**Supplementary Information**

Green polymer-based nanocomposites containing ceria and their use in the process of stem cell proliferation

Iosif V. Gofman1,\*, Alexandra L. Nikolaeva1, Albert K. Khripunov1, Elena M. Ivan’kova1, Anton S. Shabunin2, Alexander V. Yakimansky1,3, Dmitriy P. Romanov4, Anton L. Popov5,6, Artem M. Ermakov5, Sergey O. Solomevich7, Pavel M. Bychkovsky7, Alexander E. Baranchikov6, Vladimir K. Ivanov6

|  |
| --- |
|  |

1 Institute of Macromolecular Compounds, Russian Academy of Sciences, 199004, Saint Petersburg, Russia; a.l.nikolaeva@imc.macro.ru (A.L.N.); ivelen@mail.ru (E.M.I.); yakimasky@yahoo.com (A.V.Y.)

2 H.Turner National Medical Research Center for Сhildren's Orthopedics and Trauma Surgery, 196603, Pushkin, Saint-Petersburg, Russia; anton-shab@yandex.ru (A.S.S.)

3 Saint Petersburg State University, Institute of Chemistry, 198504, Peterhof, Saint-Petersburg, Russia

4 Institute of Silicate Chemistry, Russian Academy of Sciences, 199034, Saint Petersburg, Russia; dprom@mail.ru (D.P.R.)

5 Institute of Theoretical and Experimental Biophysics, 142290, Pushchino, Moscow region, Russia; antonpopovleonid@gmail.com (A.L.P.); ao\_ermakovy@rambler.ru (A.M.E.)

6 Kurnakov Institute of General and Inorganic Chemistry, Russian Academy of Sciences, 119991, Moscow, Russia; a.baranchikov@yandex.ru (A.E.B.);  van@igic.ras.ru (V.K.I.)

7 Research Institute for Physical and Chemical Problems of the Belarusian State University, 220030, Minsk, Republic of Belarus; sergeysolomevich@gmail.com (S.O.S.); bychkovsky@tut.by (P.M.B.)

\*Correspondence: gofman@imc.macro.ru

**Table S1.** Selected gene groups for PCR-RT analysis.

| **Function** | **Description** | **GeneBank** | **Symbol** | **Forward 5'-3'** | **Rewerse 5'-3'** |
| --- | --- | --- | --- | --- | --- |
| Glutathione Peroxidases (GPx) | Glutathione peroxidase 1 | NM\_000581 | GPX1 | CCTCCCCTTACAGTGCTTGTTC | GCACACATGGCGCAATTG |
| Glutathione peroxidase 2 (gastrointestinal) | NM\_002083 | GPX2 | CCGATCCCAAGCTCATCATT | TCTCAAAGTTCCAGGCCACAT |
| Glutathione peroxidase 3 (plasma) | NM\_002084 | GPX3 | CATCCCCTTCAAGCAGTATGCT | GCCCGTCAGGCCTCAGTAG |
| Glutathione peroxidase 4 (phospholipid hydroperoxidase) | NM\_002085 | GPX4 | CCGATACGCTGAGTGTGGTTT | GCTCCTGCTTCCCGAACTG |
| Glutathione peroxidase 5 (epididymal androgen-related protein) | NM\_001509 | GPX5 | TCACCACACTCTCTTCCTGCAT | AGAGTGGGAATTCTGGCAGTATG |
| Glutathione S-transferase pi 1 | NM\_000852 | GSTP1 | CAGGAGGGCTCACTCAAAGC | GTGAGGTCTCCGTCCTGGAA |
| Glutathione transferase zeta 1 | NM\_001513 | GSTZ1 | CCCAGAACGCCATCACTTG | TGCCCGCTGTGCTCTGT |
| Peroxiredoxins (TPx) | Peroxiredoxin 1 | NM\_002574 | PRDX1 | CTGGGACCCATGAACATTCC | AAGACCCCATAATCCTGAGCAA |
| Peroxiredoxin 2 | NM\_005809 | PRDX2 | TCCTTCGCCAGATCACTGTTAA | CAGCCGCAGAGCCTCATC |
| Peroxiredoxin 3 | NM\_006793 | PRDX3 | GCATTTGAGCGTCAACGATCT | TCACCAAGCGGAGGGTTTC |
| Peroxiredoxin 4 | NM\_006406 | PRDX4 | GAGGCATCCCGGGTATCG | GGCTTGGAAATCTTCGCTTTG |
| Peroxiredoxin 5 | NM\_181652 | PRDX5 | AGATGATTCGCTGGTGTCCAT | ACTATGCCATCCTGTACCACCAT |
| Peroxiredoxin 6 | NM\_004905 | PRDX6 | GGCCGCATCCGTTTCC | CCCGAGGGTGGGAGAAGA |
| Other Peroxidases | Catalase | NM\_001752 | CAT | CAGGGCATCAAAAACCTTTCTG | CGGATGCCATAGTCAGGATCTT |
| Cytochrome b-245, beta polypeptide | NM\_000397 | CYBB | CCTTTGAGTGGTTTGCAGATCTG | AGCCGGCATTGTTCCTTTC |
| Cytoglobin | NM\_134268 | CYGB | GCAGCACCTCGAGCAGAAG | CCTTGGCACCCAGAAATGG |
| Dual oxidase 1 | NM\_175940 | DUOX1 | TGAGCGGCACTTCCAGAAG | GACGGCCAAAGTGGGTGAT |
| Dual oxidase 2 | NM\_014080 | DUOX2 | CCTTCGAGCCCTTCTTCAACT | CAGCTGAACACCCCGATCTT |
| Lactoperoxidase | NM\_006151 | LPO | CAAGCTTTTCCAGCCAACTCA | CCGGCAACGCTGTGTGT |
| Myeloperoxidase | NM\_000250 | MPO | CCTGAAATTGGCGAGGAAACT | GCCGCCCATCCAGATGT |
| Prostaglandin-endoperoxide synthase 1  | NM\_000962 | PTGS1 | TGTTCGGTGTCCAGTTCCAATA | TGCCAGTGGTAGAGATGGTTGA |
| Prostaglandin-endoperoxide synthase 2 | NM\_000963 | PTGS2 | AATTGCTGGCAGGGTTGCT | GGTCAATGGAAGCCTGTGATACTT |
| Other Antioxidants | Albumin | NM\_000477 | ALB | TGAGAAAACGCCAGTAAGTGACA | GAAAAGCATGGTCGCCTGTT |
| Apolipoprotein E | NM\_000041 | APOE | CTGCGTTGCTGGTCACATTC | CTCTGTCTCCACCGCTTGCT |
| Glutathione reductase | NM\_000637 | GSR | TGCAGGGACTTGGGTGTGA | GCCTTCGTTGCTCCCATCT |
| Metallothionein 3 | NM\_005954 | MT3 | AGTGCGAGGGATGCAAATG | GCCTTTGCACACACAGTCCTT |
| Sulfiredoxin 1 | NM\_080725 | SRXN1 | TGCTGTATCCCCAAGAATCATG | GCTAGTTTGGCCCTTCCTCTTC |
| Superoxide dismutase 1, soluble | NM\_000454 | SOD1 | TGGTGTGGCCGATGTGTCT | GTGCGGCCAATGATGCA |
| Superoxide dismutase 2, mitochondrial | NM\_000636 | SOD2 | TCCGCAGAAAGGAACATTAAGG | TGACCTCCATTCTTTGCTCTCA |
| Superoxide dismutase 3, extracellular | NM\_003102 | SOD3 | GCGGAGCCCAACTCTGACT | TGCCAGATCTCCGTGACCTT |
| Genes Involved in Reactive Oxygen Species (ROS) Metabolism | Arachidonate 12-lipoxygenase | NM\_000697 | ALOX12 | CCACCCACCACCAAGGAA | TGCCGGACATCAGGTAGTGA |
| Nitric oxide synthase 2, inducible | NM\_000625 | NOS2 | CCGCATGACCTTGGTGTTT | TCCAGCATCTCCTCCTGGTAGA |
| NADPH oxidase 4 | NM\_016931 | NOX4 | AAGAGCCCAGATTCCAAGCTAATT | CGGCACAGTACAGGCACAAA |
| NADPH oxidase, EF-hand calcium binding domain 5 | NM\_024505 | NOX5 | AGGCACCAGAAAAGAAAGCATACT | ATGTTGTCTTGGACACCTTCGAT |
| Uncoupling protein 2 (mitochondrial, proton carrier) | NM\_003355 | UCP2 | CAGTTCTACACCAAGGGCTCTGA | CCTGTGGTGCTGCCTGCTA |
| Aldehyde oxidase 1 | NM\_001159 | AOX1 | GGTGTTCCGTGTTTTTCGCTAT | GGTCCATGCAGGCCTCTCT |
| BCL2/adenovirus E1B 19kDa interacting protein 3 | NM\_004052 | BNIP3 | TCCATCTCTGCTGCTCTCTCATT | AGGTTGTCAGACGCCTTCCA |
| Epoxide hydrolase 2, cytoplasmic | NM\_001979 | EPHX2 | AACTGGGCCTCTCTCAAGCA | AGCCATGTACCACACCAGCAT |
| MpV17 mitochondrial inner membrane protein | NM\_002437 | MPV17 | TCTATGGCCTGCTGTGCAGTT | GGACAACGGCCAACCTGTA |
| ATX1 antioxidant protein 1 homolog (yeast) | NM\_004045 | ATOX1 | TGCTTGCAACCCTGAAGAAA | GGACCAGGCCCCTGCTA |
| Chemokine (C-C motif) ligand 5 | NM\_002985 | CCL5 | TGCATCTGCCTCCCCATATT | AGTGGGCGGGCAATGTAG |
| 24-dehydrocholesterol reductase | NM\_014762 | DHCR24 | CATGCTGGTGCCCATGAAG | GACGTGGATGTCGTTTTGGAA |
| Forkhead box M1 | NM\_021953 | FOXM1 | AGGAAACGCTGCCCATCTC | CGTGAGCCTCCAGGATTCAG |
| Ferritin, heavy polypeptide 1 | NM\_002032 | FTH1 | CTGGCTTGGCGGAATATCTCT | GCCCGAGGCTTAGCTTTCAT |
| Glutamate-cysteine ligase, modifier subunit | NM\_002061 | GCLM | CCGCCTGCGGAAGAAGT | CATTCAAGGTTTTTTGGATACAATCA |
| Glutathione synthetase | NM\_000178 | GSS | GCAGGAAAAGACACTCGTGATG | CATGCTCGATGGCTTTGGT |
| Heme oxygenase (decycling) 1 | NM\_002133 | HMOX1 | TCCGATGGGTCCTTACACTCA | GCCTGCATTCACATGGCATA |
| Heat shock 70kDa protein 1A | NM\_005345 | HSPA1A | GCTGATTGGCCGCAAGTT | TGGAAAGGCCAGTGCTTCAT |
| Mannose-binding lectin (protein C) 2, soluble | NM\_000242 | MBL2 | AGTGAAGGCCTTGTGTGTCAAGT | TCCATTCTCTGCAGCATTCCT |
| NAD(P)H dehydrogenase, quinone 1 | NM\_000903 | NQO1 | CAGCAGACGCCCGAATTC | TGGTGTCTCATCCCAAATATTCTC |
| Ring finger protein 7 | NM\_014245 | RNF7 | AAAGGAAAGAGCTCCAAATTGAATC | CATAAGCATGCAAAAAGTTCTCTGA |
| Sirtuin 2 | NM\_012237 | SIRT2 | GCTGGAACAGGAGGACTTGGT | TGGCGCTGACGCAGTGT |
| Sequestosome 1 | NM\_003900 | SQSTM1 | GGAAGGTGAAACACGGACACTT | ACGTGGGCTCCAGTTTCCT |
| Pathway Activity Signature Genes | Aldo-keto reductase family 1 | NM\_001354 | AKR1C2 | GATTGCCCTGCGCTACCA | TGTCTGATGCGCTGCTCATT |
| BCL2-associated athanogene 2 | NM\_004282 | BAG2 | CTCACCGTTGAAGTGTCAGTAGAAA | ATCAATAATCCTTGTGGCATGCT |
| Four and a half LIM domains 2 | NM\_001450 | FHL2 | CCTGCAGGAAGCAGCTGTCT | AGTTCAGGCAGTAGGCAAAGTCA |
| Galactosidase, alpha | NM\_000169 | GLA | GGATGGCTCCCCAAAGAGAT | GGCGAATCCCATGAGGAAA |
| Heat shock protein 90kDa alpha (cytosolic), class A member 1 | NM\_001017963 | HSP90AA1 | TTGGCAGTGAAGCATTTTTCAG | GAGCACGTCGTGGGACAAA |
| Phospholysine phosphohistidine inorganic pyrophosphate phosphatase | NM\_022126 | LHPP | TGCGCACCGGGAAGTT | CACGTACCCATCAGCCTTCA |
| Trafficking protein particle complex 6A | NM\_024108 | TRAPPC6A | GGTGTTCCAGAAGCAGATGGA | AGCTGTTGTCTTGCAGGACGTA |
| Mitochondrial dysfunction | Mitochondrial ribosomal protein L43 | NM\_176794 | MRPL43 | CAGTTGCACCGCAGATCCT | GGAAGATCGGATGACTGAACTGA |
| NADH dehydrogenase (ubiquinone) 1 beta subcomplex, 11, 17.3kDa | NM\_019056 | NDUFB11 | GCAGCACCTTTGTGGCCTAT | TCCCATCCCACGCTCTTG |
| Polymerase (RNA) mitochondrial (DNA directed) | NM\_005035 | POLRMT | CACAGGTGCTGGAAGGTTTCA | CCGTACACCACCGTCATCAC |
| Sirtuin 1 | NM\_012238 | SIRT1 | TGAGCCTGATGTTCCAGAGAGA | AGCTTCATTAATTGCCTCTTGATCAT |
| Sirtuin 3 | NM\_012239 | SIRT3 | CCAGTGGCATTCCAGACTTCA | GATCGTACTGCTGGAGGTTGCT |
| Transcription factor B1, mitochondrial | NM\_016020 | TFB1M | GCCATCGAGGGCTCAGAA | CAGCCTGCCCGTGCTTT |
| Transcription factor B2, mitochondrial | NM\_022366 | TFB2M | AAGGCGTCTAAGGCCAGCTT | TTTGCGCCAGGGTCTCA |
| Copper chaperone for superoxide dismutase | NM\_005125 | CCS | GCCGCGCCATCTTCAG | ATCAGGCTGCGGCCAAT |
| Selenoprotein P, plasma, 1 | NM\_203472 | SELENOS | CTGAAACGGAAATCGGACAGA | CGCCTCCTTCACCAGACAAC |
| Anti Apoptotic | B-cell CLL/lymphoma 2  | NM\_000633.2 | BCL2 | CTGGGATGCCTTTGTGGAACT | AGACAGCCAGGAGAAATCAAACAG |
| aculoviral IAP repeat containing 3 | NM\_001165.4 | BIRC3 | GGACAGGAGTTCATCCGTCAAG | TCTCCTGGGCTGTCTGATGTG |
| myeloid cell leukemia 1 | NM\_021960.4 | MCL1 | CACGAGACGGCCTTCCAA | CACTCGAGACAACGATTTCACATC |
| TNF receptor-associated factor 2 | NM\_021138.3 | TRAF2 | GGCCGTCTGTCCCAGTGAT | TTCGTGGCAGCTCTCGTATTC |
| Autophagy | autophagy related 3 | NM\_022488.4 | ATG3 | CCATTGAAAATCACCCTCATCTG | CACCTCAGCATGCCTGCAT |
| autophagy related 12 | NM\_004707.3 | ATG12 | CCCGGGAACAGAGGAACCT | GGAGTGTCTCCCACAGCCTTT |
| nuclear factor of kappa light polypeptide gene enhancer in B-cells 1 | NM\_003998.3 | NFKB1 | GGCTACACCGAAGCAATTGAAG | CAGCGAGTGGGCCTGAGA |
| ribosomal protein S6 kinase, 70kDa, polypeptide 1 | NM\_003161.3 | RPS6KB1 | TGGCATAGAGCAGATGGATGTG | AGAGTTCGGCTGTCGTATTGGA |
| Necrosis | coiled-coil domain containing 103 | NM\_213607.2 | CCDC103 | GCTGCAAGGGCTTGTTTCAG | GCCCCTCCTTCACGGATCT |
| forkhead box I1 | NM\_012188.4 | FOXI1 | CGCCTCACTCTCAGCCAGAT | CCGGCCTTGCTCTTGTTGTA |
| junctophilin 3 | NM\_020655.3 | JPH3 | CCAGGATCACTGCCAAAGAGTT | CGCTTCGGCCTCTGGTACT |
| RAB25, member RAS oncogene family | NM\_020387.2 | RAB25 | TGTCTTCAAGGTGGTGCTGATC | CGCGTGAATCGGGAGAGTAG |
| Pro apoptotic | BCL2-associated X protein  | NM\_004324.3 | BAX | GTGGCAGCTGACATGTTTTCTG | GCAAAGTAGAAAAGGGCGACAA |
| CD40 molecule, TNF receptor superfamily member 5 | NM\_001250.4 | CD40 | ACACTGCCACCAGCACAAATACT | CTGTTTCTGAGGTGCCCTTCTG |
| CASP8 and FADD-like apoptosis regulator | NM\_003879.5 | CFLAR | GTGTGTATGGTGTGGATCAGACTCA | GGCATGAATCTCCCATGAACA |
| Fas cell surface death receptor | NM\_000043.4 | FAS | GAATCATCAAGGAATGCACACTCA | AAAGCCACCCCAAGTTAGATCTG |
| Tumor necrosis factor receptor superfamily, member 10a | NM\_003844.3 | TNFRSF1 | CTGGCGCTTGGGTCTCCTA | TGCGTTGCTCAGAATCTCGTT |
| House keeping |  glyceraldehyde-3-phosphate dehydrogenase | NM\_002046.5 | GAPDH | GTGGAAGGACTCATGACCACAGT | GCCATCACGCCACAGTTTC |
| ribosomal protein, large, P0 | NM\_001002.3 | RPLP0 | ATGCAGCAGATCCGCATGT | TTGCGCATCATGGTGTTCTT |
| beta-actin | XM\_006715764.1 | Actin | TCGTGCGTGACATTAAGGAGAA | AGCAGCCGTGGCCATCT |