal. 2011 Nov 1;15(9):2565-604. doi: 10.1089/ars.2010.3831. Epub 2011 Jun 8. Review.PMID:21453190
The thiol-based redox networks of pathogens: unexploited targets in the search for new drugs.Jaeger T, Flohé L.Biofactors. 2006;27(1-4):109-20. Review.PMID:17012768
Thioredoxin 1 is inactivated due to oxidation induced by peroxiredoxin under oxidative stress and reactivated by the glutaredoxin system.Du Y, Zhang H, Zhang X, Lu J, Holmgren A.J Biol Chem. 2013 Nov 8;288(45):32241-7. doi: 10.1074/jbc.M113.495150. Epub 2013 Sep 23.PMID:24062305
Cathepsin D and H2O2 stimulate degradation of thioredoxin-1: implication for endothelial cell apoptosis.Haendeler J, Popp R, Goy C, Tischler V, Zeiher AM, Dimmeler S.J Biol Chem. 2005 Dec 30;280(52):42945-51. Epub 2005 Nov 1.PMID:16263712
Vitamin D3-upregulated protein-1 (VDUP-1) regulates redox-dependent vascular smooth muscle cell proliferation through interaction with thioredoxin.Schulze PC, De Keulenaer GW, Yoshioka J, Kassik KA, Lee RT.Circ Res. 2002 Oct 18;91(8):689-95.PMID:12386145
Thioredoxin and protein kinases in redox signaling.Fujino G, Noguchi T, Takeda K, Ichijo H.Semin Cancer Biol. 2006 Dec;16(6):427-35. Epub 2006 Sep 26. Review.PMID:17081769
Alpha-adrenergic receptor-stimulated hypertrophy in adult rat ventricular myocytes is mediated via thioredoxin-1-sensitive oxidative modification of thiols on Ras.Kuster GM, Pimentel DR, Adachi T, Ido Y, Brenner DA, Cohen RA, Liao R, Siwik DA, Colucci WS.Circulation. 2005 Mar 8;111(9):1192-8. Epub 2005 Feb 21.PMID:15723974

Glutathione and glutaredoxin act as a backup of human thioredoxin reductase 1 to reduce thioredoxin 1 preventing cell death by aurothioglucose.Du Y, Zhang H, Lu J, Holmgren A.J Biol Chem. 2012 Nov 2;287(45):38210-9. doi: 10.1074/jbc.M112.392225. Epub 2012 Sep 13.PMID:22977247
Redox regulation of actin by thioredoxin-1 is mediated by the interaction of the proteins via cysteine 62.Wang X, Ling S, Zhao D, Sun Q, Li Q, Wu F, Nie J, Qu L, Wang B, Shen X, Bai Y, Li Y, Li Y.Antioxid Redox Signal. 2010 Sep 1;13(5):565-73. doi: 10.1089/ars.2009.2833.PMID:20218863
Glutathione and glutaredoxin act as a backup of human thioredoxin reductase 1 to reduce thioredoxin 1 preventing cell death by aurothioglucose.Du Y, Zhang H, Lu J, Holmgren A.J Biol Chem. 2012 Nov 2;287(45):38210-9. doi: 10.1074/jbc.M112.392225. Epub 2012 Sep 13.PMID:22977247
Attenuation of neuronal degeneration in thioredoxin-1 overexpressing mice after mild focal ischemia.Zhou F, Gomi M, Fujimoto M, Hayase M, Marumo T, Masutani H, Yodoi J, Hashimoto N, Nozaki K, Takagi Y.Brain Res. 2009 May 26;1272:62-70. doi: 10.1016/j.brainres.2009.03.023. Epub 2009 Mar 25.PMID:19328186
Nuclear redox-signaling is essential for apoptosis inhibition in endothelial cells--important role for nuclear thioredoxin-1.Schroeder P, Popp R, Wiegand B, Altschmied J, Haendeler J.Arterioscler Thromb Vasc Biol. 2007 Nov;27(11):2325-31. Epub 2007 Sep 6.PMID:17823364
Endogenous thioredoxin is required for redox cycling of anthracyclines and p53-dependent apoptosis in cancer cells.Ravi D, Muniyappa H, Das KC.J Biol Chem. 2005 Dec 2;280(48):40084-96. Epub 2005 Sep 13.PMID:16159878
Tagging single-nucleotide polymorphisms in antioxidant defense enzymes and susceptibility to breast cancer.Cebrian A, Pharoah PD, Ahmed S, Smith PL, Luccarini C, Luben R, Redman K, Munday H, Easton DF, Dunning AM, Ponder BA.Cancer Res. 2006 Jan 15;66(2):1225-33.PMID:16424062
Interacting with thioredoxin-1--disease or no disease?Zschauer TC, Matsushima S, Altschmied J, Shao D, Sadoshima J, Haendeler J.Antioxid Redox Signal. 2013 Mar 20;18(9):1053-62. doi: 10.1089/ars.2012.4822. Epub 2012 Sep 24. Review.PMID:22867430
Mechanisms of the regulation of thioredoxin reductase activity in cancer cells by the chemopreventive agent selenium.Gallegos A, Berggren M, Gasdaska JR, Powis G.Cancer Res. 1997 Nov 1;57(21):4965-70.PMID:9354464
Selenium and the thioredoxin and glutaredoxin systems.Björnstedt M, Kumar S, Björkhem L, Spyrou G, Holmgren A.Biomed Environ Sci. 1997 Sep;10(2-3):271-9. Review.PMID:9315320
Truncated mutants of human thioredoxin reductase 1 do not exhibit glutathione reductase activity.Urig S, Lieske J, Fritz-Wolf K, Irmler A, Becker K.FEBS Lett. 2006 Jun 26;580(15):3595-600. Epub 2006 May 23.PMID:16750198
Glutathione and glutaredoxin act as a backup of human thioredoxin reductase 1 to reduce thioredoxin 1 preventing cell death by aurothioglucose.Du Y, Zhang H, Lu J, Holmgren A.J Biol Chem. 2012 Nov 2;287(45):38210-9. doi: 10.1074/jbc.M112.392225. Epub 2012 Sep 13.PMID:22977247
Roles of thioredoxin reductase 1 and APE/Ref-1 in the control of basal p53 stability and activity.Seemann S, Hainaut P.Oncogene. 2005 Jun 2;24(24):3853-63.PMID:15824742
Thioredoxin reductase regulates AP-1 activity as well as thioredoxin nuclear localization via active cysteines in response to ionizing radiation.Karimpour S, Lou J, Lin LL, Rene LM, Lagunas L, Ma X, Karra S, Bradbury CM, Markovina S, Goswami PC, Spitz DR, Hirota K, Kalvakolanu DV, Yodoi J,

Gius D.Oncogene. 2002 Sep 12;21(41):6317-27.PMID:12214272
Thioredoxin: a redox-regulating cellular cofactor for glucocorticoid hormone action. Cross talk between endocrine control of stress response and cellular antioxidant defense system.Makino Y, Okamoto K, Yoshikawa N, Aoshima M, Hirota K, Yodoi J, Umesono K, Makino I, Tanaka H.J Clin Invest. 1996 Dec 1;98(11):2469-77.PMID:8958209
Thioredoxin in the endocrine response to stress.Tanaka H, Makino Y, Okamoto K.Vitam Horm. 1999;57:153-75. Review.PMID:10232049
Role of thioredoxin reductase 1 and thioredoxin interacting protein in prognosis of breast cancer.Cadenas C, Franckenstein D, Schmidt M, Gehrmann M, Hermes M, Geppert B, Schormann W, Maccoux LJ, Schug M, Schumann A, Wilhelm C, Freis E, Ickstadt K, Rahnenführer J, Baumbach JI, Sickmann A, Hengstler JG.Breast Cancer Res. 2010;12(3):R44. doi: 10.1186/bcr2599. Epub 2010 Jun 28.PMID:20584310
Immunohistochemical determination of thioredoxin and glutaredoxin distribution in the human cervix, and possible relation to cervical ripening.Lysell J, Stjernholm Vladic Y, Ciarlo N, Holmgren A, Sahlin L.Gynecol Endocrinol. 2003 Aug;17(4):303-10.PMID:14503974
Identification of novel interaction between ADAM17 (a disintegrin and metalloprotease 17) and thioredoxin-1.Aragão AZ, Nogueira ML, Granato DC, Simabuco FM, Honorato RV, Hoffman Z, Yokoo S, Laurindo FR, Squina FM, Zeri AC, Oliveira PS, Sherman NE, Paes Leme AF.J Biol Chem. 2012 Dec 14;287(51):43071-82. doi: 10.1074/jbc.M112.364513. Epub 2012 Oct 26.PMID:23105116
The crystal structure of TrxA(CACA): Insights into the formation of a [2Fe-2S] iron-sulfur cluster in an Escherichia coli thioredoxin mutant.Collet JF, Peisach D, Bardwell JC, Xu Z.Protein Sci. 2005 Jul;14(7):1863-9.PMID:**15987909**
Thioredoxin and glutaredoxin system proteins-immunolocalization in the rat central nervous system.Aon-Bertolino ML, Romero JI, Galeano P, Holubiec M, Badorrey MS, Saraceno GE, Hanschmann EM, Lillig CH, Capani F.Biochim Biophys Acta. 2011 Jan;1810(1):93-110. doi: 10.1016/j.bbagen.2010.06.011. Epub 2010 Jul 8.PMID:20620191
Dissection of complex protein dynamics in human thioredoxin.Qiu W, Wang L, Lu W, Boechler A, Sanders DA, Zhong D.Proc Natl Acad Sci U S A. 2007 Mar 27;104(13):5366-71. Epub 2007 Mar 16.PMID:17369362
Cathepsin D and H2O2 stimulate degradation of thioredoxin-1: implication for endothelial cell apoptosis.Haendeler J, Popp R, Goy C, Tischler V, Zeiher AM, Dimmeler S.J Biol Chem. 2005 Dec 30;280(52):42945-51. Epub 2005 Nov 1.PMID:16263712
Chloroplast NADP-malate dehydrogenase: structural basis of light-dependent regulation of activity by thiol oxidation and reduction.Carr PD, Verger D, Ashton AR, Ollis DL.Structure. 1999 Apr 15;7(4):461-75.PMID:10196131
Cloning and expression of a cDNA for human thioredoxin.Wollman EE, d'Auriol L, Rimsky L, Shaw A, Jacquot JP, Wingfield P, Graber P, Dessarps F, Robin P, Galibert F, et al.J Biol Chem. 1988 Oct 25;263(30):15506-12.PMID:3170595
A proton nuclear magnetic resonance assignment and secondary structure determination of recombinant human thioredoxin.Forman-Kay JD, Clore GM, Driscoll PC, Wingfield P, Richards FM, Gronenborn AM.Biochemistry. 1989 Aug 22;28(17):7088-97.PMID:2684271