

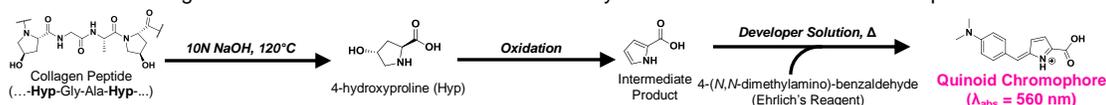
# Total Collagen Assay Kit (Perchlorate-Free)

12/17

(Catalog # K406-100; 100 Reactions; Store at -20°C)

## I. Introduction:

Collagen is the most abundant protein in mammals, accounting for nearly 30% of body protein content. Collagen is an extracellular scaffolding protein found in skin, tendons, bone, cartilage, ligaments and muscles, amongst other tissues. There are more than twenty different characterized types of collagen, but the fibrilous types I, II and III comprise more than 90% of the total collagen in mammals. Collagen has a triple helical structure, consisting of three 'procollagen' strands with a repeating Gly-X-Hyp tripeptide sequence, where X is any amino acid and Hyp is hydroxyproline, a post-translationally modified amino acid formed from proline by the enzyme prolyl-4-hydroxylase. In animals, hydroxyproline is found almost entirely in collagen (which contains approximately 12-14% hydroxyproline by mass) and contributes to its structural rigidity and high tensile strength. Hydroxyproline is thus a direct measure of the amount of collagen present in tissues. Many diseases are believed to affect collagen turnover, including tumor invasion and metastasis, rheumatoid arthritis, cardiopulmonary fibrosis and muscular dystrophy. BioVision's Total Collagen Assay Kit (Perchlorate-Free) is a quick and convenient protocol for detection of small amounts of collagen in a variety of biological samples. The assay is based upon hydrolysis of samples to yield free Hyp, which is oxidized and reacted to give a brightly-colored chromophore with an absorbance peak at 560 nm. The assay employs a proprietary acidic developer solution to accurately measure collagen in hydrolysates without the use of hazardous perchloric acid, obviating the need for any special handling and waste-disposal protocols. The assay can detect a minimum of 0.5 µg collagen per well in a 96-well format and generates colorimetric results that are virtually identical to those of the classical perchloric acid-based method.



## II. Applications:

- Detection and measurement of collagen content of various biological samples

## III. Sample Type:

- Tissue homogenates (*i.e.* muscle, liver, lung, etc.)
- Human or animal biological fluids (serum, urine)

## IV. Kit Contents:

Components	K406-100	Cap Code	Part Number
Oxidation Buffer	10 ml	WM	K406-100-1
Chloramine T Concentrate	600 µl	Red	K406-100-2
Developer Solution	5 ml	NM	K406-100-3
DMAB Concentrate (in DMSO)	5 ml	Amber	K406-100-4
Collagen I Standard (3 mg/ml)	200 µl	Yellow	K406-100-5
Microplate Sealing Film	1 film	—	K406-100-6

## V. User Supplied Reagents and Equipment:

- Microplate-based multiwell spectrophotometer
- Clear 96-well plates with flat bottom
- 10N sodium hydroxide (NaOH) and 10N hydrochloric acid (HCl)
- For hydrolysis: Polypropylene Vials (BV Cat. No. M1352) and Screw Caps (BV Cat. No. M1353)

## VI. Storage Conditions and Reagent Preparation:

Store kit at -20°C and protect from light. Allow the Oxidation Buffer to warm to room temperature prior to use. Read entire protocol before performing the assay procedure.

- Chloramine T Concentrate:** Provided as a concentrated solution in dH<sub>2</sub>O. Prior to use, warm to room temperature and vortex to ensure fully resuspended. Divide into aliquots and store at -20°C, protected from light. Limit aliquots to 2 freeze/thaw cycles.
- Developer Solution:** Store at +4°C and allow solution to come to room temperature prior to use. After use, promptly retighten cap to minimize adsorption of airborne moisture.
- DMAB Concentrate (in DMSO):** Provided as a ready-to-use solution in DMSO. Prior to use, warm to room temperature and mix by vortexing. After use, promptly retighten cap to minimize adsorption of airborne moisture. Store at -20°C, stable for 5 freeze/thaw cycles.
- Collagen I Standard:** Provided as a 3 mg/ml stock solution of solubilized Type I collagen from rat tail tendon in dilute acetic acid. Store at +4°C and allow solution to come to room temperature prior to use.

## VII. Total Collagen Assay Protocol:

### 1. Sample Preparation:

- For tissue samples, add 100 µl of dH<sub>2</sub>O for every 10 mg of tissue and thoroughly homogenize with a glass bead (Dounce) or ultrasonic probe homogenizer. Transfer 100 µl of sample homogenate to a pressure-tight, screw-capped polypropylene vial and add 100 µl of 10N concentrated NaOH (not provided). Ensure the cap is securely tightened and heat at 120°C for 1 hour (**See notes**). Following alkaline hydrolysis, place vial on ice, allow vial to cool briefly before opening cap and add 100 µl of 10N concentrated HCl (not provided) to neutralize residual NaOH. Vortex and centrifuge vials at 10,000 x g for 5 min to pellet any insoluble debris that may remain following hydrolysis.
- In case of biological fluids (urine or serum), mix samples with equal volumes of 10N concentrated NaOH (*i.e.* 100 µl urine and 100 µl 10N NaOH) in pressure-tight, screw-capped polypropylene vials and hydrolyze at 120°C for 1 hour. Cool vials on ice and neutralize hydrolysate by adding an equivalent volume (*i.e.* 100 µl) of 10N concentrated HCl. For urine samples, decolorize with activated

charcoal by adding 4 mg of activated charcoal to the neutralized hydrolysate. Vortex and centrifuge at 10,000 x g for 5 min to remove precipitate & activated charcoal and transfer clarified supernatant to a new tube.

c. Transfer 10  $\mu$ l of each neutralized sample hydrolysate to desired well(s) in a clear, flat-bottom 96-well plate.

**Notes:**

- Extremely tough samples (containing bone or exoskeletal tissue) may require heating for longer than 1 hour for complete hydrolysis.
- Hydrolysates of certain samples (e.g. fatty tissues) may contain lipid debris that is difficult to pellet by centrifugation. Take care when pipetting hydrolyzed samples to avoid transferring these insoluble globules to sample wells.
- For sample hydrolysis, polypropylene vials yield best results. We recommend Biovision's Polypropylene Vials and Caps Cat. No. M1353 and M1352)
- For unknown samples, we recommend performing a pilot experiment to ensure readings are within the standard curve range and adjusting the volume of sample hydrolysate accordingly (2-20  $\mu$ l of hydrolysate may be used) or diluting hydrolysate if necessary.

**2. Standard Curve Preparation:** Transfer 50  $\mu$ l of the Collagen I Standard to a pressure-tight, screw-capped polypropylene vial and add 50  $\mu$ l of 10N concentrated NaOH (not provided). Securely tighten cap and hydrolyze at 120°C for 1 hour. Cool vial on ice and neutralize by adding 50  $\mu$ l of 10N concentrated HCl and thoroughly vortexing (the final volume will be 150  $\mu$ l, with a final concentration of 1 mg/ml hydrolyzed collagen). Spin down the vial and add 0, 2, 4, 6, 8, and 10  $\mu$ l of the 1 mg/ml hydrolyzed Collagen I Standard solution into a series of wells, generating the equivalent of 0, 2, 4, 6, 8 and 10  $\mu$ g of collagen/well.

**3. Reaction Mix Preparation:**

- Evaporate the sample hydrolysate and standard curve wells to dryness by heating the plate at 65°C on a hot plate/dry heat block or microplate incubator. *To prevent warping/etching of the plastic, do not expose the microplate to extreme temperatures (>85°C).*
- For each reaction well to be analyzed (including standard curve wells), prepare 100  $\mu$ l of Oxidation Reagent Mix by adding 6  $\mu$ l of Chloramine T Concentrate to 94  $\mu$ l of Oxidation Buffer. Make a sufficient amount of the Oxidation Reaction Mix for all of the assay wells. Add 100  $\mu$ l of the Oxidation Reagent Mix to each well and incubate the plate at room temperature for 20 min.
- Add 50  $\mu$ l of Developer Solution to each reaction well and incubate the plate at 37°C for 5 min.
- Add 50  $\mu$ l of DMAB Concentrate solution to each reaction well and mix contents thoroughly. Seal the plate with the sealing film (provided) and incubate at 65°C on a hot plate/dry heat block or microplate incubator for 45 min.

**Notes:**

- Always prepare fresh Oxidation Reagent Mix as necessary for the number of samples and standards to be quantified. Once diluted to working concentration and exposed to light and air, Chloramine T is only stable for ~1-2 hrs.
- Following evaporation of the sample hydrolysates, a crystalline residue will be left in the well. Gentle shaking will help dissolve the crystals in Oxidation Reagent Mix more quickly. Hydrolysates from certain samples may impart a faint yellow tint to the Oxidation Reagent Mix. This slight colorization usually dissipates upon addition of Developer Solution and does not interfere with the assay.

**4. Measurement:** Remove the plate from the heat source and measure the absorbance of all sample and standard curve wells at 560 nm ( $OD_{560}$ ) in endpoint mode. *For maximum signal intensity, measure the absorbance within 20 min of removing plate from the heat source.*

**5. Calculations:** For the collagen standard curve, subtract the zero standard (0  $\mu$ g/well reagent blank) reading from all standard and test sample readings, plot the background-subtracted values and calculate the slope of the standard curve. For test samples, apply the background-subtracted  $OD_{560}$  values to the standard curve to get  $B$   $\mu$ g of collagen in the well.

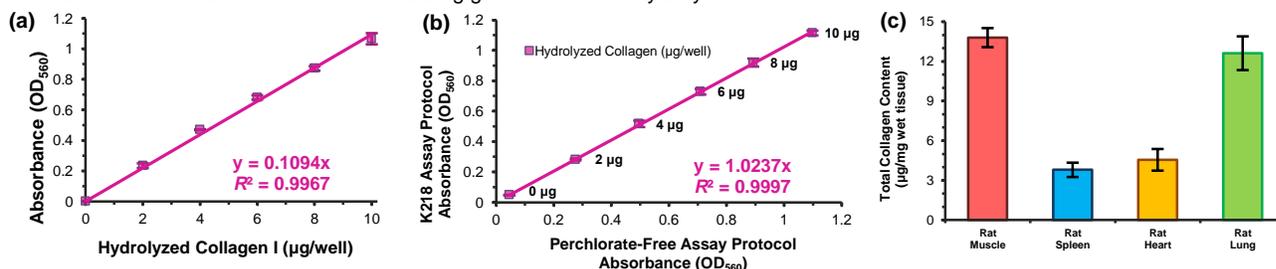
$$\text{Sample Hydrolysate Collagen Concentration} = \frac{B}{V} \times D = \mu\text{g}/\mu\text{l}$$

Where:  $B$  is the amount of collagen, calculated from the standard curve (in  $\mu$ g)

$V$  is the volume of sample hydrolysate added to the well (in  $\mu$ l)

$D$  is the *post-hydrolysis* sample dilution factor (if applicable,  $D=1$  for undiluted samples)

**Note:** The calculation above gives the collagen concentration in the sample hydrolysate. The dilution factor  $D$  is only needed if the sample is diluted *after* the hydrolysis step. When calculating the amount of collagen in the original sample homogenate, remember to account for the 3-fold dilution that occurs during generation of the hydrolysate.



**Figure:** (a) Hydrolyzed Collagen I Standard curve. (b) Correlation between collagen standard curve absorbance values obtained using the classical perchloric acid-based assay kit (Cat #K218) and the perchlorate-free assay. The two assay methods show excellent correlation ( $R^2 > 0.999$ ). (c) Estimation of total collagen content in rat tissues. Rat leg muscle, spleen, heart and lung samples were homogenized with  $dH_2O$ , hydrolyzed with 10N NaOH for 1 hour at 120°C and neutralized with 10N HCl. For each sample, 10  $\mu$ l of the final hydrolysate was assayed. Collagen levels (calculated as  $\mu$ g collagen/mg wet tissue) for the samples were:  $13.80 \pm 0.73$   $\mu$ g/mg for muscle,  $3.77 \pm 0.54$   $\mu$ g/mg for spleen,  $4.55 \pm 0.81$   $\mu$ g/mg for heart and  $12.51 \pm 1.27$   $\mu$ g/mg for lung. Data are mean  $\pm$  SEM of 3-4 replicates.

**VIII. RELATED PRODUCTS:**

Total Collagen Assay Kit (K218)

Hydroxyproline Assay Kit (K555 and K226)

Glycine Assay Kit (K589)

**FOR RESEARCH USE ONLY! Not to be used on humans.**