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Product Manual

# OxiSelect™ Hydroxyl Radical Antioxidant Capacity (HORAC) Activity Assay

Catalog Number

|           |                |
|-----------|----------------|
| STA-346   | 192 assays     |
| STA-346-5 | 5 x 192 assays |

**FOR RESEARCH USE ONLY**  
Not for use in diagnostic procedures

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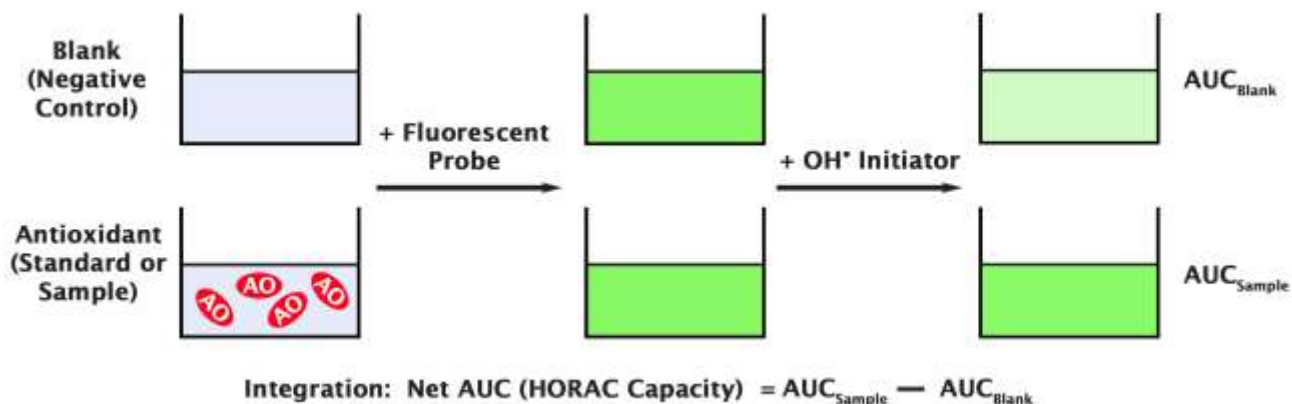
## **Introduction**

Oxidative stress is a physiological condition where there is an imbalance between concentrations of reactive oxygen species (ROS) and antioxidants. However, excessive ROS accumulation will lead to cellular injury, such as damage to DNA, proteins, and lipid membranes. The cellular damage caused by ROS has been implicated in the development of many disease states, such as cancer, diabetes, cardiovascular disease, atherosclerosis, and neurodegenerative diseases. Under normal physiological conditions, cellular ROS generation is counterbalanced by the action of cellular antioxidant enzymes and other redox molecules. Because of their potential harmful effects, excessive ROS must be promptly eliminated from the cells by this variety of antioxidant defense mechanisms. Antioxidants include both hydrophilic and lipophilic molecules for metabolizing ROS.

Although the products of ROS-induced oxidative stress are extensively used to monitor the effects of oxidative stress, it is also important to evaluate the antioxidant capacity of biological fluids, cells, and extracts. The Hydroxyl Radical Antioxidant Capacity (HORAC) Assay is a classic tool for measuring the antioxidant capacity of biomolecules from a variety of samples. The HORAC Activity Assay is based on the oxidation of a fluorescent probe by hydroxyl radicals by way of a hydrogen atom transfer (HAT) process. Hydroxyl radicals are produced by hydroxyl radical initiator and fenton reagent, which quenches the fluorescent probe over time. Antioxidants present in the assay work to block the radical hydroxyl oxidation of the fluorescent probe until the antioxidant activity in the sample is depleted. The remaining hydroxyl radicals destroy the fluorescence of the fluorescent probe. This assay continues until completion, which means both the antioxidant's inhibition time and inhibition percentage of free radical damage is a single value. The sample antioxidant capacity correlates to the fluorescence decay curve, which is usually represented as the area under the curve (AUC). The AUC is used to quantify the total hydroxyl radical antioxidant activity in a sample and is compared to a gallic acid antioxidant standard curve.

Cell Biolabs' OxiSelect™ HORAC Activity Assay is a fast and reliable kit for the direct measurement of HORAC antioxidant capacity from cell lysate, plasma, serum, tissue homogenates, and food extracts. Each kit provides sufficient reagents to perform up to 192 assays, including blanks, antioxidant standards and unknown samples. The assay is designed for use in single plate microplate readers as well as readers with high-throughput capabilities. Please read the complete kit insert prior to performing the assay.

## Assay Principle



## Related Products

1. STA-305: OxiSelect™ Nitrotyrosine Protein ELISA Kit
2. STA-310: OxiSelect™ Protein Carbonyl ELISA Kit
3. STA-312: OxiSelect™ Total Glutathione (GSSG/GSH) Assay Kit
4. STA-320: OxiSelect™ Oxidative DNA Damage ELISA Kit (8-OHdG Quantitation)
5. STA-324: OxiSelect™ Oxidative DNA Damage Quantitation Kit (AP Sites)
6. STA-330: OxiSelect™ TBARS Assay Kit (MDA Quantitation)
7. STA-337: OxiSelect™ 8-iso-Prostaglandin F2 $\alpha$  ELISA Kit (96 Assays)
8. STA-340: OxiSelect™ Superoxide Dismutase Activity Assay
9. STA-341: OxiSelect™ Catalase Activity Assay
10. STA-345: OxiSelect™ ORAC Activity Assay

## Kit Components

1. 96-well Microtiter Plate (Part No. 234501): Two 96-well clear bottom black plates.
2. HORAC Fluorescein Probe (100X) (Part No. 234601): One 0.5 mL tube.
3. Hydroxyl Radical Initiator (5X) (Part No. 234602): One 1.0 mL amber tube.
4. Gallic Acid Antioxidant Standard (Part No. 234603): One 1.5 mL tube of a 5 mM solution.
5. Fenton Reagent (Part No. 234604): One 5.0 mL bottle.
6. Assay Diluent (2X) (Part No. 234605): One 50 mL bottle.

## **Materials Not Supplied**

1. Sample extracts for testing
2. Deionized water
3. 37°C incubator
4. Bottles, flasks, and conical or microtubes necessary for reagent preparation
5. Reagents and materials necessary for sample extraction and purification
6. 10 µL to 1000 µL adjustable single channel micropipettes with disposable tips
7. 50 µL to 300 µL adjustable multichannel micropipette with disposable tips
8. Multichannel micropipette reservoir
9. Fluorescence microplate reader equipped with a 485 nm excitation filter and 530 nm emission filter

## **Storage**

Upon receipt, store the HORAC Fluorescein Probe (100X) and Antioxidant Standard at -20°C. Aliquot as necessary to avoid multiple freeze/thaw cycles. Store all remaining kit components at 4°C.

## **Preparation of Reagents**

- Assay Diluent (2X): Dilute the Assay Diluent 1:2 with deionized water. Mix to homogeneity. Use this for all sample and standard dilutions. Store the 1X Assay Diluent at 4°C.
- Fluorescein Probe (100X): Dilute the Fluorescein Probe 1:100 with Assay Diluent. Mix to homogeneity. Label this as 1X Fluorescein Solution. Use only enough Fluorescein Probe as necessary for immediate applications.
- Hydroxyl Radical Initiator (5X): Dilute the Hydroxyl Radical Initiator 1:5 with deionized or distilled water. Mix to homogeneity. Label this solution as 1X Hydroxyl Radical Initiator Solution. Use only enough Hydroxyl Radical Initiator as necessary for immediate use.

*Note: Do not store diluted Fluorescein Probe or Hydroxyl Radical Initiator solutions.*

## **Preparation of Samples**

*Note: Samples should be stored at -70°C prior to performing the assay. Sample should be prepared at the discretion of the user. The following recommendations are only guidelines and may be altered to optimize or complement the user's experimental design.*

- Deproteinized Fractions: Samples can be deproteinized and have their non-protein fractions assayed. Mix samples with 0.5 M perchloric acid (1:2, v/v), centrifuge at 10,000 x g for 10 minutes at 4°C. Remove the supernatant for measuring the non-protein fraction in the assay.
- Cell Culture: Wash cells 3 times with cold PBS prior to lysis. Lyse cells with sonication or homogenation in cold PBS and centrifuge at 10,000 x g for 10 minutes at 4°C. Aliquot and store the supernatant for use in the assay.
- Lipophilic Fractions: Lipophilic samples must be treated in order to be soluble in an aqueous environment. Dissolve samples in 100% acetone and then dilute in a solution of 7% beta-

cyclodextrin and 50% acetone. Incubate the mixture for 1 hour at room temperature with mixing. Further dilute samples as necessary prior to testing.

- Plasma: Collect blood with heparin and centrifuge at 4°C for 10 minutes. Remove the plasma and aliquot samples for testing. Blood plasma or serum should be diluted 100-fold or more with Assay Diluent prior to performing the assay.
- Tissue Lysate: Sonicate or homogenize tissue sample on cold PBS and centrifuge at 10,000 x g for 10 minutes at 4°C. Aliquot and store the supernatant for use in the assay.
- Plasma or Serum: Once samples are collected they may be tested after diluted 100 fold with Assay Diluent.
- Urine: Once samples are collected they may be tested directly or diluted with Assay Diluent if appropriate.
- Nutrition Samples: Nutritional sample results may vary depending on sample source and purification. Dilution and preparation of these samples is at the discretion of the user. Aqueous samples, such as juice extracts, may be tested directly without further manipulation. Solid food samples or high protein samples may be processed as follows:
  - Solid Samples: Weigh solid sample and then homogenize after adding deionized water (1:2, w/v). Centrifuge the homogenate at 10-12,000 x g for 10 minutes at 4°C. Recover the supernatant which is the water-soluble fraction. The solid pulp, or insoluble fraction is also recovered and washed with deionized water. Combine this wash with the supernatant. The pooled supernatant can be diluted with Assay Diluent and used directly in the assay. The pulp is further extracted by adding pure acetone (1:4, w(solid pulp)/v) and mixing at room temperature for 30-60 minutes. Centrifuge the extract/solid at 12,000 x g for 10 minutes at 4°C. Recover the acetone extract and dilute with Assay Diluent as necessary prior to running the assay. The total ORAC value is calculated by combining the results from the water-soluble fraction and the acetone extract from the pulp fraction.
  - Aqueous Samples: Centrifuge the sample at 5-10,000 x g for 10 minutes at 4°C to remove any particulates. Dilute the supernatant as necessary prior to running the assay.

## **Preparation of Antioxidant Standard Curve**

1. Prepare fresh standards by diluting the 5 mM Gallic Acid Antioxidant Standard stock solution in 1X Assay Diluent. Use only enough Gallic Acid Antioxidant Standard as necessary for immediate applications.
2. Prepare a series of the remaining antioxidant standards according to Table 1 below.

| <b>Tubes</b> | <b>Gallic Acid Antioxidant Standard (<math>\mu\text{L}</math>)</b> | <b>Assay Diluent (<math>\mu\text{L}</math>)</b> | <b>Gallic Acid Concentration (<math>\mu\text{M}</math>)</b> |
|--------------|--|---|---|
| 1            | 90   | 410   | 900   |
| 2            | 80   | 420   | 800   |
| 3            | 70   | 430   | 700   |
| 4            | 60   | 440   | 600   |
| 5            | 50   | 450   | 500   |
| 6            | 40   | 460   | 400   |
| 7            | 30   | 470   | 300   |
| 8            | 20   | 480   | 200   |
| 9            | 10   | 490   | 100   |
| 10           | 0  | 500   | 0   |

**Table 1. Preparation of Gallic Acid Antioxidant Standards**

*Note: Do not store diluted Antioxidant Standard solutions. Prepare fresh Antioxidant Standards for every assay performed.*

## **Assay Protocol**

*Note: Each Antioxidant Standard and samples should be assayed in duplicate or triplicate. A freshly prepared standard curve should be used each time the assay is performed.*

1. Add 20  $\mu\text{L}$  of the diluted Antioxidant Standards or samples to be tested to the 96-well Microtiter Plate.
2. Add 140  $\mu\text{L}$  of the 1X Fluorescein Solution to each well. Mix thoroughly. Incubate the plate for 30 minutes at room temperature.
3. Add 20  $\mu\text{L}$  of the 1X Hydroxyl Radical Initiator into each well using either a multichannel pipette or a plate reader liquid handling system.
4. Immediately add 20  $\mu\text{L}$  of the Fenton Reagent to each well. Shake the plate immediately for 15 seconds to ensure homogeneity.
5. Immediately begin reading sample and standard wells with a fluorescent microplate reader with an excitation wavelength of 480nm and an emission wavelength of 530nm. Read the wells in increments between 1 and 5 minutes for a total of 60 minutes. Save values for Calculation of Results below.

*Note: The final assay values of blank control should be less than 10% of the initial values in order for the assay to be completed.*

## Example of Results

The following figure demonstrates typical OxiSelect™ HORAC Activity Assay results. One should use the data below for reference only. This data should not be used to interpret or calculate actual sample results.

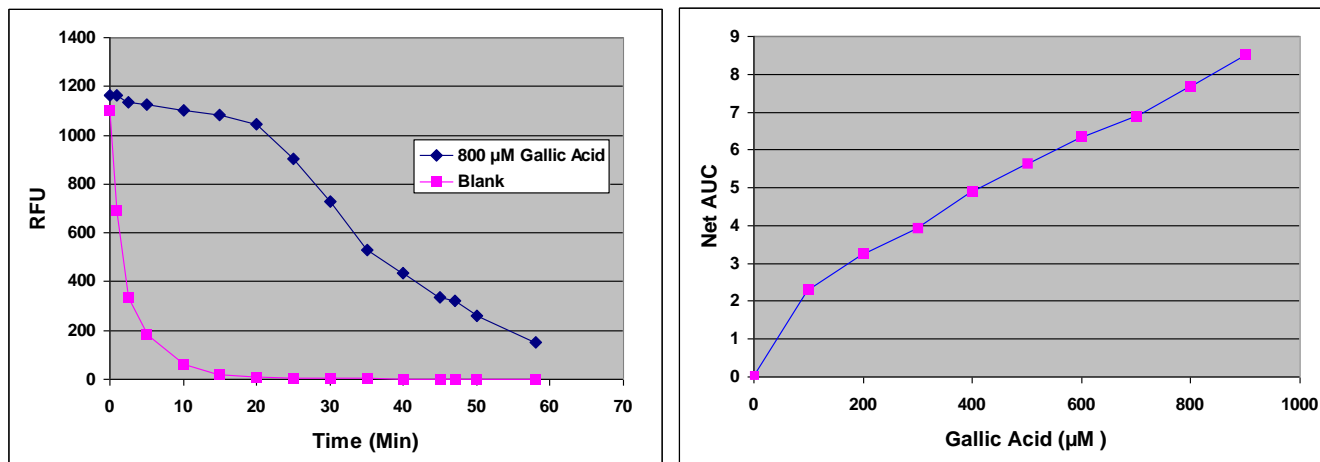


Figure 1: HORAC Activity Assay Standard Curve.

## Calculation of Results

Note: A spreadsheet application or plate reader software can be used to perform the calculations.

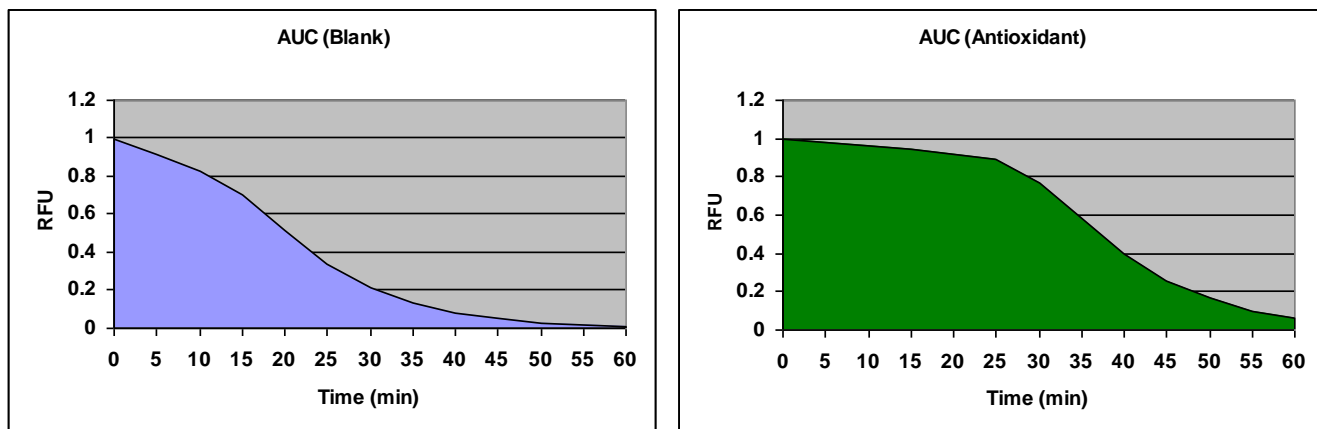
1. Calculate the area under the curve (AUC) for each sample and standard using the final assay values and the linear regression formula below.

The AUC can be calculated from the equation below:

$$\text{AUC} = 1 + \text{RFU}_1/\text{RFU}_0 + \text{RFU}_2/\text{RFU}_0 + \text{RFU}_3/\text{RFU}_0 + \dots + \text{RFU}_{59}/\text{RFU}_0 + \text{RFU}_{60}/\text{RFU}_0$$

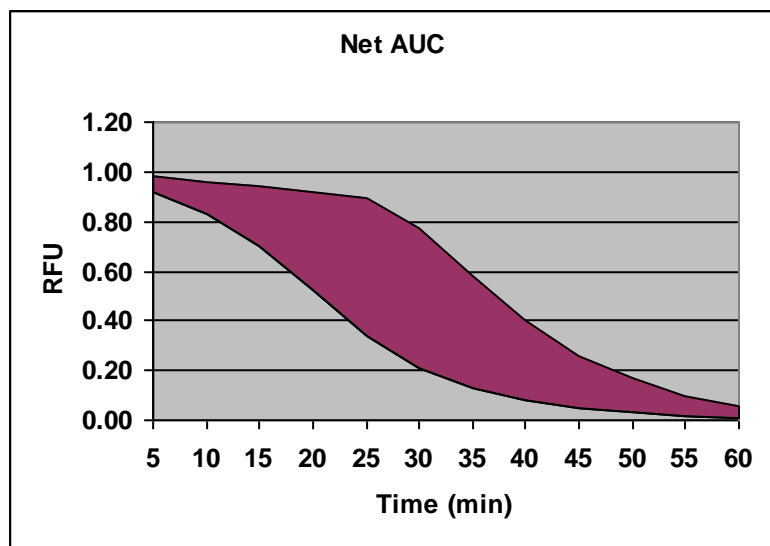
**RFU<sub>0</sub>** = relative fluorescence value of time point zero.

**RFU<sub>x</sub>** = relative fluorescence value of time points (eg. RFU<sub>5</sub> is relative fluorescence value at minute five)



2. Calculate the Net AUC by subtracting the Blank AUC from the AUC of each sample and standard.

$$\text{Net AUC} = \text{AUC (Antioxidant)} - \text{AUC (blank)}$$



3. Graph the Net AUC on the y-axis against the Gallic Acid Antioxidant Standard concentration on the x-axis (see Figure 1)
4. Calculate the  $\mu\text{Mole Gallic Acid Equivalents (GAE)}$  of unknown sample by comparing the standard curve. Results (HORAC value) may be expressed as GAE per L or g of sample.

#### Calculation Example:

20  $\mu\text{L}$  of 10-fold diluted sample is assayed along with 20  $\mu\text{L}$  of each Gallic Acid antioxidant standard including blank as described in Assay Protocol. The average AUC is 2.2 for blank and 7.0 for sample.

$$\text{Net AUC} = \text{AUC (Antioxidant)} - \text{AUC (blank)} = 7.0 - 2.2 = 4.8$$

Based on the Gallic Acid antioxidant standard curve, the equivalent Gallic Acid concentration is 400  $\mu\text{M}$ , therefore,

$$\text{HORAC value (Sample)} = 400 \mu\text{M} \times 10 \text{ (dilution factor)} = 4000 \mu\text{M GAE} = 4000 \mu\text{Mole GAE/L}$$

#### References

1. Huang, D., Ou, B., & Prior, R. (2005) *J. Agric. Food Chem.* 53: 1841-1856.
2. Ou, B., Hampsch-Woodill, M., and Prior, R. (2001) *J. Agric. Food Chem.* 49: 4619-4626.
3. Ou, B., Hampsch-Woodill, M., Flanagan J., Deemer E., Prior, R. and Huang D. (2002) *J. Agric. Food Chem.* 50: 2772-2777.



## **Recent Product Citations**

1. Kassem, S. et al. (2022). In vivo study of dose-dependent antioxidant efficacy of functionalized core-shell yttrium oxide nanoparticles. *Naunyn Schmiedebergs Arch Pharmacol.* doi: 10.1007/s00210-022-02219-1.
2. Sun, W. et al. (2022). Self-oxygenation mesoporous MnO<sub>2</sub> nanoparticles with ultra-high drug loading capacity for targeted arteriosclerosis therapy. *J Nanobiotechnology.* **20**(1):88. doi: 10.1186/s12951-022-01296-x.
3. Ansar, M. et al. (2021). Lack of Type I Interferon Signaling Ameliorates Respiratory Syncytial Virus-Induced Lung Inflammation and Restores Antioxidant Defenses. *Antioxidants (Basel).* **11**(1):67. doi: 10.3390/antiox11010067.
4. Ishihara, K. et al. (2021). Isolation of Balenine from Opah (*Lampris megalopsis*) Muscle and Comparison of Antioxidant and Iron-chelating Activities with Other Major Imidazole Dipeptides. *Food Chem.* doi: 10.1016/j.foodchem.2021.130343.
5. Zhang, X. et al. (2021). Antioxidant and C5a-blocking strategy for hepatic ischemia-reperfusion injury repair. *J Nanobiotechnology.* **19**(1):107. doi: 10.1186/s12951-021-00858-9.
6. Zhang, D.Y. et al. (2020). Ultrasmall Platinum Nanozymes as Broad-Spectrum Antioxidants for Theranostic Application in Acute Kidney Injury. *Chem. Eng. J.* doi: 10.1016/j.cej.2020.127371.
7. Wake, H. et al. (2020). Histidine-rich glycoprotein possesses anti-oxidant activity through self-oxidation and inhibition of hydroxyl radical production via chelating divalent metal ions in Fenton's reaction. *Free Radic Res.* doi: 10.1080/10715762.2020.1825703.
8. Rosenkrans, Z.T. et al. (2020). Selenium-Doped Carbon Quantum Dots Act as Broad-Spectrum Antioxidants for Acute Kidney Injury Management. *Adv. Sci.* doi: 10.1002/advs.202000420.
9. Pham, T.N.M. et al. (2020). Protective Mechanisms of Avocado Oil Extract Against Ototoxicity. *Nutrients.* **12**(4). pii: E947. doi: 10.3390/nu12040947.
10. Ansar, M. et al. (2020). Increased Lung Catalase Activity Confers Protection Against Experimental RSV Infection. *Sci Rep.* **10**(1):3653. doi: 10.1038/s41598-020-60443-2.
11. Xin, H. et al. (2019). Attenuated glutamate induced ROS production by antioxidative compounds in neural cell lines. *RSC Adv.* **9**:34735–34743. doi: 10.1039/c9ra03848e.
12. Li, S. et al. (2019). Intrathecal Administration of Nanoclusters for Protecting Neurons against Oxidative Stress in Cerebral Ischemia/Reperfusion Injury. *ACS Nano.* doi: 10.1021/acsnano.9b06780.
13. Choi, B. et al. (2019). Highly selective microglial uptake of ceria-zirconia nanoparticles for enhanced analgesic treatment of neuropathic pain. *Nanoscale.* doi: 10.1039/c9nr02648g.
14. Gardner, A.W. et al. (2019). Vascular Inflammation, Calf Muscle Oxygen Saturation, and Blood Glucose are Associated With Exercise Pressor Response in Symptomatic Peripheral Artery Disease. *Angiology.* 3319719838399. doi: 10.1177/0003319719838399.
15. Gardner, A.W. et al. (2019). Changes in vascular and inflammatory biomarkers after exercise rehabilitation in patients with symptomatic peripheral artery disease. *J Vasc Surg.* pii: S0741-5214(19)30222-8. doi: 10.1016/j.jvs.2018.12.056.
16. Jiang, D. et al. (2018). DNA origami nanostructures can exhibit preferential renal uptake and alleviate acute kidney injury. *Nat Biomed Eng.* **2**(11):865-877. doi: 10.1038/s41551-018-0317-8.
17. Ni, D. et al. (2018). Molybdenum-based nanoclusters act as antioxidants and ameliorate acute kidney injury in mice. *Nat Commun.* **9**(1):5421. doi: 10.1038/s41467-018-07890-8.
18. Ortecho-Zuta, U. et al. (2018). Effects of Enzymatic Activation of Bleaching Gels on Hydrogen Peroxide Degradation Rates, Bleaching Effectiveness, and Cytotoxicity. *Oper Dent.* doi: 10.2341/17-276-L.

19. Gregory Rivera, M. et al. (2018). Peptide Inhibitor of Complement C1 (PIC1) demonstrates antioxidant activity via single electron transport (SET) and hydrogen atom transfer (HAT). *PLoS One*. **13**(3):e0193931. doi: 10.1371/journal.pone.0193931.
20. Molinari, R. et al. (2018). Tartary buckwheat malt as ingredient of gluten-free cookies. *Journal of Cereal Science*. **80**:37-43. doi: 10.1016/j.jcs.2017.11.011.
21. Oraby, H.F. et al. (2017). Changes in the concentration of avenanthramides in response to salinity stress in CBF 3 transgenic oat. *J. Cereal Sci.* doi: 10.1016/j.jcs.2017.06.010.
22. Gardner, A.W. et al. (2017). Association between daily walking and antioxidant capacity in patients with symptomatic peripheral artery disease. *J Vasc Surg*. doi: 10.1016/j.jvs.2016.12.108.
23. Gardner, A. W. et al. (2016). Association between gait characteristics and endothelial oxidative stress and inflammation in patients with symptomatic peripheral artery disease. *AGE (Dordr)*. doi:10.1007/s11357-016-9925-y.
24. Gardner, A. W. et al. (2015). Endothelial cell inflammation and antioxidant capacity are associated with exercise performance and microcirculation in patients with symptomatic peripheral artery disease. *Angiology*. doi:10.1177/0003319714566863.
25. Jeong, M. H. et al. (2014). In vitro evaluation of Cordyceps militaris as a potential radioprotective agent. *Int J Mol Med*. **34**:1349-1357.
26. Mishra, S. et al. (2014). Semiquinone glucoside derivative (SQGD) isolated from Bacillus sp. INM-1 protects against gamma radiation-induced oxidative stress. *Environ Toxicol Pharmacol*. **37**:553-562.
27. Gardner, A. W. et al. (2014). Gender and racial differences in endothelial oxidative stress and inflammation in patients with symptomatic peripheral artery disease. *J Vasc Surg*. **61**:1249-1257.
28. Gardner, A. W. et al. (2014). Greater endothelial apoptosis and oxidative stress in patients with peripheral artery disease. *Int J Vasc Med*. doi:10.1155/2014/160534.
29. Gardner, A. W. et al. (2014). Impaired vascular endothelial growth factor A and inflammation in patients with peripheral artery disease. *Angiology*. **65**:683-690.
30. Jeong, M.H. et al. (2014). Protective activity of a novel resveratrol analogue, HS-1793, against DNA damage in 137Cs-irradiated CHO-K1 cells. *J Radiat Res*. **55**:464-475.

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