

---

Product Manual

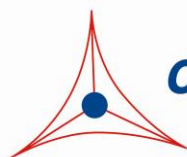
# OxiSelect™ *In Vitro* Nitric Oxide (Nitrite / Nitrate) Assay Kit (Colorimetric)

## Catalog Number

STA-802	100 assays
STA-802-5	5 x 100 assays

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

---

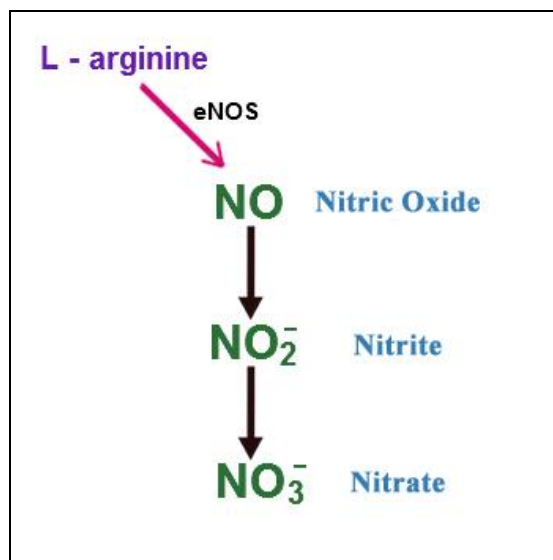


**CELL BIOLABS, INC.**  
*Creating Solutions for Life Science Research*

## Introduction

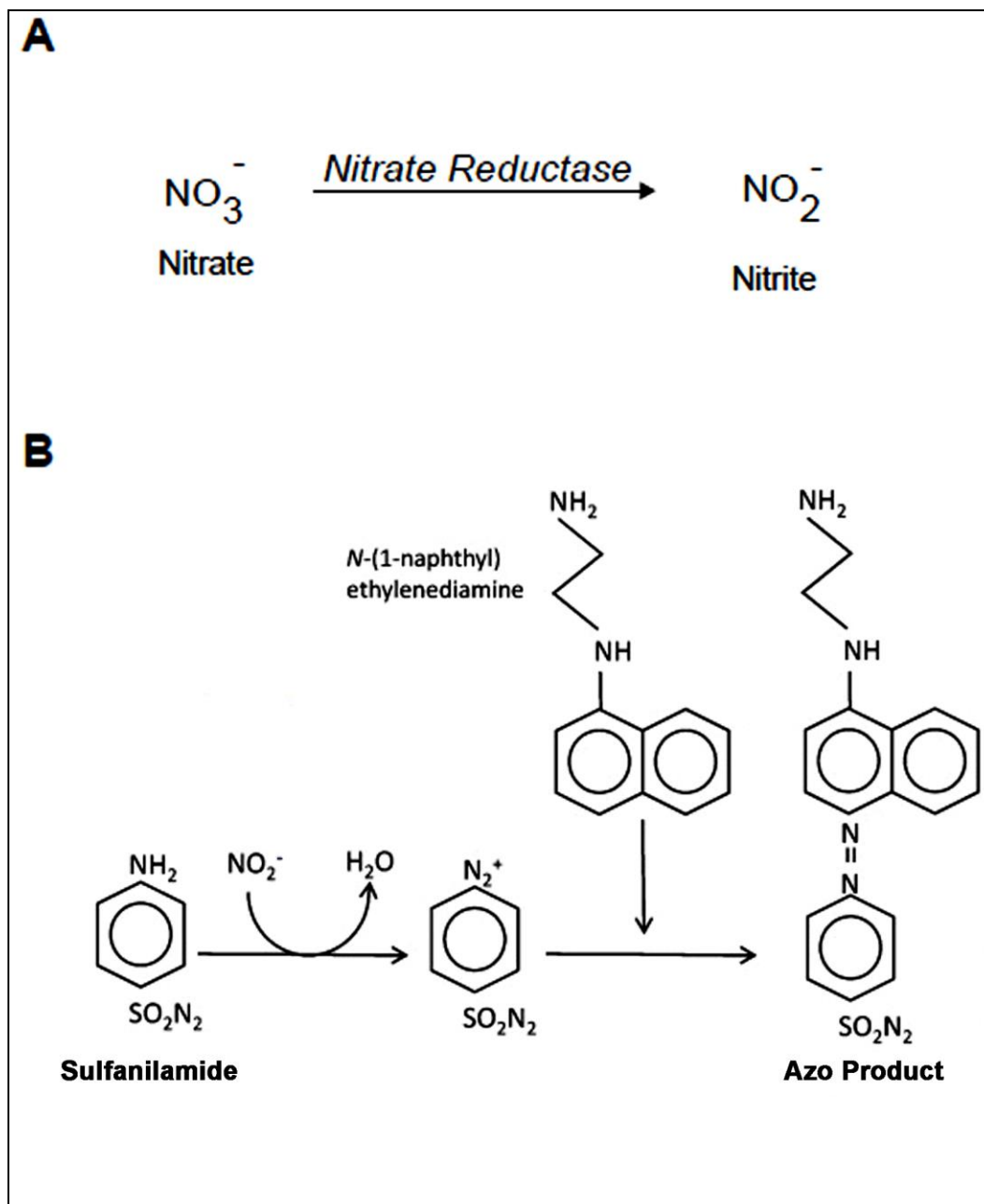
Reactive nitrogen intermediates (RNI) and reactive oxygen intermediates (ROI) work together to damage cells and have been implicated in the pathogenesis of several disease states. RNI are a family of molecules derived from nitric oxide (NO) and superoxide anion ( $O_2^-$ ), produced via nitric oxide synthase (NOS) and NADPH oxidase, respectively. Nitric oxide is an established mediator in vascular diseases, diabetes, renal ischemia, atherosclerosis, inflammatory diseases, and cancer. However, because of its extremely short half life, direct quantitation of NO production remains challenging and unsuitable for most detection systems. Therefore, the common method for measurement of total NO has become the sum of its final oxidized products, nitrite ( $NO_2^-$ ) and nitrate ( $NO_3^-$ ) (Figure 1).

Cell Biolabs' OxiSelect™ Nitric Oxide (Nitrite/Nitrate) Assay Kit is a simple, colorimetric assay that quantitatively measures NO in various samples by  $NO_2^-/NO_3^-$  determination. First, the nitrate ( $NO_3^-$ ) in the sample is converted to nitrite ( $NO_2^-$ ) by nitrate reductase enzyme (Figure 2). Next, total nitrite is detected with Griess Reagents as a colored azo dye product (absorbance 540 nm). Each kit provides sufficient reagents to perform up to 100 assays using a 96-well microtiter plate format, including blanks, standards and unknown samples. The kit is suitable for serum, plasma, urine, saliva, lysates, and media (see Preparation of Samples) with detection sensitivity limit of  $\sim 2 \mu M$  (in 50  $\mu L$  sample volume).



**Figure 1: Oxidation of L-arginine to nitrate.**

## Assay Principle



**Figure 2: Conversion of nitrate to nitrite by nitrate reductase (A), followed by the Griess Reaction (B).**

## Related Products

1. STA-342: OxiSelect™ Intracellular ROS Assay Kit (Green Fluorescence)
2. STA-344: OxiSelect™ Hydrogen Peroxide/Peroxidase Assay Kit
3. STA-347: OxiSelect™ In Vitro ROS/RNS Assay Kit (Green Fluorescence)

4. STA-800: OxiSelect™ Intracellular Nitric Oxide Assay Kit (Fluorometric)

### **Kit Components**

1. Nitrite Standard (Part No. 280201): One 500 µL vial of 14 mM sodium nitrite.
2. Nitrate Standard (Part No. 280202): One 500 µL vial of 14 mM sodium nitrate.
3. Enzyme Mixture (Part No. 280203): Three 1.4 mL vials.
4. Enzyme Cofactor (Part No. 280204): One 20 µL amber vial.
5. Griess Reagent A (Part No. 280205): Three 1.8 mL vials.
6. Griess Reagent B (Part No. 280206): Three 1.8 mL vials.

### **Materials Not Supplied**

1. Deionized or distilled water
2. PBS for sample dilution
3. 10 kDa MWCO ultrafilter (for high protein content samples)
4. 96-well microtiter plate
5. Microtiter plate shaker
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. Microplate reader capable of reading at 540 nm

### **Storage**

Store the entire kit at -80°C. Avoid multiple freeze/thaws by aliquoting. The Enzyme Cofactor is light sensitive and should be maintained in amber tubes.

### **Preparation of Reagents**

- Nitrite and Nitrate Standards should be thawed/maintained at 4°C during assay preparation. Both are stable for 2 weeks at 4°C. For longer term storage, each should be aliquoted and frozen at -80°C to avoid multiple freeze/thaws.
- Enzyme Mixture should be thawed/maintained at 4°C during assay preparation. The solution is stable for 1 week at 4°C. Any unused material should be aliquoted and frozen at -80°C to avoid multiple freeze/thaws.

*Note: This component is provided in multiple tubes to minimize multiple freeze/thaws.*

- Enzyme Cofactor should be thawed/maintained at 4°C during assay preparation. The stock solution is stable for 1 week at 4°C. Immediately before use, dilute the Enzyme Cofactor 1:100 with deionized water. Stir to homogeneity. Do not store diluted solutions. Any unused stock material should be aliquoted and frozen at -80°C to avoid multiple freeze/thaws.

- Griess Reagent A and Reagent B should be thawed/maintained at 4°C during assay preparation. Both are stable for 4 weeks at 4°C. For longer term storage, each should be aliquoted and frozen at -80°C to avoid multiple freeze/thaws.

*Note: This component is provided in multiple tubes to minimize multiple freeze/thaws.*

### **Preparation of Nitrite or Nitrate Standards**

- Thaw the nitrite or nitrate standards at 4°C and mix well. Freshly prepare a dilution series of standard in the concentration range of 0 μM – 140 μM by diluting the standard stock solution (provided at 14 mM) in deionized water (Table 1) or desired sample buffer.

<b>Standard Tubes</b>	<b>14 mM Nitrite or Nitrate Standard (μL)</b>	<b>DI Water or Desired Buffer (μL)</b>	<b>Nitrite or Nitrate Standard (μM)</b>
1	10	990	140
2	500 of Tube #1	500	70
3	500 of Tube #2	500	35
4	500 of Tube #3	500	17.5
5	500 of Tube #4	500	8.75
6	500 of Tube #5	500	4.38
7	500 of Tube #6	500	2.19
8	0	500	0

**Table 1. Preparation of Nitrite or Nitrate Standards**

### **Preparation of Samples**

- Plasma: Collect plasma with an anticoagulant such as heparin, citrate or EDTA and mix by inversion. Samples must then be filtered through a 10 kDa MWCO ultrafilter before assaying (to reduce protein interference and turbidity). Use immediately or store at -80°C.

*Note: Citrate or EDTA plasma is recommended. Heparin is known to interfere with the assay when samples contain > 1 IU/mL; however, ultrafiltering will remove average MW heparin (15 kDa and larger). If low MW heparin is used, a 3 kDa MWCO ultrafilter should be used.*

- Serum: Collect serum with no anticoagulant. Samples must then be filtered through a 10 kDa MWCO ultrafilter before assaying (to reduce protein interference and turbidity). Use immediately or store at -80°C.
- Urine: Samples must then be filtered through a 10 kDa MWCO ultrafilter before assaying (to reduce protein interference and turbidity). Urine must be diluted before assaying (typically 1:10 or greater in PBS). Use immediately or store at -80°C.
- Saliva: Samples must then be filtered through a 10 kDa MWCO ultrafilter before assaying (to reduce protein interference and turbidity). Use immediately or store at -80°C.
- Culture Media: Media known to contain high levels of nitrite/nitrate (e.g. RPMI) should be avoided. Remove particulates/debris in samples by centrifugation or filtration. To account for any

background caused by media components, nitrite/nitrate standards should be prepared in the same media. Phenol red or FBS raise background values slightly.

- Cell and Tissue Lysates: Remove particulates/debris in samples by centrifugation or filtration. Samples must then be filtered through a 10 kDa MWCO ultrafilter before assaying (to reduce protein interference and turbidity). Use immediately or store at -80°C.

### **Potential Interference from Sample Components**

Components known to interfere with the Griess Reaction are antioxidants, nucleophiles, and compounds containing sulfur (e.g., azide, ascorbic acid, cysteine, glutathione, DTT,  $\beta$ -ME) at concentrations of 10  $\mu$ M and above. Samples containing high concentrations of SDS (~ 0.1 %) are also incompatible. However, to accurately determine the degree of total interference, both the nitrate and nitrite standard curves should be prepared in water vs. sample buffer. Dilution of the buffer, and ultimately samples, may be required to completely eliminate interference. Even with some interference, accurate quantitation can be achieved by running standards in the same buffer as samples, although kit sensitivity may be compromised.

### **Assay Protocol**

*Note: This kit may be used for measurement of nitrite only, or for total nitrite plus nitrate through nitrate reduction. If desired, nitrate only levels in samples may be calculated by subtracting the nitrite only level from the total nitrite plus nitrate.*

#### **I. Measurement of Nitrite only**

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

1. Add 50  $\mu$ L of the nitrite standards, samples, or blanks to the 96-well microtiter plate.
2. Add 50  $\mu$ L of PBS to each well, adjusting the total volume to 100  $\mu$ L per well.
3. Add 50  $\mu$ L of Griess Reagent A to each well.
4. Immediately add 50  $\mu$ L of Griess Reagent B to each well.
5. Incubate the plate at room temperature for 10 minutes, allowing color development.
6. Read absorbance at 540 nm on a microplate reader.
7. Calculate the concentration of nitrite within samples by comparing the sample absorbance to the standard curve. Negative controls (without nitrite) should be subtracted.

#### **II. Measurement of Total Nitrite/Nitrate via Nitrate Reduction**

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

1. Add 50  $\mu$ L of the nitrate standards, samples, or blanks to the 96-well microtiter plate.
2. **Maintain Enzyme Mixture and Cofactor at 4°C.** According to Table 2 (below), prepare the desired volume of Enzyme Reaction Mixture (based on the # of tests) in the following sequence:
  - a. In a tube, add the appropriate volume of Enzyme Mixture.

- b. Next, add the corresponding volume of diluted, Enzyme Cofactor Solution (see Preparation of Reagents).

*Note: Enzyme Cofactor is diluted 1:100 in deionized water immediately before use.*

- c. Mix well and immediately use.

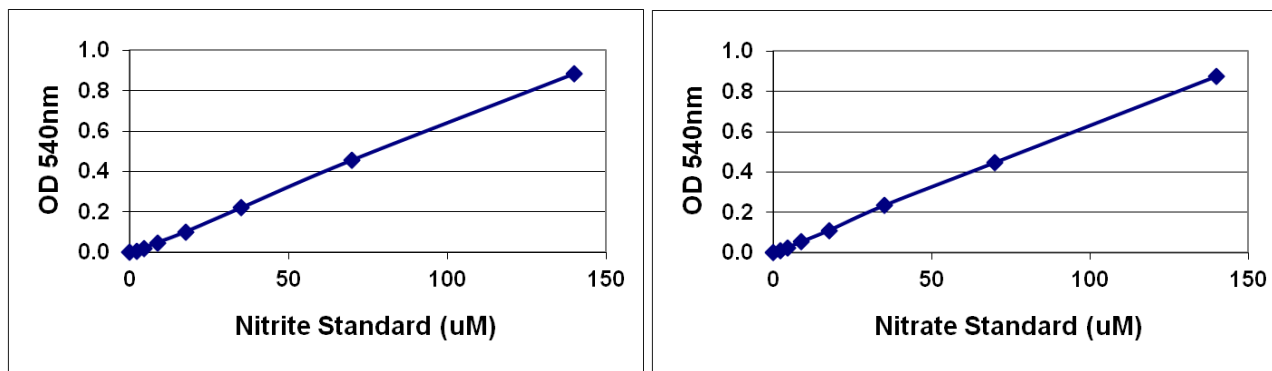
# of Tests in 96-well Plate (50 $\mu$ L/test)	Enzyme Mixture (mL)	Diluted Cofactor Solution (mL)	Total Volume of Enzyme Reaction Mixture (mL)
100	4	1	5
50	2	0.5	2.5
25	1	0.25	1.25

**Table 2. Preparation of Enzyme Reaction Mixture**

- Transfer 50  $\mu$ L of the above Enzyme Reaction Mixture to each well (already containing 50  $\mu$ L of nitrate standard or sample).
- Cover the plate wells to protect the reaction from light.
- Incubate at room temperature for 1 hour on an orbital shaker.
- Add 50  $\mu$ L of Griess Reagent A to each well.
- Immediately add 50  $\mu$ L of Griess Reagent B to each well.
- Incubate the plate at room temperature for 10 minutes, allowing color development.
- Read absorbance at 540 nm on a microplate reader.
- Calculate the concentration of nitrate within samples by comparing the sample absorbance to the standard curve. Negative controls (without nitrate) should be subtracted.

### **Example of Results**

The following figures demonstrate typical Nitric Oxide Assay Kit results. One should use the data below for reference only. This data should not be used to interpret actual results.



**Figure 3: Nitrite and Nitrate Standard Curves.** Nitrite (left) and nitrate (right) standard curves were performed according to the Assay Protocol.

## References

1. Moncada, S. (1992) *Acta Physiol. Scand.* **145**, 201-227.
2. Nathan, C. (1992) *FASEB J.* **6**, 3051-3064.
3. Schreck, R. and Baeuerle, P.A. (1991) *Trends Cell Biol.* **1**, 39-42.
4. Ignarro, L.J. (1990) *Pharmacol. Toxicol.* **67**, 1-7.
5. Green, L.C., et al. (1982) *Anal. Biochem.* **126**, 131-138.

## Recent Product Citations

1. Doryab, A. et al. (2023). Breathing-induced stretch enhances the efficacy of an inhaled and orally delivered anti-fibrosis drug in vitro. *J Drug Deliv Sci Technol.* doi: 10.1016/j.jddst.2023.104316.
2. Li, C.Y. et al. (2023). Repurposing nitric oxide donating drugs in cancer therapy through immune modulation. *J Exp Clin Cancer Res.* **42**(1):22. doi: 10.1186/s13046-022-02590-0.
3. Natsume, K. et al. (2022). Biological properties of self-assembled nanofibers of elastin-like block polypeptides for tissue-engineered vascular grafts: platelet inhibition, endothelial cell activation and smooth muscle cell maintenance. *Regen Biomater.* doi: 10.1093/rb/rbac111.
4. Versaci, F. et al. (2022). Aging-Related Decline of Autophagy in Patients with Atrial Fibrillation-A Post Hoc Analysis of the ATHERO-AF Study. *Antioxidants (Basel).* **11**(4):698. doi: 10.3390/antiox11040698.
5. Raparelli, V. et al. (2022). Testosterone-to-estradiol ratio and platelet thromboxane release in ischemic heart disease: the EVA project. *J Endocrinol Invest.* doi: 10.1007/s40618-022-01771-0.
6. Irace, F.G. et al. (2021). Role of Oxidative Stress and Autophagy in Thoracic Aortic Aneurysms. *JACC Basic Transl Sci.* **6**(9-10):719-730. doi: 10.1016/j.jacbts.2021.08.002.
7. Liu, Q. et al. (2021). Air Pollution Particulate Matter Exposure and Chronic Cerebral Hypoperfusion and Measures of White Matter Injury in a Murine Model. *Environ Health Perspect.* **129**(8):87006. doi: 10.1289/EHP8792.
8. Ishikawa, K. et al. (2020). Non-thermal plasma-activated lactate solution kills U251SP glioblastoma cells in an innate reductive manner with altered metabolism. *Arch Biochem Biophys.* doi: 10.1016/j.abb.2020.108414.
9. Kang, J.Y. et al. (2020). Therapeutic potential of miR-21 regulation by human peripheral blood derived-small extracellular vesicles in myocardial infarction. *Clin Sci (Lond).* **134**(8):985-999. doi: 10.1042/CS20191077.
10. Park, J. et al. (2019). Non-thermal atmospheric pressure plasma induces epigenetic modifications that activate the expression of various cytokines and growth factors in human mesoderm-derived stem cells. *Free Radic Biol Med.* **148**:108-122. doi: 10.1016/j.freeradbiomed.2019.12.035.
11. Signorello, M.G. et al. (2019). The Ca<sup>2+</sup>/calmodulin kinase/AMP-activated protein kinase pathway regulates the lectin phaseolus vulgaris agglutinin induced NO production in human platelets. *Integr Mol Med.* doi: 10.15761/IMM.1000369.
12. Tanzilli, G. et al. (2019). Glutathione infusion before primary percutaneous coronary intervention: a randomised controlled pilot study. *BMJ Open.* **9**(8):e025884. doi: 10.1136/bmjopen-2018-025884.
13. Nier, A. et al. (2019). Short-Term Isocaloric Intake of a Fructose- but not Glucose-Rich Diet Affects Bacterial Endotoxin Concentrations and Markers of Metabolic Health in Normal Weight Healthy Subjects. *Mol Nutr Food Res.* **63**(6):e1800868. doi: 10.1002/mnfr.201800868.
14. Mohd Heikal, M.Y. et al. (2019). Stichopus chloronotus aqueous extract as a chondroprotective agent for human chondrocytes isolated from osteoarthritis articular cartilage in vitro. *Cytotechnology.* doi: 10.1007/s10616-019-00298-2.



15. Abdrabouh, A.E. (2019). Liver disorders related to exposure to gasoline fumes in male rats and role of fenugreek seed supplementation. *Environ Sci Pollut Res Int.* **26**(9):8949-8957. doi: 10.1007/s11356-019-04307-x.
16. Kurake, N. et al. (2019). Non-thermal plasma-activated medium modified metabolomic profiles in the glycolysis of U251SP glioblastoma. *Arch Biochem Biophys.* **662**:83-92. doi: 10.1016/j.abb.2018.12.001.
17. Takahashi, Y. et al. (2018). Cytotoxicity of cancer HeLa cells sensitivity to normal MCF10A cells in cultivations with cell culture medium treated by microwave-excited atmospheric pressure plasmas. *Journal of Physics D: Applied Physics.* **51**(11):115401. doi:10.1088/1361-6463/aaab09.
18. Beltrán-Barrientos, L.M. et al. (2018). Mechanistic Pathways Underlying the Antihypertensive Effect of Fermented Milk with *Lactococcus lactis* NRRL B-50571 in Spontaneously Hypertensive Rats. *Nutrients.* **10**(3). pii: E262. doi: 10.3390/nu10030262.
19. Brubaker, T. R. et al. (2017). Dynamic analysis of reactive oxygen nitrogen species in plasma-activated culture medium by UV absorption spectroscopy. *Journal of Applied Physics.* **122**(21), 213301. doi:10.1063/1.4999256.
20. Li, M. et al. (2017). Targeting reactive nitrogen species suppresses hereditary pancreatic cancer. *PNAS USA.* **114**(27):7106-7111.
21. Vincent, A. et al. (2016). Herring and chicken/pork meals lead to differences in plasma levels of TCA intermediates and arginine metabolites in overweight and obese men and women. *Mol. Nut. Food Res.* doi:10.1002/mnfr.201600400.
22. Son, D.J. et al. (2016). Novel synthetic (E)-2-methoxy-4-(3-(4-methoxyphenyl) prop-1-en-1-yl) phenol inhibits arthritis by targeting signal transducer and activator of transcription 3. *Sci. Rep.* **6**:36852.
23. Wang, Z. et al. (2015). Dual-microstructured porous, anisotropic film for biomimicking of endothelial basement membrane. *ACS Appl Mater Interfaces.* doi:10.1021/acsami.5b02464.

## **Warranty**

These products are warranted to perform as described in their labeling and in Cell Biolabs literature when used in accordance with their instructions. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THIS EXPRESSED WARRANTY AND CELL BIOLABS DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR WARRANTY OF FITNESS FOR PARTICULAR PURPOSE. CELL BIOLABS' sole obligation and purchaser's exclusive remedy for breach of this warranty shall be, at the option of CELL BIOLABS, to repair or replace the products. In no event shall CELL BIOLABS be liable for any proximate, incidental or consequential damages in connection with the products.

## **Contact Information**

Cell Biolabs, Inc.  
 7758 Arjons Drive  
 San Diego, CA 92126  
 Worldwide: +1 858-271-6500  
 USA Toll-Free: 1-888-CBL-0505  
 E-mail: [tech@cellbiolabs.com](mailto:tech@cellbiolabs.com)  
[www.cellbiolabs.com](http://www.cellbiolabs.com)

©2013-2023: Cell Biolabs, Inc. - All rights reserved. No part of these works may be reproduced in any form without permissions in writing.