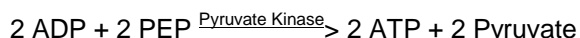
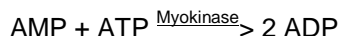
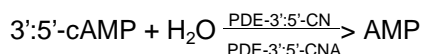


**SIGMA QUALITY CONTROL TEST  
PROCEDURE****Enzymatic Assay of PHOSPHODIESTERASE, 3':5'-CYCLIC NUCLEOTIDE  
ACTIVATOR (Calmodulin)****Sigma Prod. Nos. P-0270, P-1431, P-1915, P-2277,  
P-3922, P-4046, P-5779, P-6654, and P-9707****PRINCIPLE:**

Abbreviations used:

3':5'-cAMP = Adenosine 3':5'-Cyclic Monophosphate

PDE-3':5'-CN = Phosphodiesterase, 3':5'-Cyclic Nucleotide

PDE-3':5'-CNA = Phosphodiesterase, 3':5'-Cyclic Nucleotide Activator (Calmodulin)

AMP = Adenosine 5'-Monophosphate

ATP = Adenosine 5'-Triphosphate

ADP = Adenosine 5'-Diphosphate

PEP = Phospho(enol)pyruvate

 $\beta$ -NADH =  $\beta$ -Nicotinamide Adenine Dinucleotide, Reduced Form $\beta$ -NAD =  $\beta$ -Nicotinamide Adenine Dinucleotide, Oxidized Form**CONDITIONS:** T = 30°C, pH = 7.5, A<sub>340nm</sub>, Light path = 1 cm**METHOD:** Continuous Spectrophotometric Rate Determination**REAGENTS:**

- A. 200 mM Tris HCl Buffer, pH 7.5 at 30°C  
(Prepare 50 ml in deionized water using Trizma Base, Sigma Prod. No. T-1503. Adjust to pH 7.5 at 30°C with 1 M HCl.)
- B. 1.0 M Potassium Chloride Solution (KCl)  
(Prepare 1 ml in deionized water using Potassium Chloride, Sigma Prod. No. P-4504.)

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P-3922, P-4046, P-5779, P-6654, and P-9707**

**REAGENTS:** (continued)

- C. 60 mM Magnesium Sulfate Solution ( $\text{MgSO}_4$ )  
(Prepare 10 ml in deionized water using Magnesium Sulfate, Heptahydrate, Sigma Prod. No. M-1880.)
- D. 0.665 mM Phospho(enol)pyruvate Solution (PEP)  
(Prepare by dissolving Phospho(enol)pyruvate, Monopotassium Salt, Sigma Prod. No. P-7127, in 3.7 ml of Reagent A. Then add: 0.6 ml of Reagent B, 1.2 ml of Reagent C, and 4.5 ml of deionized water. **PREPARE FRESH.**)
- E. 30 mM Adenosine 5'-Triphosphate Solution (ATP)  
(Prepare 10 ml in deionized water using Adenosine 5'-Triphosphate, Disodium Salt, Sigma Prod. No. A-5394. Adjust to pH 7.5 with solid Sodium Bicarbonate, Sigma Prod. No. S-8875. **PREPARE FRESH.**)
- F. 60 mM Adenosine 3':5'-Cyclic Monophosphate Solution (3':5'-cAMP)  
(Prepare 1 ml in deionized water using Adenosine 3':5'-Cyclic Monophosphate, Sodium Salt, Sigma Prod. No. A-6885. **PREPARE FRESH.**)
- G. PK/LDH Enzymes Solution<sup>1</sup>  
(Use PK/LDH Enzymes Solution in 50% Glycerol, Sigma Prod. No. P-0294.)
- H. Myokinase Enzyme Solution (MK)  
(Immediately before use, prepare a solution containing 200 units/ml of Myokinase, Sigma Prod. No. M-3003, in cold deionized water.)
- I. 0.70 mM Calcium Acetate Solution ( $\text{Ca}(\text{OAc})_2$ )  
(Prepare 10 ml in deionized water using Calcium Acetate, Sigma Prod. No. C-1000.)
- J.  $\beta$ -Nicotinamide Adenine Dinucleotide, Reduced Form Solution ( $\beta$ -NADH)  
(Use  $\beta$ -Nicotinamide Adenine Dinucleotide, Reduced Form, Disodium Salt, Sigma Stock No. 340-101. **PREPARE FRESH.**)
- K. Phosphodiesterase, 3':5'-Cyclic Nucleotide-Activator Solution (PDE-3':5'-CNA)  
(Immediately before use, prepare a solution containing 100 units/ml of Phosphodiesterase, 3':5'-Cyclic Nucleotide-Activator, Sigma Prod. No. P-0270, in cold deionized water.)

**Enzymatic Assay of PHOSPHODIESTERASE, 3':5'-CYCLIC NUCLEOTIDE  
ACTIVATOR (Calmodulin)**  
**Sigma Prod. Nos. P-0270, P-1431, P-1915, P-2277,  
P-3922, P-4046, P-5779, P-6654, and P-9707**

**REAGENTS:** (continued)

- L. 100 mM Tris HCl Buffer, pH 7.5 at 30°C (Enz Dil)  
(Prepare 25 ml in deionized water using Trizma Base, Sigma Prod. No. T-1503. Adjust to pH 7.5 at 30°C.)
- M. Phosphodiesterase, 3':5'-Cyclic Nucleotide Enzyme, Solution (PDE-3':5'-CN)  
(Immediately before use dissolve Phosphodiesterase 3':5'cyclic Nucleotide, Activator Deficient, Sigma Prod. No. P-0520, 0.5 unit vial in 0.5 ml Reagent L.)
- N. Phosphodiesterase 3':5'-Cyclic Nucleotide Enzyme, Working Solution (PDE-3':5'-CN Working Solution)  
Assay of Reagent M:

Prepare a reaction cocktail by pipetting (in milliliters) the following reagents into a 1 ml vial of Reagent J.:

Reagent D (PEP)	9.00
Reagent E (ATP)	0.10
Reagent F (3':5'-cAMP)	0.10
Reagent G (PK/LDH)	0.05
Reagent H (MK)	0.05
Reagent I (Ca(OAc) <sub>2</sub> )	0.15

Mix by inversion.

Pipette (in milliliters) the following reagents into a suitable cuvette.

	<u>Activated</u>
Reaction Cocktail	3.00
Reagent K	0.10

Mix by inversion and equilibrate to 30°C, monitor the  $A_{340\text{nm}}$  until constant, using a suitably thermostatted spectrophotometer. Then add:

Reagent M	0.015
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Immediately mix by inversion and record the decrease in  $A_{340\text{nm}}$  for approximately 15 minutes. Obtain the maximum linear rate for the Activated solution.

**Enzymatic Assay of PHOSPHODIESTERASE, 3':5'-CYCLIC NUCLEOTIDE  
ACTIVATOR (Calmodulin)  
Sigma Prod. Nos. P-0270, P-1431, P-1915, P-2277,  
P-3922, P-4046, P-5779, P-6654, and P-9707**

**REAGENTS:** (continued)

N. Continued:

Calculation:

I. PDE-3':5'-CN

$$\text{PDE-3':5'-CN Activated units/ml} = \frac{(\Delta A_{340}/\text{min Activated})(3.115)}{2(6.22)(0.015)}$$

PDE-3':5'-CN Activated units/ml equal units/ml Reagent M.

Dilute Reagent M, (with known activated units/ml) to 0.17 units/ml with Reagent L. This resulting 0.17 units/ml solution is now Reagent N, Phosphodiesterase 3':5' Cyclic Nucleotide Enzyme working solution.

O. Phosphodiesterase 3':5'-Cyclic Nucleotide Activator Sample Solution (PDE-3':5'-CNA/Sample) (Immediately before use, prepare a solution containing approximately 10 units/ml of Phosphodiesterase 3':5'-Cyclic Nucleotide Activator in cold deionized water.)

**PROCEDURE:**

Pipette (in milliliters) the following reagents into suitable cuvettes:

	<u>Non-Activated</u>	<u>Activated</u>	<u>Test</u>
Reaction Cocktail	3.00	3.00	3.00
Deionized Water	0.15	0.05	0.05
Reagent K (PDE-3':5'-CNA)	-----	0.10	-----
Reagent O (PDE-3':5'-CNA/Sample)	-----	-----	0.10

Mix by inversion and equilibrate to 30°C. Monitor the A<sub>340nm</sub> until constant, using a suitably thermostatted spectrophotometer. Each cuvette must contain exactly 0.0085 unit of PDE-3':5'-CN (Reagent M) in a total volume of 3.20 ml. Then add:

	<u>Non-Activated</u>	<u>Activated</u>	<u>Test</u>
Reagent N (PDE-3':5'-CN)	0.05	0.05	0.05

**Enzymatic Assay of PHOSPHODIESTERASE, 3':5'-CYCLIC NUCLEOTIDE  
ACTIVATOR (Calmodulin)  
Sigma Prod. Nos. P-0270, P-1431, P-1915, P-2277,  
P-3922, P-4046, P-5779, P-6654, and P-9707**

**PROCEDURE:** (continued)

Immediately mix by inversion and record the decrease in  $A_{340\text{nm}}$  for approximately 20 minutes. Obtain the maximum linear rate for the Non-Activated, Activated, and Test solutions.

The Test activity should be as close to 1.0 unit of PDE-3':5'-CNA in the cuvette as possible (acceptable range is 0.90-1.10 units). If not in this range, change the sample preparation scheme appropriately and repeat the assay.

**CALCULATIONS:**

I. PDE-3':5'-CN

$$\text{PDE -3':5'-CN Non-Activated Units/ml} = \frac{(\Delta A_{340\text{nm}}/\text{min Non-Activated})(3.2)}{(2)(6.22)(0.05)}$$

3.2 = Total volume (in milliliters) of assay  
2 = 2  $\mu\text{moles}$  of  $\beta\text{-NAD}$  produced per mole of 3':5'-cAMP hydrolyzed  
6.22 = Millimolar extinction coefficient of  $\beta\text{-NADH}$  at 340 nm  
0.05 = Volume (in milliliter) of PDE-3':5'-CN enzyme used

$$\text{PDE-3':5'-CN Test Units/ml} = \frac{(\Delta A_{340\text{nm}}/\text{min Test})(3.2)}{(2)(6.22)(0.05)}$$

3.2 = Total volume (in milliliters) of assay  
2 = 2  $\mu\text{moles}$  of  $\beta\text{-NAD}$  produced per mole of 3':5'-cAMP hydrolyzed  
6.22 = Millimolar extinction coefficient of  $\beta\text{-NADH}$  at 340 nm  
0.05 = Volume (in milliliter) of PDE-3':5'-CN enzyme used

$$\text{PDE-3':5'-CN Activated Units/ml} = \frac{(\Delta A_{340\text{nm}}/\text{min Activated})(3.2)}{(2)(6.22)(0.05)}$$

3.2 = Total volume (in milliliters) of assay  
2 = 2  $\mu\text{moles}$  of  $\beta\text{-NAD}$  produced per mole of 3':5'-cAMP hydrolyzed  
6.22 = Millimolar extinction coefficient of  $\beta\text{-NADH}$  at 340 nm  
0.05 = Volume (in milliliter) of PDE-3':5'-CN enzyme used

**Enzymatic Assay of PHOSPHODIESTERASE, 3':5'-CYCLIC NUCLEOTIDE  
ACTIVATOR (Calmodulin)**  
Sigma Prod. Nos. P-0270, P-1431, P-1915, P-2277,  
P-3922, P-4046, P-5779, P-6654, and P-9707

**CALCULATIONS:** (continued)

II. PDE-3':5'-CNA

$$\text{Ratio} = \frac{(\text{Units/ml PDE-3':5'-CN Test} - \text{Units/ml PDE-3':5'-CN Non-Activated})}{(\text{Units/ml PDE-3':5'-CN Activated} - \text{Units/ml PDE-3':5'-CN Non-Activated})}$$

This ratio should be as close to 0.50 as possible. Repeat the assay until the ratio is in the range of 0.45 - 0.55.

$$\text{Units/ml PDE-3':5'-CNA Sample} = \frac{(\text{Ratio})(2)(3.2)}{3.0} \times \frac{\text{df}}{\text{sample volume (ml)}}$$

or

$$= \frac{(\text{Ratio})(2.1333)(\text{df})}{\text{sample volume (ml)}}$$

df = Dilution factor

2 = Conversion factor since 50% of the maximum activity is obtained as per the Unit Definition

3.2 = Total volume (in milliliters) of assay

3 = Conversion factor to 3 ml assay

**UNIT DEFINITION:**

One unit will stimulate 0.008 activated units of phosphodiesterase 3':5'-cyclic nucleotide, P-0520, in a 3 ml reaction volume at pH 7.5 and 30°C to 50% of the maximum activity of the enzyme when saturated with activator, in the presence of 0.01 mM Ca<sup>2+</sup>.

**FINAL ASSAY CONCENTRATIONS:**

In a 3.20 ml reaction mix (Test), the final concentrations are 66 mM Tris, 54 mM potassium chloride, 6.4 mM magnesium sulfate, 0.6 mM phospho(enol)pyruvate, 0.30 mM adenosine 5'-triphosphate, 0.6 mM adenosine 3':5'-cyclic monophosphate, 0.01 mM calcium acetate, 11 units pyruvate kinase, 16 units L-lactic dehydrogenase, 3 units myokinase, 0.1 mM β-nicotinamide adenine dinucleotide, reduced form, 0.0085 unit phosphodiesterase 3':5'-cyclic nucleotide, and 1.0 unit phosphodiesterase 3':5'-cyclic nucleotide activator.

**Enzymatic Assay of PHOSPHODIESTERASE, 3':5'-CYCLIC NUCLEOTIDE  
ACTIVATOR (Calmodulin)**

**Sigma Prod. Nos. P-0270, P-1431, P-1915, P-2277,  
P-3922, P-4046, P-5779, P-6654, and P-9707**

**REFERENCE:**

Chock, S.P. and Huang, C.Y. (1984) *Analytical Biochemistry* **138**, 34-43

**NOTES:**

1. Contains not less than 700 Pyruvate Kinase units and 1000 L-Lactic Dehydrogenase units each per ml.
2. Values greater than 0.17 unit/ml are acceptable. However, the volume of PDE-3':5'-CN added to the cuvette must be adjusted so that each assay contains 0.0085 unit of PDE-3':5'-CN in a final volume of 3.2 ml.
3. This reaction is very sensitive to chelators which sequester  $\text{Ca}^{++}$  ions at low  $\text{Ca}^{++}$  concentrations. EDTA or EGTA concentrations of 0.005 mM in the cuvette will almost completely inhibit the reaction. The concentration of EDTA or EGTA should be less than 0.001 mM in the cuvette. Cuvettes should be completely cleaned with 3% (w/v) NaOH before each use, since PDE-3':5'-CNA can bind to glass or quartz cuvettes.
4. L-Lactic Dehydrogenase Unit Definition: One unit will reduce 1.0  $\mu\text{mole}$  of pyruvate to L-lactate per minute at pH 7.5 at 37°C.
5. Pyruvate Kinase Unit Definition: One unit will convert 1.0  $\mu\text{mole}$  of phospho(enol)pyruvate to pyruvate per minute at pH 7.6 at 37°C.
6. Myokinase Unit Definition: One unit will convert 2.0  $\mu\text{moles}$  of ADP to ATP and AMP per minute at pH 7.6 at 37°C.
7. Phosphodiesterase 3':5'-Cyclic Nucleotide Unit Definition: One unit will hydrolyze 1.0  $\mu\text{mole}$  of 3':5'-cyclic-AMP to 5'-AMP per minute at pH 7.5 at 30°C.
8. This assay is based on the cited reference.
7. Where Sigma Product or Stock numbers are specified, equivalent reagents may be substituted.

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