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Product Manual

# NADP<sup>+</sup>/NADPH Assay Kit (Colorimetric)

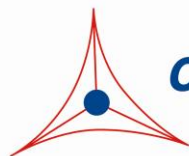
Catalog Number

MET-5018

100 assays

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

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*Creating Solutions for Life Science Research*

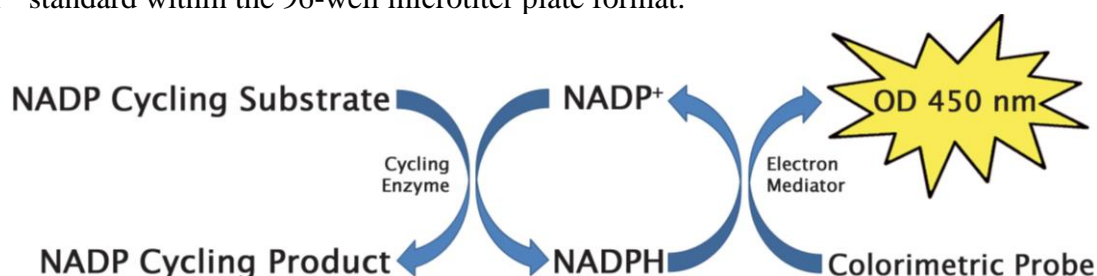
## **Introduction**

Nicotinamide adenine dinucleotide phosphate (NADP<sup>+</sup>) is an enzymatic cofactor involved in metabolic redox and cell signaling reactions. Its main function in animal metabolism is to shift electrons from one redox reaction to another. During these reactions, the coenzyme cycles between the electron donating reduced form (NADPH) and the electron accepting oxidized form (NADP<sup>+</sup>). The major source of NADPH produced in animal cells is the oxidative branch of the pentose phosphate pathway (PPP). NADPH is involved with macromolecule biosynthesis by providing reducing power. These characteristics have made NADPH an important molecule in cancer cell proliferation and metabolism. NADPH is also involved in the accumulation of Reactive Oxygen Species (ROS) and protecting against its toxicity. It is also involved in anabolic pathways, such as fatty acid elongation and lipid and cholesterol synthesis. Understanding the metabolism of these cofactors has become important to developing new therapeutic methods against pathological disease states.

Cell Biolabs' NADP<sup>+</sup>/NADPH Assay Kit is a simple colorimetric assay that can measure both NADP<sup>+</sup> and NADPH present in biological samples such as cell lysates or tissue extracts in a 96-well microtiter plate format. The kit is specific for NADP<sup>+</sup>, NADPH, and their ratio. The kit will not detect NAD or NADH. Each kit provides sufficient reagents to perform up to 100 assays, including blanks, NADP<sup>+</sup> standards and unknown samples. The total NADP<sup>+</sup>/NADPH concentrations of unknown samples are determined by comparison with a known NADP<sup>+</sup> standard. Determination of both NADP<sup>+</sup> and NADPH requires two separate samples for quantification. NADP<sup>+</sup> and NADPH do not need to be purified from samples, but rather can be extracted individually with a simple acid or base treatment prior to performing the assay. The kit has a detection sensitivity limit of approximately 4 nM NADP<sup>+</sup>.

## **Assay Principle**

Cell Biolabs' NADP<sup>+</sup>/NADPH Assay Kit is a convenient quantitative tool that measures NADP<sup>+</sup> and NADPH within biological samples. The assay is based on an enzymatic cycling reaction in which NADP<sup>+</sup> is reduced to NADPH. NADPH reacts with a colorimetric probe that produces a colored product which can be measured at 450 nm. The intensity of the product color is proportional to the NADP<sup>+</sup> and NADPH within a sample. A simple acid or base treatment will differentiate NADPH from NADP<sup>+</sup> within a sample. Samples and standards are incubated for 1-4 hours and then read with a standard 96-well colorimetric plate reader (Figure 1). Samples are compared to a known concentration of NADP<sup>+</sup> standard within the 96-well microtiter plate format.



**Figure 1. NADP<sup>+</sup>/NADPH Cycling Assay Principle.**

## **Related Products**

1. STA-617: Lipid Quantification Kit (Fluorometric)
2. MET-5011: Lipid Droplet Isolation Kit

3. STA-612: Lipid Extraction Kit
4. MET-5147: Guanine Assay Kit (Colorimetric)
5. MET-5163: ATP Assay Kit (Fluorometric)

## **Kit Components**

### **Box 1 (shipped at room temperature)**

1. Colorimetric Probe (Part No. 50181C): One 1.0 mL amber tube
2. NADP Cycling Substrate (Part No. 50182B): One 50  $\mu$ L tube
3. Assay Buffer (Part No. 50184B): One 25 mL bottle
4. Extraction Buffer (10X) (Part No. 50185B): One 10 mL bottle

### **Box 2 (shipped on blue ice packs)**

1. NADP Cycling Enzyme (Part No. 50183D): One 15  $\mu$ L amber tube
2. NADP<sup>+</sup> Standard (Part No. 50186D): One 50  $\mu$ L amber tube of a 20 mM NADP<sup>+</sup> solution

## **Materials Not Supplied**

1. Distilled or deionized water
2. 0.1 N NaOH
3. 0.1 N HCl
4. 10 kDa molecular weight cutoff (MWCO) centrifuge spin filter (e.g., Amicon Ultra 0.5mL)
5. 1X PBS
6. 0.5 N H<sub>2</sub>SO<sub>4</sub>
7. Standard 96-well clear microtiter plate and/or clear cell culture microplate

## **Storage**

Upon receipt, store the NADP Cycling Enzyme and NADP<sup>+</sup> Standard at -80°C. Store the Colorimetric Probe at -20°C. Store the remaining components at 4°C.

## **Preparation of Reagents**

- 1X Extraction Buffer: Dilute the stock 10X Extraction Buffer 1:10 with deionized water for a 1X solution. Stir or vortex to homogeneity.
- NADP Cycling Reagent: Prepare an NADP Cycling Reagent for the number of assays being tested and just before use. Prepare by diluting the NADP Cycling Substrate 1:100, NADP Cycling Enzyme 1:400, and Colorimetric Probe 1:5 in 1X Assay Buffer. (eg. For 100 assays, combine 50  $\mu$ L NADP Cycling Substrate, 12.5  $\mu$ L NADP Cycling Enzyme, 1000  $\mu$ L Colorimetric Probe to 3.938 mL of 1X Assay Buffer for a 5 mL total solution). Use the NADP Cycling Reagent the same day as preparation.

## **Preparation of Samples**

These preparation protocols are intended as a guide for preparing unknown samples. The user may need to adjust the sample treatment accordingly. It is highly recommended that all samples should be

assayed immediately upon preparation or stored for up to 1 month at -80°C. A trial assay with a representative test sample should be performed to determine the sample compatibility with the dynamic range of the standard curve. High levels of interfering substances may cause variations in results. Samples may be diluted in deionized water as necessary before testing. Run proper controls and account for any sample dilutions. Always run a standard curve with samples.

- Tissue homogenates: Sonicate or homogenize 100 mg tissue sample in 0.5 mL cold 1X Extraction Buffer. Centrifuge at 14,000 rpm for 5 minutes at 4°C to remove insoluble material. Filter the solution with a 10kDa spin filter to deproteinate the sample. Collect flow through. Perform dilutions in cold deionized water. Sample may be tested immediately for total NADP<sup>+</sup>/NADPH quantification or extracted with acid or base to separate the cofactors. Store unused samples at -80°C for up to 1 month.
- Cell lysates: Culture cells until confluent and harvest. Centrifuge and wash cell pellet with 1X PBS. Centrifuge to pellet cells and remove wash. Resuspend cells at 1-5 x 10<sup>6</sup> cells/mL in 0.5 mL 1X Extraction Buffer. Homogenize or sonicate the cells on ice. Centrifuge at 14,000 rpm for 5 minutes 4°C to remove debris. Filter the solution with a 10kDa spin filter to deproteinate the sample. Collect flow through. Perform dilutions in cold deionized water. Sample may be tested immediately for total NADP<sup>+</sup>/NADPH quantification or extracted with acid or base to separate the cofactors. Store unused samples at -80°C for up to 1 month.

*Note: Enzymes in tissue and cell sample lysates may deplete NADPH rapidly and affect results. Samples should be deproteinized before extracting the cofactors or using within the assay. A spin filter with a 10 kDa cutoff is recommended for efficient and clean separation.*

#### **NADPH Extraction Procedure:**

To measure NADPH and destroy NADP<sup>+</sup>, add 25 µL of sample to a microcentrifuge tube. Add 5 µL of 0.1 N NaOH and mix thoroughly. Incubate the tube at 80°C for 60 minutes and protected from light. Centrifuge the tube to pool all sample solution. Add 20 µL of 1X Assay Buffer to shift the pH of the sample back to neutral. Vortex to mix and centrifuge to pool sample. Sample pH should be between 6.0 and 8.0; if not, neutralize accordingly with acid or base. Keep sample on ice until assaying.

#### **NADP<sup>+</sup> Extraction Procedure:**

To measure NADP<sup>+</sup> and destroy NADPH, add 25 µL of sample to a microcentrifuge tube. Add 5 µL of 0.1 N HCl and mix thoroughly. Incubate the tube at 80°C for 60 minutes and protected from light. Centrifuge the tube to pool all sample solution. Add 20 µL of 1X Assay Buffer to shift the pH of the sample back to neutral. Vortex to mix and centrifuge to pool sample. Sample pH should be between 6.0 and 8.0; if not, neutralize accordingly with acid or base. Keep sample on ice until assaying.

#### **Notes:**

- *If testing both total NADP<sup>+</sup>/NADPH and individual cofactors, dilute the total NADP<sup>+</sup>/NADPH samples 1:2 with Assay buffer to maintain sample dilution consistency.*
- *Avoid samples containing SH groups like DTT, β-mercaptoethanol, or reduced glutathione.*
- *Samples should be close to neutral pH before harvesting. Samples with extremely high or low pH values could fail to yield reliable results.*

### **Preparation of Standard Curve**

1. Prepare NADP<sup>+</sup> standards immediately before use. **First, dilute the stock 20 mM NADP<sup>+</sup> Standard solution 1:200 in deionized water to yield a 100  $\mu$ M NADP<sup>+</sup> Solution** (e.g., add 5  $\mu$ L of the stock 20 mM NADP<sup>+</sup> Standard to 995  $\mu$ L of deionized water). **Vortex thoroughly.**
2. Use the 100  $\mu$ M NADP<sup>+</sup> solution to prepare a series of NADP<sup>+</sup> standards according to Table 1. Do not store standard solutions.

Standard Tubes	100 $\mu$ M NADP <sup>+</sup> Solution ( $\mu$ L)	1X Extraction Buffer ( $\mu$ L)	NADP <sup>+</sup> ( $\mu$ M)	NADP <sup>+</sup> (pmol/well)
1	5	495	1	50
2	250 of Tube #1	250	0.5	25
3	250 of Tube #2	250	0.25	12.5
4	250 of Tube #3	250	0.125	6.25
5	250 of Tube #4	250	0.063	3.13
6	250 of Tube #5	250	0.031	1.56
7	250 of Tube #6	250	0.015	0.78
8	250 of Tube #7	250	0.008	0.4
9	250 of Tube #8	250	0.004	0.2
10	0	250	0	0

**Table 1. Preparation of NADP<sup>+</sup> Standards**

### **Assay Protocol**

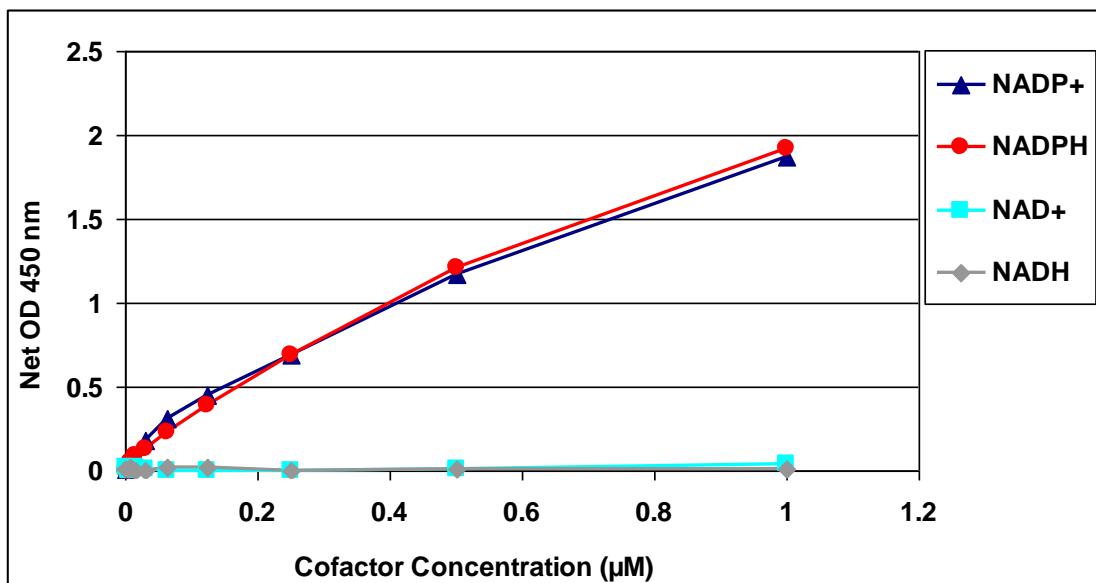
1. Prepare and mix all reagents thoroughly before use. Each sample, including unknowns and standards, should be assayed in duplicate or triplicate.
2. Add 50  $\mu$ L of each NADP<sup>+</sup> standard or unknown sample into wells of a 96-well microtiter plate.
3. Add 50  $\mu$ L of NADP Cycling Reagent to each well. Mix the well contents thoroughly and incubate for 1-4 hours at room temperature protected from light.

*Note: This assay is continuous (not terminated) and therefore may be measured at multiple time points to follow the reaction kinetics. The assay may be stopped at a desired time point by adding 50  $\mu$ L 0.5 N H<sub>2</sub>SO<sub>4</sub>.*

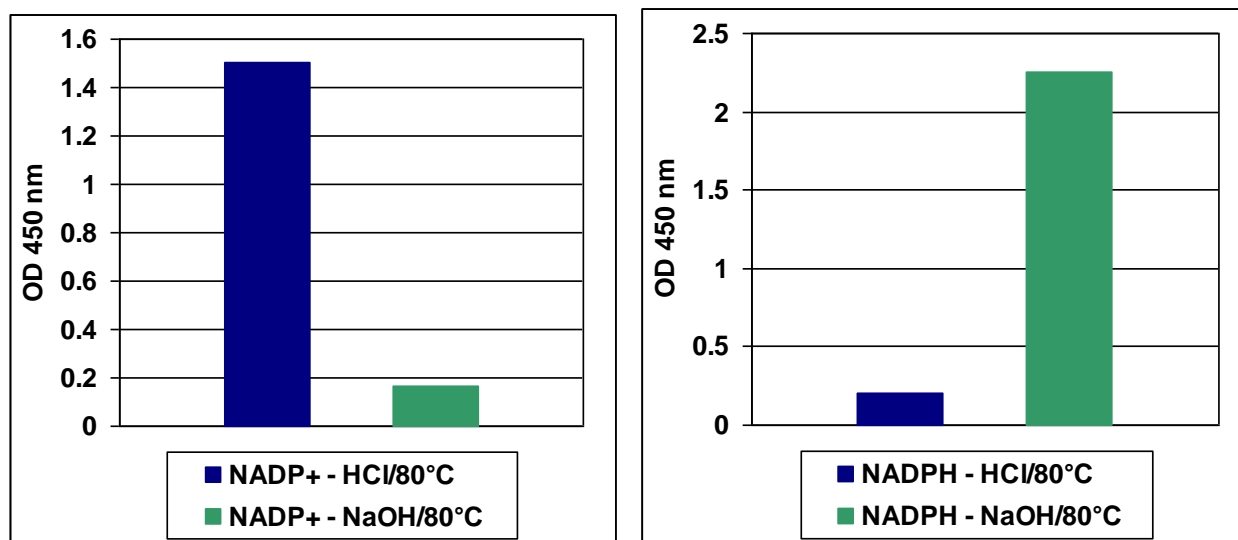
4. Read the plate with a spectrophotometric microplate reader at 450 nm.
5. Calculate the concentration of NADP<sup>+</sup>/NADPH within samples by comparing the sample OD to the standard curve.

### **Example of Results**

The following figures demonstrate typical NADP<sup>+</sup>/NADPH Assay Kit results. One should use the data below for reference only. This data should not be used to interpret or calculate actual sample results.



**Figure 2: NADP<sup>+</sup> Standard Curve and Specificity of Assay for NADP<sup>+</sup> and NADPH.** NADP<sup>+</sup>, NADPH, NAD<sup>+</sup>, and NADH, were tested in the NADP<sup>+</sup>/NADPH Assay Kit.



**Figure 3: NADP<sup>+</sup>/NADPH Detection.** NADP<sup>+</sup> and NADPH were both tested at 1 μM with the extraction procedure. NADP<sup>+</sup> or NADPH were incubated for 60 minutes at 80°C with 0.1N HCl or 0.1N NaOH.

### Calculation of Results

1. Calculate the average absorbance values for every standard, control, and sample. Subtract the average zero standard value from itself and all standard and sample values. This is the corrected background absorbance. If sample background control value is high, subtract the sample background control value from the sample reading.
2. Plot the corrected absorbance for the NADP<sup>+</sup> standards against the final concentration of the standards from Table 1 to determine the best slope (μM<sup>-1</sup>). See Figure 2 for an example standard curve.

3. Since all NADP<sup>+</sup> is converted to NADPH by the Cycling Reagent, use the standard curve to determine the total NADP<sup>+</sup>/NADPH concentration in pmoles within the sample. Determine the total concentration of the samples with the equation obtained from the linear regression analysis of the standard curve. Substitute the corrected absorbance values for each sample. Remember to account for dilution factors.

$$\text{Total NADP}^+/\text{NADPH} = \left[ \frac{\text{Sample corrected absorbance}}{\text{Slope}} \right] \times \text{Sample dilution}$$

## **References**

1. Bedard K, et al. *Physiol. Rev.* **87**: 245-313.
2. Berger F, et al., (2004) *Trends Biochem. Sci.* **29** (3): 111-118.
3. Hedekov CJ, et al. (1987) *Biochem. J.* **241**: 161-167.
4. Khan JA, et al. (2007) *Expert Opin. Cell Biol.* **11** (5): 695-705.
5. Veech RL, et al. (1969) *Biochem. J.* **115** (4): 609-619.

## **Recent Product Citations**

1. Qi, H. et al. (2023). Oncogenic role of copper-induced cell death-associated protein DLD in human cancer: A pan-cancer analysis and experimental verification. *Oncol Lett.* **25**(5):214. doi: 10.3892/ol.2023.13800.
2. Ogawa, K. et al. (2020). Forced expression of miR-143 and -145 in cardiomyocytes induces cardiomyopathy with a reductive redox shift. *Cell Mol Biol Lett.* **25**:40. doi: 10.1186/s11658-020-00232-x.
3. Liu, J. et al. (2020). Taurine protects against cardiac dysfunction induced by pressure overload through SIRT1–p53 activation. *Chem Biol Interact.* doi: 10.1016/j.cbi.2020.108972.

## **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's 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.

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