

# Fluoro: SSAO™ Semicarbazide-Sensitive Amine Oxidase Detection Kit

## Contact Information

Address	Cell Technology Inc 48820 Kato Road Suite 400B Fremont, CA 94538 USA
Telephone	650-960-2170
Toll Free	888 7ASSAYS (727-7297)
Fax	650-960-0367
General Information	info@celltechnology.com
Sales	sales@celltechnology.com
Technical Questions	techsupport@celltechnology.com
Website	www.celltechnology.com

### Notes

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## I. Assay Principle:

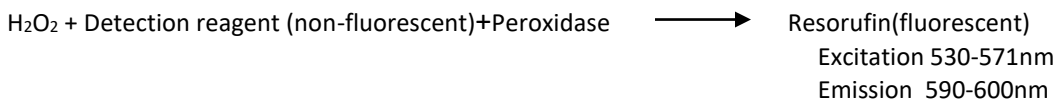
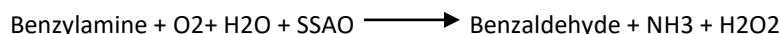
Semicarbazide-sensitive amine oxidase (**SSAO**) is a common name for a widely distributed enzyme in nature. In man, this enzyme is present in the vascular system and circulates in plasma. SSAO differs from the monoamine oxidases A and B in substrate and inhibitor patterns. These enzymes have been widely studied and their tissue distribution, molecular properties, substrate specificities and inhibitor sensitivities are extensively reviewed (2,3).

SSAO exists in two forms: tissue bound and soluble (plasma SSAO). Tissue bound SSAO activity is associated with blood vessels, mainly in smooth muscle layers, however it is also associated with spleen, placenta, bone marrow, kidney, sclera, retina, endothelial cells, adipocytes, chondrocytes and fibroblasts. (4,5). It is expected and evidence suggests that Plasma SSAO originates from the cleavage of membrane-bound form. The possible sources of plasma SSAO are still unclear, but it has been suggested that it may be derived from liver, retina, placenta and bone tissue (6,7,8).

SSAO's functional role has been suggested to be involved in: apoptosis, atherogenesis, cell adhesion, leukocyte trafficking, glucose transport and local production of hydrogen peroxide. Elevated levels of SSAO have been reported in congestive heart failure, diabetes mellitus, Alzheimer's disease and various other inflammatory diseases. Furthermore, by products of SSAO deamination, such as formaldehyde and methylglyoxal, have been proposed to be involved in pathogenesis of cancer, aging and atherosclerosis (1 review).

The Fluoro SSAO detection kit utilizes a non-fluorescent detection reagent to measure  $H_2O_2$  released from the conversion of Benzylamine to Benzaldehyde via SSAO. Furthermore  $H_2O_2$  oxidizes the detection reagent in a 1:1 stoichiometry to produce a fluorescent product resorufin. This oxidation is catalyzed by Peroxidase.

Reaction:



## II. Storage:

1. The kit contains **multiple storage temperature components**. Please see labels of individual components for storage instructions.
2. Once a vial of the Detection reagent is opened, it should be used promptly and frozen since it is subject to oxidation by air. It is also light-sensitive.

## III. Warnings and Precautions:

1. For Research use only. Not for use in diagnostic procedures.
2. Practice safe laboratory procedures by wearing protective clothing and eyewear.
3. The fluorescent product of the detection reagent is not stable in the presence of thiols (DTT or 2-mercaptoethanol). Keep these reactants below  $10\mu M$ . If you are using your own buffer, keep the reaction between pH 7-8 (optimal pH 7.4).
4. NADH and glutathione (reduced form: GSH) may interfere with the assay.
5. See Technical note #5.

#### IV. Part # 5016: Kit contents and Storage (for 500 assays).

Unopened kit can be stored at 4-8°C for two weeks except for Part # 6006 and Part # 7004 which must be stored at –20°C immediately upon arrival. For long term storage see table below.

Description	Part#	Long term Storage Kit or Reconstitution of Reagents.
1 Bottle: 5X Reaction Buffer pH 7.4	3019	4-8°C
1 vial: Detection reagent	4008	Aliquot in single use vials: Below –20°C
1 vial: Horseradish Peroxidase	6005	4-8°C
1 vial: SSAO substrate Benzylamine	7001	Aliquot in vials: Below –20°C
1 vial: SSAO Enzyme @ 100U/ml	6006	Aliquot in single use vials: Below –20°C
1 vial Pargyline: Monoamine Oxidase B inhibitor <sup>(9-11)</sup>	7003	Aliquot in vials: Below –20°C
1 vial Semicarbazide: Semicarbazide-sensitive amine oxidase inhibitor.	7004	Aliquot in single use vials: Below –20°C

#### Materials required but not supplied:

1. Dimethyl sulfoxide (DMSO)
2. Black 96-well plates
3. Fluorescence plate reader
4. Deionized water
5. Resorufin (optional; Sigma Cat# 424455 or R3257. Consult Sigma on how to dissolve the dye).

#### V. Preparation of reagent working solutions:

1. **1 X Reaction Buffer Part# 3019:** To prepare a 1X solution of Reaction buffer, dilute the 5X buffer 1:5 with Di water. For example to prepare 20 ml of 1X Reaction buffer add 4ml of 5X Reaction buffer to 16ml of deionized water.
2. **Horseradish Peroxidase Part# 6005.** Make a 100X stock solution of HRP by diluting it 1:18.9 with 1X Reaction Buffer. For example take out 5.29µL of the HRP reagent and add 94.71µL 1X Reaction Buffer. Make enough HRP for a day's worth of experiments.
3. **Detection Reagent Part# 4008:** Dissolve the contents of one vial in 500µL of DMSO. Allow the contents to sit at Room Temperature for 15 minutes. Next gently pipette up and down several times to dissolve any clumps. Once dissolved the detection reagent should be used promptly and any remaining reagent can be aliquoted and frozen at –70°C. Avoid repeated freeze thaw cycles.  
**Note: Protect the Detection Reagent from light.**
4. **SSAO Enzyme Part # 6006:** Semicarbazide-sensitive amine oxidase SSAO enzyme is at 100 Units/mL. **Dilute to 10 U/ml in 1X Reaction Buffer before use.**

5. **Substrate: Benzylamine Hydrochloride Part# 7001:** Make a 0.5M solution by adding 0.6 mL of Di water to the vial. Allow the vial to sit at room temperature for 15 minutes. Gently vortex the vial from time to time.
6. **Pargyline Part# 7003:** MAO-B inhibitor: Make a 100mM solution by reconstituting the Vial with 0.5mL of Di water. Gently vortex the vial and allow the contents to dissolve at room temperature for 15 minutes.
7. **Semicarbazide Part# 7004:** SSAO inhibitor is at a concentration of 0.5M. Dilute in 1X Reaction Buffer as needed.

## VI. Assay Protocol: Detection of SSAO in Samples.

1. Prepare 10ml **reaction cocktail** for 100 assays:
  - 100µL Detection Reagent .
  - 100µL of 100X HRP.
  - 100µL of SSAO Substrate, Benzylamine.
  - 9.7ml of 1X Reaction buffer

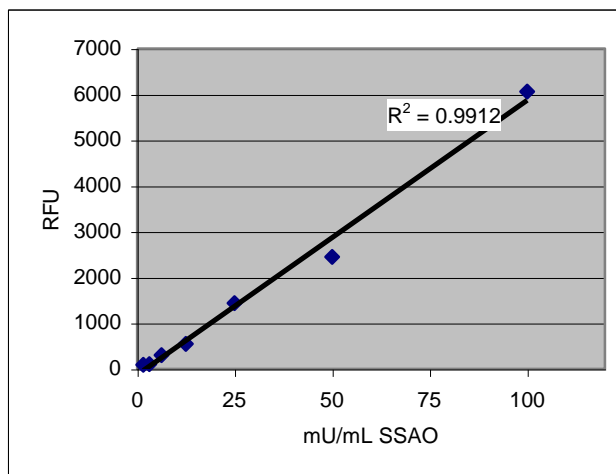
The volume of the **reaction cocktail** can be scaled down or up (as needed) provided that the **ratios** of the ingredients are kept constant.

**Note:** See *Technical note #1*.
2. Positive control: Make a 2X solution of the SSAO enzyme by diluting the enzyme (Part# 6006) 1:500 in 1X reaction buffer. The resulting SSAO solution will have an activity of approximately 0.2 Units/mL. One unit results in the oxidation of one micromole of benzylamine per minute at 25°C. The SSAO enzyme can be used as a positive control. **Note:** See *Technical note #2*.
3. Preparation of samples:
 

Samples (microsomes, cell membrane preparations or serum) can be diluted in 1X Reaction Buffer. Since Benzylamine is a substrate for both SSAO and Monoamine oxidase B, pargyline, a Monoamine oxidase B inhibitor can be added to samples 30 minutes prior to the assay. Pargyline can be added to a final concentration of 0.5mM to each sample and incubated for 30 minutes at 37°C.

**Note:** See *Technical note #2 & #3 and 4*
4. Assay for Titration of SSAO:
  1. To a black 96 well plate add 100 µL of sample or positive control to each individual wells.
  2. Add 100 µL of Reaction Cocktail prepared in Section VI step 1 above.
  3. Incubate the sample at 37°C for 1-3 hours.

**Note:** Each investigator should optimize the incubation time for their particular application.
5. **Optional:** A standard curve can be prepared from resorufin (fluorescent end product of the DETECTION REAGENT) to determine moles of product produced from DETECTION REAGENT. Standard curve can be constructed in the 1X Reaction Buffer, from 0 – 50 µM. Pipette 200µL of this standard curve to individual wells, prior to reading your samples.
6. Read samples using excitation: 530-570nm (570nm is optimal) and measure fluorescence at 590-600nm.



**Figure 1.** Bovine serum Semicarbazide-sensitive amine oxidase was serially diluted in 1X Reaction buffer. The serially diluted samples were run as described in the protocol. The samples were read after a 3 hours incubation period. Excitation: 530nm and emission: 590nm.

## VII: Assay for testing inhibition of SSAO using Semicarbazide:

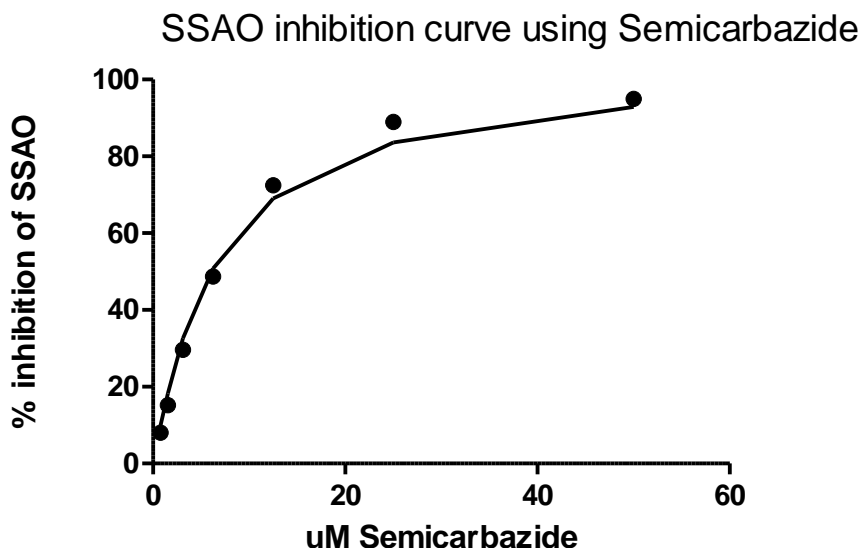
### Part # 7004: Semicarbazide:

1. Prepare a 200 $\mu$ M (4X) solution from the 0.5M stock of the semicarbazide. (1:2500 dilution)  
First, dilute 0.5M 1:100 by adding 10 $\mu$ L of 0.5M stock to 990 $\mu$ L of 1X RB.  
Then further dilute it 1:25 by adding 40 $\mu$ L of the 5mM dilution prepared above to 960 $\mu$ L of 1X Reaction Buffer (Part# 3019 from step V above). Now serially dilute the 200 $\mu$ M solution 1:2 to 3.125 $\mu$ M (7 points).  
The final concentration in the well will be 4-fold less than the concentration in the tube.

Tube #	$\mu$ M inhibitor in tube	Final $\mu$ M inhibitor in well
1	200	50
2	100	25
3	50	12.5
4	25	6.25
5	12.5	3.125
6	6.25	1.5625
7	3.125	0.78
8	0	0

2. Prepare the SSAO enzyme at 2U/ml (4X) by diluting the supplied enzyme (100 U/ml) 1:50 with 1X Reaction Buffer. For each mL of 2U/ml enzyme required, use 20 $\mu$ L of 100U/ml enzyme + 980 $\mu$ L of 1X Reaction Buffer.
3. In a black 96-well plate, 50 $\mu$ L of the 4X enzyme is incubated with 50 $\mu$ L of the semicarbazide dilutions prepared above.
4. Then add 100 $\mu$ L of the Reaction cocktail, incubate at 37°C for 2 hours, and read on the plate reader with excitation at 530-570 nm and emission at 590 nm.

- Calculate % inhibition by dividing fluorescence by the wells in which no inhibitor is present. Graph % inhibition on Y-axis vs.  $\mu\text{M}$  concentration of inhibitor on the X-axis.



**Figure 2.** Bovine Plasma Amine Oxidase (0.5 U/mL) was incubated with serial dilutions of the inhibitor, semicarbazide. The activity of Bovine Plasma Amine Oxidase was then measured with the Fluoro SSAO kit as described. Data point reading taken after 2 hours at 37°C.

### VIII. Technical Notes:

- Final concentration of SSAO substrate Benzylamine = 2.5mM. Each investigator should titrate benzylamine to optimize the kinetic reaction for their particular enzyme.
- SSAO Enzyme= Bovine Plasma Amine Oxidase I.U.B.: 1.4.3.6.  
Caution for serum samples: Serum may contain catalase activity that will interfere with the assay. A catalase inhibitor should be used in such cases to suppress catalase activity (Do not use Azide as it will also suppress HRP activity).
- For detailed information on inhibitor concentrations see reference 10.
- The fluorescent product of the detection reagent is no stable in the presence of thiols (DTT or 2-mercaptoethanol). Keep these reactants below 5 $\mu\text{M}$ .  
If you are using your own buffer, keep the reaction between pH 7-8 (optimal pH 7.4).
- At NADH levels above 10 $\mu\text{M}$ , detection reagent oxidation results from side chain reaction between NADH and HRP. This could result in aberrant readings. To minimize this interference it is recommended to add superoxide dismutase (SOD) at 40U/mL to the reaction <sup>12</sup>.  
At glutathione (reduced form GSH) above 300 $\mu\text{M}$ , detection reagent oxidation results from side chain reaction between GSH and HRP. This could result in aberrant readings. To minimize this interference it is recommended to add superoxide dismutase (SOD) at 40U/mL to the reaction <sup>12</sup>.

## IX. References:

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