
Certificate of Analysis

Acetyl-Histone H4 Immunoprecipitation (ChIP) Assay Kit

Catalog # 17-229

Lot # 0611045943

Kit Components

Anti-acetyl-Histone H4, Catalog # 06-866, Lot # 31992, see page two for more information. One vial containing **200 μ L** of rabbit antiserum with 0.05% sodium azide. Frozen solution.

Protein A Agarose/Salmon Sperm DNA, Catalog # 16-157C, Lot # 0608038187. One vial containing **1.5 mL** packed beads with **600 μ g** sonicated salmon sperm DNA, 1.5 mg BSA, ~4.5 mg recombinant protein A. Provided as a 50% gel slurry for a final volume of 3 mL. Suspended in TE buffer containing 0.05% sodium azide. Liquid suspension.

SDS Lysis Buffer, Catalog # 20-163. One vial containing **10 mL** of 1% SDS, 10 mM EDTA, 50 mM Tris-HCl, pH 8.1.

ChIP Dilution Buffer, Catalog # 20-153. Two vials, each containing **24 mL** of 0.01% SDS, 1.1% Triton X-100, 1.2 mM EDTA, 16.7 mM Tris-HCl, pH 8.1, 167 mM NaCl.

Low Salt Immune Complex Wash Buffer, Catalog # 20-154. One vial containing **24 mL** of 0.1% SDS, 1% Triton X-100, 2 mM EDTA, 20 mM Tris-HCl, pH 8.1, 150 mM NaCl.

High Salt Immune Complex Wash Buffer, Catalog # 20-155. One vial containing **24 mL** of 0.1% SDS, 1% Triton X-100, 2 mM EDTA, 20 mM Tris-HCl, pH 8.1, 500 mM NaCl.

LiCl Immune Complex Wash Buffer, Catalog # 20-156. One vial containing **24 mL** of 0.25 M LiCl, 1% NP40, 1% deoxycholate, 1 mM EDTA, 10 mM Tris-HCl, pH 8.1.

TE Buffer, Catalog # 20-157. Two vials, each containing **24 mL** of 10 mM Tris-HCl, 1 mM EDTA, pH 8.0.

0.5 M EDTA, Catalog # 20-158. One vial containing **250 μ L** of 0.5 M EDTA, pH 8.0.

5 M NaCl, Catalog # 20-159. One vial containing **500 μ L** of 5 M NaCl.

1 M Tris-HCl, pH 6.5, Catalog # 20-160. One vial containing **500 μ L** of 1 M Tris-HCl, pH 6.5.

**FOR RESEARCH USE ONLY
NOT FOR USE IN HUMANS**

Kit Description

Quantity: 22 chromatin immunoprecipitation (ChIP) assays.

Storage and Stability: Stable for 1 year at 4°C from date of shipment.

Use: The assay kit contains reagents optimized for immunoprecipitation of transcriptionally active chromatin from mammalian cells using anti-Acetyl-Histone H4, ChIP grade rabbit antiserum. Detection of the gene or promoter of interest in immunoprecipitated chromatin must be empirically determined by the researcher. Quantitative PCR or Southern slot-blot analysis, using promoter specific primers or probe, is recommended.

Technical Information for Kit Components

Anti-acetyl-Histone H4 (rabbit antiserum)

Immunogen: KLH conjugated peptide corresponding to amino acids 2-19 [AGG_{Ac}KGG_{Ac}KGMG_{Ac}KVGA_{Ac}KRHS-C] of *Tetrahymena* histone H4.

Specificity: Recognizes acetylated histone H4, Mr ~10 kDa. Cross-reacts with acetylated histone H2B from *Tetrahymena* and weakly cross-reacts with acetylated histone H2B from HeLa cells. May cross-react with other acetylated proteins.

Species Cross-reactivity: Human, mouse and *Tetrahymena*; broad species cross-reactivity is expected.

Storage and Stability: Stable for six months at 4°C or 2 years at -20°C. Aliquot to avoid repeated freezing and thawing).

Application References:

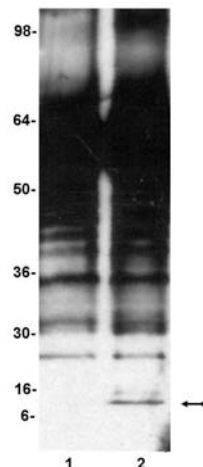
1. Sakai, N., *et al* (2003). Involvement of histone acetylation in ovarian steroid-induced decidualization of human endometrial stromal cells. *J Biol Chem* **278**: 16675-82.
2. El-Osta, A., *et al* (2002). Precipitous release of methyl-CpG binding protein 2 and histone deacetylase 1 from the methylated human multidrug resistance gene (MDR1) on activation. *Mol Cell Biol* **22**: 1844-57.
3. He, G. and Margolis, D. M. (2002). Counterregulation of chromatin deacetylation and histone deacetylase occupancy at the integrated promoter of human immunodeficiency virus type 1 (HIV-1) by the HIV-1 repressor YY1 and HIV-1 activator Tat. *Mol Cell Biol* **22**: 2965-73.

General References:

4. Alberts, A S, *et al* (1998). Activation of SRF-regulated chromosomal templates by Rho-family GTPases requires a signal that also induces H4 hyperacetylation. *Cell* **92**: 475-87.
5. Braunstein, M, *et al* (1993). Transcriptional silencing in yeast is associated with reduced nucleosome acetylation. *Genes Dev* **7**: 592-604.
6. Perry, C A, *et al* (1993). Analysis of nucleosome assembly and histone exchange using antibodies specific for acetylated H4. *Biochemistry* **32**: 13605-14.
7. Lin, R, *et al* (1989). Antibodies specific to acetylated histones document the existence of deposition- and transcription-related histone acetylation in *Tetrahymena*. *J Cell Biol* **108**: 1577-88.

Quality Control Testing

Chromatin Immunoprecipitation: 10 µL of Anti-acetyl Histone H4, ChIP grade immunoprecipitated acetylated histone H4 as determined by subsequent immunoblot analysis using 2 µg/mL anti-acetyl Histone H4 antibody (Catalog # 06-598) to detect histone from 1 X 10⁶ 3T3/A431 cells treated overnight with 5 mM sodium butyrate.



Chromatin Immunoprecipitation
Representative blot from a previous lot. Anti-acetyl Histone H4, ChIP grade, was used to immunoprecipitate chromatin from lysates of quiescent 3T3/A31 cells (lane 1) or sodium butyrate treated 3T3/A31 cells (lane 2). The immunoprecipitates were resolved by electrophoresis, transferred to nitrocellulose and probed with 1 µg/mL anti-acetyl Histone H4 (Catalog # 06-598). Proteins were visualized using a goat anti-rabbit secondary antibody conjugated to HRP and a chemiluminescence detection system. Arrow indicates acetylated H4.

Other components required but not included as part of kit are:

Reagents

- Cells, stimulated or treated as appropriate for the experimental system
- 37% Formaldehyde
- PBS
- Dry ice
- Elution buffer: 1% SDS, 0.1 M NaHCO₃
- Molecular Biology grade Proteinase K
- Glycogen or tRNA
- 50% Phenol/50%Chloroform (containing 1% isoamyl alcohol)
- >95% Ethanol
- 70% Ethanol

Equipment

- vortex mixer
- rotating wheel/platform
- shaking incubator
- timer
- variable volume (5-1000 μ L) pipettors + tips
- microfuge
- variable temperature water bath
- humidified 37°C incubator
- cell scraper
- sonicator

Safety Warnings and Precautions: Formaldehyde should be used in a certified fume hood. Culture dishes containing formaldehyde should be placed in a sealed bag if returned to a humidified 37°C incubator to prevent exposing other cells in the incubator to formaldehyde. Ear protection must be worn during sonication. All chemicals should be considered potentially hazardous and handled with the principles of good laboratory practice.

Chromatin Immunoprecipitation Protocol

Part A. Optimization of DNA Shearing

Establish optimal conditions required for shearing cross-linked DNA to 200-1000 base pairs in length by following steps 1- 9 below. Vary the power setting and/or the number of 10-second pulses during sonication of the samples. Be sure to keep the sample on ice at all times (the sonication generates heat which will denature the DNA). Check the size of sonicated DNA by gel electrophoresis after reversion of cross-links. Our experience shows DNA is sheared to the appropriate length with 3-4 sets of 10-second pulses using a Cole Parmer, High Intensity Ultrasonic Processor/Sonicator, 50-watt model equipped with a 2 mm tip and set to 30% of maximum power. **Once sonication conditions have been optimized, keep cell number consistent for subsequent experiments. The protocol below for the optimization of DNA Shearing is for one Chip assay (~1 x 10⁶ cells per condition).**

Note: Steps 3- 7 should be done on ice.

1. Stimulate or treat 1 x 10⁶ cells on a 10 cm dish as appropriate. (Cells should be treated under conditions for which transcriptional activation of the gene of interest has been demonstrated). Include one extra dish (1 X 10⁶ cells) to be used solely for estimation of cell number.
2. Cross link histones to DNA by adding formaldehyde directly to culture medium to a final concentration of 1% and incubate for 10 minutes at 37°C. (For example, add 270 μ L 37% formaldehyde into 10ml of growth medium on plate).
3. Aspirate medium, removing as much medium as possible. Wash cells twice using ice cold PBS containing protease inhibitors (1 mM phenylmethylsulfonyl fluoride (PMSF), 1 μ g/mL aprotinin and 1 μ g/mL pepstatin A). **Note:** Add protease inhibitors to PBS just prior to use. PMSF has a half-life of approximately 30 minutes in aqueous solutions.
4. Scrape cells into conical tube.
5. Pellet cells for 4 minutes at 2000 rpm at 4°C. Warm **SDS Lysis Buffer (Catalog # 20-163)** to room temperature to dissolve precipitated SDS and add protease inhibitors (inhibitors: 1 mM PMSF, 1 μ g/mL aprotinin and 1 μ g/mL pepstatin A).

6. Resuspend cell pellet in 200 μL of **SDS Lysis Buffer (Catalog # 20-163)** and incubate for 10 minutes on ice. **Note:** The 200 μL of SDS Lysis Buffer is per 1×10^6 cells; if more cells are used, the resuspended cell pellet should be divided into 200 μL aliquots so that each 200 μL aliquot contains $\sim 1 \times 10^6$ cells.
7. Sonicate lysate to shear DNA to lengths between 200 and 1000 basepairs being sure to keep samples ice cold (**Note:** Once sonication conditions have been optimized following steps 1 to 9, proceed to Part B, step 1 below).
8. Add 8 μL **5 M NaCl (Catalog # 20-159)** and reverse crosslinks at 65°C for 4 hours.
9. Recover DNA by phenol/chloroform extraction and run sample (example 5 μL , 10 μL and 20 μL samples) in an agarose gel to visualize shearing efficiency.

Part B. Experimental protocol.

If sonication conditions have been optimized (Part A), complete steps 1 through 7 and continue with the protocol below. For a negative/background control, prepare a sample to use as a no-antibody immunoprecipitation control in step 5 below. Additionally, transcriptionally unactivated DNA samples should be prepared as controls for PCR in section II.

1. Centrifuge samples (part A, step 7) for 10 minutes at 13,000 rpm at 4°C, and add 200 μL of the sonicated cell supernatant to a new 2 mL-microcentrifuge tube. Discard pellet.
2. Dilute the sonicated cell supernatant 10 fold in **ChIP Dilution Buffer (Catalog # 20-153)**, adding protease inhibitors as above. This is done by adding 1800 μL ChIP Dilution Buffer to the 200 μL sonicated cell supernatant for a final volume of 2 mL in each immunoprecipitation condition. **Note:** *If proceeding to PCR a portion of the diluted cell supernatant 1% ($\sim 20 \mu\text{L}$) can be kept to quantitate the amount of DNA present in different samples at the PCR protocol, Part B, section II, step 6. This sample is considered to be your input/starting material and needs to have the Histone-DNA crosslinks reversed by heating at 65°C for 4 hours (see section II, step 3.).*
3. To reduce nonspecific background, pre-clear the 2 mL diluted cell supernatant with 80 μL of **Protein A Agarose/Salmon Sperm DNA -50% Slurry (Catalog # 16-157C)** for 30 minutes at 4°C with agitation.
4. Pellet agarose by brief centrifugation and collect the supernatant fraction.
5. Add the immunoprecipitating antibody (the amount will vary per antibody) to the 2 mL supernatant fraction and incubate overnight at 4°C with rotation. *For a negative control, perform a no-antibody immunoprecipitation by incubating the supernatant fraction with 60 μL of Protein A Agarose/Salmon Sperm DNA -50% Slurry (Catalog # 16-157C) for one hour at 4°C with rotation and proceed to step 7.*
6. Add 60 μL of **Protein A Agarose/Salmon Sperm DNA (Catalog # 16-157C)** for one hour at 4°C with rotation to collect the antibody/histone complex.
7. Pellet agarose by gentle centrifugation (700 to 1000 rpm at 4°C, $\sim 1\text{min}$). Carefully remove the supernatant that contains unbound, non-specific DNA. Wash the protein A agarose/antibody/histone complex for 3-5 minutes on a rotating platform with 1 mL of each of the buffers listed in the order as given below:
 - a) Low Salt Immune Complex Wash Buffer (Catalog # 20-154), **one wash**
 - b) High Salt Immune Complex Wash Buffer (Catalog # 20-155), **one wash**
 - c) LiCl Immune Complex Wash Buffer (Catalog # 20-156), **one wash**
 - d) TE Buffer (Catalog # 20-157), **two washes**

After step 7 above, the sample is now a protein A/antibody/histone/DNA complex ready for either an Immunoprecipitation/Immunoblot assay (Section I) or Polymerase Chain Reaction (PCR) assay (Section II):

Section I. Immunoprecipitation/Immunoblot protocol to detect histone.

1. Following washing of the beads in part B, step 7, immunoprecipitated histones can be analyzed by immunoblot analysis. Add 25 μL of 1X Laemmli buffer per sample and boil for 10 minutes. Load 20 μL per lane and perform immunoblot procedure as described per appropriate antibody.

Section II. PCR protocol to amplify DNA that is bound to the immunoprecipitated histone.

1. Freshly prepare elution buffer (1%SDS, 0.1 M NaHCO₃).
2. Elute the histone complex from the antibody by adding 250 μ L elution buffer to the pelleted protein A agarose/antibody/histone complex from step 7d above. Vortex briefly to mix and incubate at room temperature for 15 minutes with rotation. Spin down agarose, and carefully transfer the supernatant fraction (eluate) to another tube and repeat elution. Combine eluates (total volume = ~500 μ L).
3. Add 20 μ L 5 M NaCl (Catalog # 20-159) to the combined eluates (500 μ L) and reverse histone-DNA crosslinks by heating at 65°C for 4 hours. At this step the sample can be stored at -20°C and the protocol continued the next day.

Note: Include the input/starting material (*the sample saved from Part B, step 2, which has had the Histone-DNA crosslinks reversed*) as well as a transcriptionally-unactivated DNA sample as negative and background controls for the PCR reaction. *Previously, a 5 μ L sample has been used in a nested PCR reaction. However, the amount of sample used per reaction must be determined empirically (e.g., titrate the sample at this step by using 1, 2, 5, or 10 μ L per PCR reaction).* If PCR results are poor, complete steps 4, 5 and 6 below to purify the DNA sample. NOTE: Handle the samples carefully, some DNA may be lost during the purification steps.

4. Add 10 μ L of 0.5 M EDTA (Catalog # 20-158), 20 μ L 1 M Tris-HCl, pH 6.5 (Catalog # 20-160) and 2 μ L of 10 mg/mL Proteinase K to the combined eluates and incubate for one hour at 45°C.
5. Recover DNA by phenol/chloroform extraction and ethanol precipitation. Addition of an inert carrier, such as 20 μ g glycogen or yeast tRNA, helps visualize the DNA pellet. Wash pellets with 70% ethanol and air dry.
6. Resuspend pellets in an appropriate buffer for PCR or slot-blot reactions. PCR or slot-blot conditions must be determined empirically.