β-Hydroxybutyrate (Ketone Body) Fluorometric Assay Kit

Item No. 700740

Customer Service 800.364.9897 * Technical Support 888.526.5351
www.caymanchem.com
**Materials Supplied**

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Item</th>
<th>Quantity/Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>700191</td>
<td>β-HB Assay Buffer</td>
<td>1 vial</td>
</tr>
<tr>
<td>700192</td>
<td>β-Hydroxybutyrate Standard</td>
<td>2 vials</td>
</tr>
<tr>
<td>700741</td>
<td>β-HB Fluorometric Cofactors</td>
<td>2 vials</td>
</tr>
<tr>
<td>700742</td>
<td>β-Hydroxybutyrate Dehydrogenase</td>
<td>2 vials</td>
</tr>
<tr>
<td>700743</td>
<td>β-HB Developing Enzyme</td>
<td>2 vials</td>
</tr>
<tr>
<td>700004</td>
<td>Fluorometric Developer Reagent</td>
<td>2 vials/60 µg</td>
</tr>
<tr>
<td>700517</td>
<td>Potassium Carbonate Assay Reagent</td>
<td>1 vial/5 ml</td>
</tr>
<tr>
<td>700518</td>
<td>MPA Assay Reagent</td>
<td>1 vial/2 g</td>
</tr>
<tr>
<td>400017</td>
<td>96-Well Solid Plate (black)</td>
<td>1 plate</td>
</tr>
<tr>
<td>400012</td>
<td>96-Well Cover Sheet</td>
<td>1 cover</td>
</tr>
</tbody>
</table>

If any of the items listed above are damaged or missing, please contact our Customer Service department at (800) 364-9897 or (734) 971-3335. We cannot accept any returns without prior authorization.

**WARNING:** This product is for laboratory research use only: not for administration to humans. Not for human or veterinary diagnostic or therapeutic use.
Precautions

Please read these instructions carefully before beginning this assay. It is recommended to take appropriate precautions when using the kit reagents (i.e., lab coat, gloves, eye goggles, etc.) as some of them may be harmful. MPA (metaphosphoric acid) and potassium carbonate are corrosive and harmful if swallowed. Contact with skin may cause burns. In case of contact with skin or eyes, rinse immediately with plenty of water for 15 minutes.

For research use only. Not for human or diagnostic use.

If You Have Problems

Technical Service Contact Information

Phone: 888-526-5351 (USA and Canada only) or 734-975-3888
Fax: 734-971-3641
Email: techserv@caymanchem.com
Hours: M-F 8:00 AM to 5:30 PM EST

In order for our staff to assist you quickly and efficiently, please be ready to supply the lot number of the kit (found on the outside of the box).

Storage and Stability

This kit will perform as specified if stored at -20°C and used before the expiration date indicated on the outside of the box.

Materials Needed But Not Supplied

1. A plate reader with the capacity to measure fluorescence using an excitation wavelength of 530-540 nm and an emission wavelength of 585-595 nm
2. Adjustable pipettes and a repeating pipettor
3. A source of pure water; glass distilled water or HPLC-grade water is acceptable

INTRODUCTION

Background

β-Hydroxybutyrate (β-HB; 3-hydroxybutyric acid) is a “ketone body” which is produced in the liver, mainly from the oxidation of fatty acids, and is exported to peripheral tissues for use as an energy source. The term ‘ketone body’ refers to three molecules, acetoacetate, β-HB, and acetone. β-HB and acetoacetate transport energy from the liver to the other tissues and acetone is generated by spontaneous decarboxylation of acetoacetate. The presence of ketosis may be normal or pathologic. Normally ketosis can indicate that lipid metabolism has been activated and the pathway of lipid degradation is intact. Normal ketosis is prevalent in many circumstances such as during fasting, after prolonged exercise or after a high fat diet. Pathological causes of ketosis include multiple organ failure, diabetes, childhood hypoglycemia, corticosteroid or growth hormone deficiency, intoxication with alcohol or salicylates and several inborn errors of metabolism. In acutely ill patients, these ketone bodies can accumulate in the body to cause ketoacidosis, which leads to the potentially life threatening condition known as metabolic acidosis. The presence and degree of ketosis can be determined by measuring blood levels of β-HB.

Ordinarily, β-HB accounts for approximately 75% of the ketone bodies in serum. Measurement of β-HB provides a reliable index of the level of ketoacidosis, including the detection of subclinical ketosis. In diabetics, β-HB measurements (and blood glucose) can be used for the assessment of the severity of diabetic coma and is essential for the exclusion of hyperosmolar non-ketotic diabetic coma. The measurement of β-HB is also used to monitor insulin requirements, based on existing hyperketonemia. β-HB has more recently been evaluated for use in neurodegenerative diseases and inhibition of adipocyte lipolysis.

About This Assay

Cayman’s β-HB (Ketone Body) Fluorometric Assay Kit provides a simple, reproducible, and sensitive tool for assaying β-HB from plasma, serum, urine, tissue homogenates, and cell culture samples. The method for β-HB determination is based upon the oxidation of D-3-Hydroxybutyrate to acetoacetate by the enzyme 3-hydroxybutyrate dehydrogenase. Concomitant with this oxidation, the cofactor NAD+ is reduced to NADH. NADH reacts with the fluorometric developer to yield a highly fluorescent product which can be analyzed with an excitation wavelength of 530-540 nm and an emission wavelength of 585-595 nm. The fluorescence is directly proportional to the β-HB concentration.
Pre-Assay Preparation

Reagent Preparation

1. β-HB Assay Buffer - (Item No. 700191)
The vial contains 25 ml of 100 mM Tris-HCl, pH 8.5. Thaw the Assay Buffer at room temperature. Once thawed, the Assay Buffer is ready to use in the assay and for diluting reagents and samples. When stored at -20°C, the thawed Assay Buffer is stable for at least six months.

2. β-Hydroxybutyrate Standard - (Item No. 700192)
Each vial contains a lyophilized powder of DL-Hydroxybutyrate. Reconstitute the contents of the vial with 1 ml of β-HB Assay Buffer (Item No. 700191). This reconstituted Standard Solution is used to prepare the β-HB standard curve. The reconstituted Standard is stable for six hours on ice. NOTE: When reconstituted, the solution will become a 1.0 mM D-Hydroxybutyrate solution.

3. β-HB Fluorometric Cofactors - (Item No. 700741)
Each vial contains a lyophilized powder of cofactors. Reconstitute the contents of the vial with 2 ml of Assay Buffer. Store the reconstituted Cofactor solution on ice. This is sufficient reagent to evaluate 80 wells. Prepare the additional vial as needed. The reconstituted Cofactors are stable for one hour at 4°C.

4. β-Hydroxybutyrate Dehydrogenase - (Item No. 700742)
Each vial contains a lyophilized powder of β-Hydroxybutyrate Dehydrogenase. Reconstitute the contents of the vial with 2 ml of Assay Buffer and put the vial on ice. One vial of the enzyme solution is sufficient to evaluate 80 wells. Prepare the additional vial as needed. The reconstituted enzyme is stable for one hour at 4°C.

5. β-HB Developing Enzyme - (Item No. 700743)
Each vial contains lyophilized Developing Enzyme. Reconstitute the contents of the vial with 600 µl of Assay Buffer and put the vial on ice. One vial is sufficient to evaluate 60 wells. Prepare the additional vial as needed. The reconstituted enzyme is stable for one hour at 4°C.

6. Fluorometric Developer Reagent - (Item No. 700004)
Each vial contains a lyophilized powder of fluorometric developer. Reconstitute the contents of the vial with 600 µl of HPLC-grade water (do not use Assay Buffer). One vial is sufficient to evaluate 60 wells. Prepare the additional vial as needed. The Developer Solution is stable for four hours at room temperature.

7. Potassium Carbonate Assay Reagent - (Item No. 700517)
The vial contains 5 ml of 5 M potassium carbonate. The reagent is ready to use as supplied.

8. MPA Assay Reagent - (Item No. 700518)
The vial contains 2 g of metaphosphoric acid (MPA). To prepare 1 M MPA for deproteinating the samples, dissolve the 2 g of MPA in 25 ml of HPLC-grade water. Store the diluted acid solution at room temperature. The diluted acid is stable for three months at room temperature.

Sample Preparation

We recommend deproteinating samples upon collection and then storing at -80°C.

Plasma
Typically, normal human plasma has a β-HB range of 0.02-0.27 mM (0.2-2.81 mg/dL).6,7,17

1. Collect blood using either an anticoagulant such as heparin, EDTA, or citrate.
2. Centrifuge the blood at 700-1,000 x g for 10 minutes at 4°C. Pipette off the top yellow plasma layer without disturbing the white buffy layer. Store plasma on ice.
3. Add 500 µl of plasma to a tube. To deproteinate, add 500 µl of 1 M MPA to the plasma, vortex, and place on ice for five minutes.
4. Centrifuge at 10,000 x g for five minutes at 4°C to pellet the proteins. Remove the supernatant and add 75 µl of Potassium Carbonate to neutralize the acid and bring the pH to approximately 8.5.
5. Centrifuge at 10,000 x g for five minutes at 4°C to remove any additional debris. Remove the supernatant for assaying.
6. If not assaying the same day, freeze at -80°C. The deproteinated plasma sample will be stable for one month while stored at -80°C.
7. If necessary, dilute 1:2 with Assay Buffer before assaying.
**Pre-Assay Preparation**

**Serum**

Typically, normal human serum has a β-HB range of 0.02-0.27 mM (0.2-2.81 mg/dL).6,7,17

1. Collect blood without using an anticoagulant.
2. Allow blood to clot for 30 minutes at 25°C.
3. Centrifuge the blood at 2,000 x g for 15 minutes at 4°C. Pipette off the top yellow serum layer without disturbing the white buffy layer. Store serum on ice.
4. Add 500 µl of serum to a tube. To deproteinate, add 500 µl of 1 M MPA to the serum, vortex, and place on ice for five minutes.
5. Centrifuge at 10,000 x g for five minutes at 4°C to pellet the proteins. Remove the supernatant and add 75 µl of Potassium Carbonate to neutralize the acid and bring the pH to approximately 8.5.
6. Centrifuge at 10,000 x g for five minutes at 4°C to remove any additional debris. Remove the supernatant for assaying.
7. If not assaying the same day, freeze at -80°C. The deproteinated serum sample will be stable for one month while stored at -80°C.
8. If necessary, dilute 1:2 with Assay Buffer before assaying.

**Urine**

Typically, normal human urine has a β-HB range of 0-15 mmol/mol creatinine.18

1. Collection of urine does not require any special treatments.
2. Add 500 µl of urine to a tube. To deproteinate, add 500 µl of 1 M MPA to the urine, vortex, and place on ice for five minutes.
3. Centrifuge at 10,000 x g for five minutes at 4°C to pellet the proteins. Remove the supernatant and add 85 µl of Potassium Carbonate to neutralize the acid and bring the pH to approximately 8.5.
4. Centrifuge at 10,000 x g for five minutes at 4°C to remove any additional debris. Remove the supernatant for assaying.
5. If not assaying the same day, freeze at -80°C. The deproteinated urine sample will be stable for one month while stored at -80°C.
6. If necessary, dilute 1:2 with Assay Buffer before assaying.

**Cell Lysate**

1. Collect cells (~10 x 10^6 cells) by centrifugation (i.e., 1,000-2,000 x g for 10 minutes at 4°C). For adherent cells, do not harvest using proteolytic enzymes; rather use a rubber policeman.
2. Add 500 µl of Assay Buffer to the cell pellet (or see Interferences, on page 17, for additional choices) and vortex.
3. To deproteinate, add 500 µl of 1 M MPA to the cells, vortex, and place on ice for five minutes.
4. Centrifuge at 10,000 x g for five minutes at 4°C to pellet the proteins. Remove the supernatant and add 75 µl of Potassium Carbonate to neutralize the acid and bring the pH to approximately 8.5.
5. Centrifuge at 10,000 x g for five minutes at 4°C to remove any additional debris. Remove the supernatant for assaying.
6. If not assaying the same day, freeze at -80°C. The deproteinated sample will be stable for one month while stored at -80°C.
7. If necessary, dilute 1:2 with Assay Buffer before assaying.

**Tissue Homogenate**

1. Prior to dissection, rinse tissue with a phosphate buffered saline (PBS) solution, pH 7.4, to remove any red blood cells and clots.
2. Homogenate the tissue in 5-10 ml of cold Assay Buffer (containing protease inhibitors of choice; see Interferences on page 17) per gram weight of tissue.
3. To deproteinate, add 500 µl of 1 M MPA to 500 µl of tissue homogenate, vortex, and place on ice for five minutes.
4. Centrifuge at 10,000 x g for five minutes at 4°C to pellet the proteins. Remove the supernatant and add 75 µl of Potassium Carbonate to neutralize the acid and bring the pH to approximately 8.5.
5. Centrifuge at 10,000 x g for five minutes at 4°C to remove any additional debris. Remove the supernatant for assaying.
6. If not assaying the same day, freeze at -80°C. The deproteinated sample will be stable for one month while stored at -80°C.
7. If necessary, dilute 1:2 with Assay Buffer before assaying.

**NOTE:** β-HB values from urine samples can be standardized using Cayman's Creatinine (urinary) Assay Kit (Item No. 500701).
ASSAY PROTOCOL

Plate Set Up

There is no specific pattern for using the wells on the plate. However, a β-HB standard curve in duplicate has to be assayed with the samples. We suggest that each sample be assayed at least in duplicate in the presence and absence of β-Hydroxybutyrate Dehydrogenase (Item No. 700742). A typical layout of standards, samples, and sample backgrounds to be measured in duplicate is given below in Figure 1. We suggest you record the contents of each well on the template sheet provided (see page 23).

A BH = Standards
S1-S20 = Sample Wells
B1-B20 = Sample Background Wells

Figure 1. Sample plate format

Pipetting Hints

• It is recommended that a repeating pipettor be used to deliver reagents to the wells. This saves time and helps to maintain more precise incubation times.
• Before pipetting each reagent, equilibrate the pipette tip in that reagent (i.e., slowly fill the tip and gently expel the contents, repeat several times).
• Do not expose the pipette tip to the reagent(s) already in the well.

General Information

• The final volume of the assay is 120 µl in all wells.
• All reagents except the enzymes and cofactors must be equilibrated to room temperature before beginning the assay.
• It is not necessary to use all the wells on the plate at one time.
• We recommend assaying samples at least in duplicate (triplicate preferred).
• The assay is performed at 37°C.
• Monitor the fluorescence with an excitation wavelength of 530-540 nm and an emission wavelength of 585-595 nm.
**Standard Preparation**

Dilute 100 µl of the reconstituted β-hydroxybutyrate Standard with 900 µl of Assay Buffer to yield a stock concentration of 100 µM. Take eight clean glass or polystyrene tubes and mark them A-H. Add the amount of the 100 µM Stock Solution and Assay Buffer to each tube as described in Table 1. The diluted Standards are stable for no more than one hour.

<table>
<thead>
<tr>
<th>Tube</th>
<th>β-HB Stock Solution (µl)</th>
<th>Assay Buffer (µl)</th>
<th>β-HB Concentration (µM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>600</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>15</td>
<td>585</td>
<td>2.5</td>
</tr>
<tr>
<td>C</td>
<td>30</td>
<td>570</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>60</td>
<td>540</td>
<td>10</td>
</tr>
<tr>
<td>E</td>
<td>120</td>
<td>480</td>
<td>20</td>
</tr>
<tr>
<td>F</td>
<td>180</td>
<td>420</td>
<td>30</td>
</tr>
<tr>
<td>G</td>
<td>240</td>
<td>360</td>
<td>40</td>
</tr>
<tr>
<td>H</td>
<td>300</td>
<td>300</td>
<td>50</td>
</tr>
</tbody>
</table>

**Table 1. Preparation of β-Hydroxybutyrate standards**

**Performing the Assay**

1. **Standard Wells** - Add 50 µl of Standard (tubes A-H), 25 µl of β-HB Fluorometric Cofactors, 10 µl of β-HB Developing Enzyme, and 10 µl of Fluorometric Developer Reagent per well in the designated wells on the plate (see Sample Plate Format, Figure 1, page 10).

2. **Sample Wells** - Add 50 µl of sample, 25 µl of β-HB Fluorometric Cofactors, 10 µl of β-HB Developing Enzyme, and 10 µl of Fluorometric Developer Reagent to two or three wells.

3. **Sample Background Wells** - Add 50 µl of sample, 25 µl of β-HB Fluorometric Cofactors, 10 µl of β-HB Developing Enzyme, 25 µl of Assay Buffer, and 10 µl of Fluorometric Developer Reagent to two or three wells.

4. Initiate the reactions by adding 25 µl of β-Hydroxybutyrate Dehydrogenase to the standard and sample wells only. **DO NOT add to the sample background wells.**

5. Carefully shake the microtiter plate for a few seconds to mix.

6. Cover the plate with the plate cover and incubate for 30 minutes at 37°C.

7. Remove the plate cover and read fluorescence using an excitation wavelength of 530-540 nm and an emission wavelength of 585-595 nm.
Table 2. Pipetting summary

<table>
<thead>
<tr>
<th></th>
<th>Standard Wells (μl)</th>
<th>Sample Wells (μl)</th>
<th>Sample Background Wells (μl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assay Buffer</td>
<td>-</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td>Fluorometric Cofactors</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Developing Enzyme</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Fluorometric Developer Reagent</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Standard</td>
<td>50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sample</td>
<td>-</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>β-Hydroxybutyrate Dehydrogenase</td>
<td>25</td>
<td>25</td>
<td>-</td>
</tr>
</tbody>
</table>

Initiate reactions

Calculations

1. Determine the average fluorescence of each standard and sample background.
2. Subtract the fluorescence value of standard A (0 μM) from itself and all other standards. This is the corrected fluorescence (CF).
3. Plot the corrected fluorescence values (from step 2 above) of each standard as a function of the final β-hydroxybutyrate concentration (µM) from Table 1. See Figure 2, on page 16, for a typical standard curve.
4. Subtract the average fluorescence value of the sample background from the fluorescence of the sample wells to yield the corrected sample fluorescence value (CSF).
5. Calculate the β-hydroxybutyrate concentration of the samples using the equation obtained from the linear regression of the standard curve substituting the CSF values for each sample.

\[
\beta\text{-Hydroxybutyrate (µM)} = \left(\frac{CSF - (y\text{-intercept})}{Slope}\right) \times \text{Sample dilution}
\]
**Figure 2.** β-Hydroxybutyrate standard curve

**Performance Characteristics**

**Sensitivity:**
The limit of detection for the assay is 1 µM (±0.5 µM) β-HB.

**Precision:**
When a series of 48 human plasma samples were assayed on the same day, the intra-assay coefficient of variation was 4.1%. When a series of 48 human plasma samples were assayed on five different days under the same experimental conditions, the inter-assay coefficient of variation was 4.6%.

<table>
<thead>
<tr>
<th>Reagent</th>
<th>Will Interfere (Yes or No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffers</td>
<td></td>
</tr>
<tr>
<td>Borate</td>
<td>No</td>
</tr>
<tr>
<td>HEPES</td>
<td>Yes (22%)</td>
</tr>
<tr>
<td>MES</td>
<td>No</td>
</tr>
<tr>
<td>Phosphate</td>
<td>No</td>
</tr>
<tr>
<td>Detergents</td>
<td></td>
</tr>
<tr>
<td>Polysorbate 20 (≤1%)</td>
<td>No</td>
</tr>
<tr>
<td>Triton X-100 (0.1%)</td>
<td>Yes (15%)</td>
</tr>
<tr>
<td>Protease Inhibitors/Chelators/Enzymes</td>
<td></td>
</tr>
<tr>
<td>Antipain (100 µg/ml)</td>
<td>No</td>
</tr>
<tr>
<td>Chymostatin (10 µg/ml)</td>
<td>No</td>
</tr>
<tr>
<td>EDTA (1 mM)</td>
<td>No</td>
</tr>
<tr>
<td>EGTA (1 mM)</td>
<td>No</td>
</tr>
<tr>
<td>Leupeptin (10 µg/ml)</td>
<td>No</td>
</tr>
<tr>
<td>PMSF (200 µM)</td>
<td>No</td>
</tr>
<tr>
<td>Trypsin (10 µg/ml)</td>
<td>No</td>
</tr>
<tr>
<td>Solvents</td>
<td></td>
</tr>
<tr>
<td>Dimethylsulfoxide (5%)</td>
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</tr>
<tr>
<td>Ethanol (5%)</td>
<td>No</td>
</tr>
<tr>
<td>Methanol (5%)</td>
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</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
<tr>
<td>BSA (1%)</td>
<td>Yes (59%)</td>
</tr>
<tr>
<td>Glycerol (≤10%)</td>
<td>No</td>
</tr>
<tr>
<td>Sucrose (250 mM)</td>
<td>No</td>
</tr>
</tbody>
</table>
## Troubleshooting

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Causes</th>
<th>Recommended Solutions</th>
</tr>
</thead>
</table>
| Erratic values; dispersion of duplicates/triplicates | A. Poor pipetting/technique  
B. Bubble in the well(s) | A. Be careful not to splash the contents of the wells  
B. Carefully tap the side of the plate with your finger to remove bubbles |
| No fluorescence detected above background in the sample wells | A. The β-Hydroxybutyrate concentration is too low to detect  
B. The sample does not contain β-Hydroxybutyrate, or the sample contains something that is interfering | A. Re-assay the sample using a lower dilution  
B. Check the Interference section for possible interferences (see page 17) |
| The β-Hydroxybutyrate concentration was above the highest point on the standard curve | A. The β-Hydroxybutyrate concentration was too high in the sample  
B. The sample was too concentrated | Dilute samples with Assay Buffer and re-assay; NOTE: Remember to account for the dilution factor when calculating β-hydroxybutyrate concentration |
| The fluorometer exhibited 'MAX' values for the wells | The GAIN setting is too high | Reduce the GAIN and re-read |

## References


**Related Products**

- Adipogenesis Assay Kit - Item No. 10006908
- Adipolysis Assay Kit - Item No. 10009381
- p-Aminohippuric Acid (PAH) Assay Kit - Item No. 700880
- Calcium Assay Kit - Item No. 700550
- Chloride Colorimetric Assay Kit - Item No. 700610
- Cholesterol Fluorometric Assay Kit - Item No. 10007640
- Coenzyme A Assay Kit - Item No. 700440
- Creatine Kinase Fluorometric Assay Kit - Item No. 700630
- Creatinine (urinary) Colorimetric Assay Kit - Item No. 500701
- DPP (IV) Inhibitor Screening Assay Kit - Item No. 700210
- Free Fatty Acid Fluorometric Assay Kit - Item No. 700310
- Glucose Colorimetric Assay Kit - Item No. 10009582
- Glucose-6-Phosphate Fluorometric Assay Kit - Item No. 700750
- Glucose-6-Phosphate Dehydrogenase Activity Assay Kit - Item No. 700300
- Glycerol Colorimetric Assay Kit - Item No. 10010755
- Glyceral Fluorometric Assay Kit - Item No. 700720
- Glycogen Assay Kit - Item No. 700480
- β-Hydroxybutyrate (Ketone Body) Colorimetric Assay Kit - Item No. 700190
- Inulin Fluorometric Assay Kit - Item No. 700770
- D-Lactate Assay Kit - Item No. 700520
- L-Lactate Assay Kit - Item No. 700510
- Malate Fluorometric Assay Kit - Item No. 700790
- Pyruvate Assay Kit - Item No. 700470
- Triglyceride Colorimetric Assay Kit - Item No. 10010303
- Uric Acid Assay Kit - Item No. 700320
Warranty and Limitation of Remedy

Cayman Chemical Company makes no warranty or guarantee of any kind, whether written or oral, expressed or implied, including without limitation, any warranty of fitness for a particular purpose, suitability and merchantability, which extends beyond the description of the chemicals hereof. Cayman warrants only to the original customer that the material will meet our specifications at the time of delivery. Cayman will carry out its delivery obligations with due care and skill. Thus, in no event will Cayman have any obligation or liability, whether in tort (including negligence) or in contract, for any direct, indirect, incidental or consequential damages, even if Cayman is informed about their possible existence. This limitation of liability does not apply in the case of intentional acts or negligence of Cayman, its directors or its employees.

Buyer’s exclusive remedy and Cayman’s sole liability hereunder shall be limited to a refund of the purchase price, or at Cayman’s option, the replacement, at no cost to Buyer, of all material that does not meet our specifications.

Said refund or replacement is conditioned on Buyer giving written notice to Cayman within thirty (30) days after arrival of the material at its destination. Failure of Buyer to give said notice within thirty (30) days shall constitute a waiver by Buyer of all claims hereunder with respect to said material.

For further details, please refer to our Warranty and Limitation of Remedy located on our website and in our catalog.