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**MPCR Kit for Rat Cathepsin Genes**  
**Cat No. MP-70036: 50 reactions**  
**Cat No. MP-70035: 100 reactions**

**INSTRUCTION  
MANUAL**

**ID-M10090**  
**Revised August 7, 2002**

\*These products are designed and sold for use in the Multiplex PCR (MPCR) covered by patent # 5,582,989. Use of the MPCR process requires a license. A limited, non-automated research field license under the patent to use only this amount of the product to practice the MPCR process is conveyed to the purchaser by the purchase of this product.

The Polymerase Chain Reaction (PCR) process is covered by patents owned by Hoffman-LaRoche. Use of the PCR process requires a license. A license for diagnostic purposes may be obtained from Roche Molecular System. A license for research may be obtained by the purchase and the use of authorized reagents and DNA thermocyclers from the Perkin-Elmer Corporation or by negotiating a license with Perkin-Elmer.

This product is intended for research use only and not for diagnostic purposes.

## INTRODUCTION

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Cathepsin B, H, K, L and S are papsin family cysteine proteinases involved in a variety of physiologic processes such as proenzyme activation, enzyme inactivation, antigen presentation, hormone maturation, tissue remodeling and bone matrix resorption. In addition, cysteine proteinases appear to be involved in a variety of pathologic processes, cancer invasion and metastasis. All of them are glycoproteins and contain an essential cysteine residue in their active site but differ in some enzymatic properties, including substrate specificities and pH stability.

Cathepsin B, H and L have been shown to participate in processes of tumor growth, vascularization, invasion and metastasis. Their levels in tumor tissue extracts can provide useful clinical information to predict disease-free and overall survival in breast, lung, colorectal, brain and head and neck cancer patients. It was shown that both cysteine cathepsin and their endogenous protein inhibitor stefins and cystatin C can also predict prognosis when measured extracellularly. In melanoma and colorectal cancer patients' high serum levels of Cathepsin B and H correlated with shorter survival. However, the cathepsin B/cystatin C complex was found to be less abundant in sera of patients with malignant tumors than in those with benign diseases or in healthy controls, suggesting an imbalance between the enzyme and its inhibitor in cancer patients.

Major histocompatibility complex class II antigen presentation requires the participation of lysosomal proteases in two convergent processes. First, the antigens endocytosed by the antigen-presenting cells must be broken down into antigenic peptides. Second, class II molecules are synthesized with their peptide-binding site blocked by invariant chain (Ii), and they acquire the capacity to bind antigens only after Ii has been degraded in the compartments where peptides reside. Cathepsins B and D, previously considered major players in MHC class II antigen presentation, are dispensable for degradation of Ii and for generation of several antigenic determinants. By contrast, Cat S and L plays an essential role in removal of Ii in different cells. Accordingly, the absence of Cat S and L have major consequences for the onset of humoral immune responses and for T-cell selection, respectively. It is likely that other as yet uncharacterized lysosomal enzymes also play a role in Ii degradation and in generation of antigenic determinants.

The rat cathepsin genes MPCR kit has been designed to detect the expression of rat cathepsin S, cathepsin L, cathepsin H, cathepsin K, Cathepsin B, and 18S genes. The PCR primers have similar T<sub>m</sub> and no obvious 3'-end overlap to enhance multiple amplifications. The 554 bp (18S), 208 bp (CAT-S), 233 bp (CAT-L), 262 bp (CAT-H), 297 bp (CAT-K), and 353 bp (CAT-B) PCR products can be generated from rat RNA or the positive control, which is included in this kit.

## PCR PRODUCT QUANTITATION

### I: Radioactive Quantitation

In our experience, visual inspection of an EtBr-stained agarose gel is sensitive and precise enough to detect changes as low as two-fold. If greater discrimination is necessary, several methods are available. The simplest procedure is to add a radioactively labeled dNTP to the PCR reaction. After gel analysis, the band may be excised and counted in a scintillation counter. Alternatively the gel may be dried and an autoradiogram may be generated which can be scanned in a densitometer. Another method is to label the 5' end of one or both of the primers with  $^{32}\text{P}$ , which is incorporated into the PCR products and then assayed for radioactivity (4).

Southern blot hybridization with synthetic DNA probes may also be performed to verify and quantitate PCR generated products, either by densitometry of an autoradiogram or by excising and counting the signal from a hybridization membrane. This method also quantitates only the target product without interference from nontarget products or primer-generated artifacts.

### II: Non-Radioactive Quantitation

Nonradioactive quantitation methods include the use of biotinylated or digoxigenin-labeled primers in conjunction with the appropriate detection methods (5), use of a bioanalyzer or WAVE. For an in-depth discussion of the various methods of PCR product quantitation, refer to the review article by Bloch (6).

In addition to the above methods, several companies now offer gel video systems which can scan and quantitate EtBr-stained gel bands in much the same way a densitometer does. Lab-on-a-chip (BioAnalyzer), CE, HPLC, and WAVE may also be used to analyze MPCR products and quantitate simultaneously.

## COMPARISON OF MPCR WITH RPA

<b>MPCR (Multiplex Polymerase Chain Reaction)</b>	<b>RPA (RNase Protection Assay)</b>
√ Non-isotope method with high sensitivity 0.1-1 $\mu\text{g}$ total RNA per MPCR	√ Isotope or Non-Isotope methods 1-20 $\mu\text{g}$ total RNA per RPA assay
√ Whole process takes only a few hours	√ Whole process takes two days
√ Detect Multiple Genes Simultaneously & Quantitatively	√ Detect Multiple Genes Simultaneously & Quantitatively
√ Signal can be quantified directly from gel if isotope is included in MPCR. Additional techniques can be used to quantify MPCR product (using Bioanalyzer, HPLC, and WAVE.)	√ Signal can be quantified directly from gel
√ Non-specific products can be eliminated by using probes and southern hybridization.	√ Non-specific signal can be generated by either low stringent conditions or high-secondary-structure template.
√ Ready-to-use	√ Make own "hot" RNA probes

## MPCR KIT DESCRIPTION

MPCR Amplification Kits include all necessary MPCR amplification reagents with the exception of *Taq* Polymerase. These kits have been designed to direct the simultaneous amplification of specific regions of human DNA.

MPCR Kits come in two quantities:

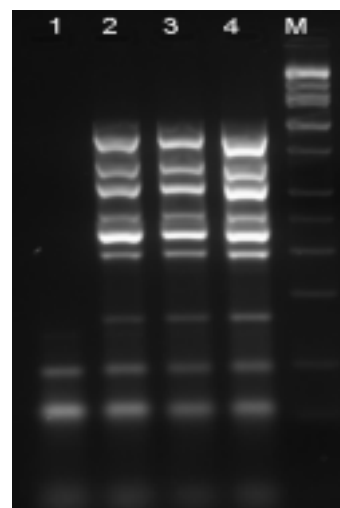
- 50X 50 $\mu$ L reaction kits
- 100X 50 $\mu$ L reaction kits

Each kit offers Maxim's optimal primer/buffer system which will enhance amplification specificity.

Figure 1 shows quality control MPCR results obtained by following MPCR kit manual using different concentrations of positive control.

For optimal results, please read and follow the instructions in this manual carefully. If you have any questions, please contact Maxim Biotech Customer Service at (650) 871-1919.

Figure 1



Lane 1: Negative control (without Positive)  
 Lane 2: MPCR Primers with 0.25 X Positive  
 Lane 3: MPCR Primers with 0.5 X Positive  
 Lane 4: MPCR Primers with 1 X Positive  
 Lane M: 100 bp DNA M.W. Marker

## MPCR PRIMER INFORMATION

Product Code	Gene	5'/3' Tm	Amplicon Size	Accession No.	Intron Span	Genomic Size
rCAT1S-CATS	Rat Cathepsin S	67°C/67°C	208bp	NM_017320	no	208bp
rCAT1S-CATL	Rat Cathepsin L	68°C/68°C	233bp	NM_013156	no	233bp
rCAT1S-CATH	RAT Cathepsin H	68°C/68°C	262bp	NM_012939	no	262bp
rCAT1S-CATK	Rat Cathepsin K	69°C/68°C	297bp	NM_031560	no	297bp
rCAT1S-CATB	Rat Cathepsin B	68°C/68°C	353bp	NM_022597	no	353bp
rCAT1S-18S	Rat 18S	71°C/71°C	554bp	V01270	no	554bp

## KIT COMPONENTS

### MP-70036

50X50 $\mu$ L MPCR reaction kit  
Store all reagents at -20°C

Product Code	Kit Component	Amount
rCAT1S-B001	2X rCAT1S MPCR Buffer (containing chemicals, enhancer, stabilizer and dNTPs)	1250 $\mu$ l
rCAT1S-C001	10X rCAT1S Pos. Control	50 $\mu$ l
rCAT1S-P001	10X rCAT1S MPCR Primer	250 $\mu$ l
MRB-0014	DNA M.W. Marker (100 bp ladder)	100 $\mu$ l
MRB-0011P	ddH <sub>2</sub> O (DNase free)	2.0 ml
	Instruction Manual	

### MP-70035

100X50 $\mu$ L MPCR reaction kit  
Store all reagents at -20°C

Product Code	Kit Component	Amount
rCAT1S-B001	2X rCAT1S MPCR Buffer (containing chemicals, enhancer, stabilizer and dNTPs)	1250 $\mu$ l X2
rCAT1S-C001	10X rCAT1S Pos. Control	50 $\mu$ l X2
rCAT1S-P001	10X rCAT1S MPCR Primer	250 $\mu$ l X2
MRB-0014	DNA M.W. Marker (100 bp ladder)	100 $\mu$ l X2
MRB-0011P	ddH <sub>2</sub> O (DNase free)	2.0 ml X2
	Instruction Manual	

NOTE: SPIN ALL TUBES BEFORE USING AND VORTEX ALL REAGENTS FOR AT LEAST 15 SECONDS BEFORE USING!!

## PROCEDURE

### RT Protocol:

The isolation of undegraded, intact RNA is an essential prerequisite for successful first strand synthesis and PCR amplification. Care should be taken to avoid RNase contamination of buffers and containers used for RNA work by pretreating with DEPC, autoclaving, and baking. Always wear sterile gloves when handling reagents. Use cDNA derived from  $10^5$  cells ( $1\mu\text{g}$  cDNA) and apply them to each MPCR reaction.

1. Prepare total RNA, mRNA or use the control GAPDH RNA which is provided in Maxim's MPCR kit. **NOTE:** It is best to use cDNA derived from  $0.5\text{-}1 \times 10^5$  cells (  $0.5\text{-}1\mu\text{g}$  cDNA derived from RNA) for each MPCR reaction.
2. Equilibrate 3 water baths:  $37^\circ\text{C}$ ,  $70^\circ\text{C}$  and  $95^\circ\text{C}$ .
3. **On ice**, pipet  $1\text{-}2\mu\text{g}$  mRNA or  $10\mu\text{g}$  total RNA (from  $10^6$  cells) dissolved in pure water or  $2\mu\text{l}$  control GAPDH RNA into a RNAase free reaction vial. We strongly recommend including a positive control reaction when setting up an RT-PCR reaction for the first time.
4. Add sterile water to a final volume of  $14.5\mu\text{l}$ .
5. Add  $4\mu\text{l}$  random hexamer ( $50\text{ mM}$ ) or Oligo(dT) ( $50\text{ mM}$ ).  
**NOTE:** The hexamer and Oligo(dT) RT reactions may be run simultaneously.
6. Incubate tube(s) at  $70^\circ\text{C}$  for 5 minutes and quickly chill on ice.
7. Begin your RT reaction by adding the following reagents to your hexamer or Oligo mixture:

Reagent	Description	Volume per Reaction
RNase Inhibitor	$130\text{U}/\mu\text{l}$	$0.5\mu\text{l}$
5 X RT buffer	$250\text{mM}$ Tris-HCl ( $\text{pH}8.3$ ) $375\text{mM}$ KCl, $15\text{mM}$ $\text{MgCl}_2$ , $50\text{mM}$ DTT	$10\mu\text{l}$
dNTPs	$1\text{mM}$ each	$20\mu\text{l}$
MMLV RT	$250\text{U}/\mu\text{l}$	$1\mu\text{l}$

8. Incubate the RT mixture at  $37^\circ\text{C}$  for 60 minutes.
9. Then, heat RT mixture at  $95^\circ\text{C}$  for 10 minutes and quickly chill on ice.
10. Add another  **$50\mu\text{l}$**  water or  $0.1\text{X}$  TE buffer.
11.  **$2\text{-}5\mu\text{l}$**  of above cDNA is sufficient for most genes in a standard MPCR reaction. However, more or less DNA may be needed in PCR depending on the copy number of the specific gene.

### PCR Protocol:

1. *Taq* DNA polymerase from Perkin-Elmer or its derivatives are highly recommended for MPCR. Ampli-*Taq* Gold, however, is not recommended because its own optimal buffer system is required.
2. **Reaction Mixture Preparation:**
  - A. Set up MPCR reactions with the test samples and MPCR buffers provided in the MPCR kit according to the table on the next page:

## PROCEDURE

Volume (Per assay)	Reagent (Add in order)
25.0 µl	2X MPCR BufferMixture
5.0µl	10X MPCR Primers
0.5µl	<i>Taq</i> DNA Polymerase(5U/ml)
5.0µl	Specimen cDNA or 10X Control cDNA from kit
14.5µl	H <sub>2</sub> O
50.0µl	Mineral Oil (optional)

\*: <sup>32</sup>P dNTPs may be used here to achieve higher sensitivity and better quantitation. 5-10 µCi [*a*-<sup>32</sup>P]dCTP (3000 Ci/mmole) should be used here per MPCR. Keep final dNTPs concentration same as without <sup>32</sup>P-dNTPs.

B. EDTA concentration in test sample must not exceed 0.5 mM because Mg<sup>++</sup> concentration in MPCR Buffers is limited to certain ranges. Additional Mg<sup>++</sup> may be added to the PCR mixture to compensate for EDTA. We strongly recommend running an MPCR reaction with the positive control provided in the kit. Since the MPCR DNA polymerase needed in each reaction is in a very small volume, it is recommended that all of the PCR components be premixed in a sufficient quantity for daily needs and then dispensed into individual reaction vials. This will help you to achieve more accurate measurements.

### 3. PCR thermocycle profile:

Reaction profiles will need to be optimized according to the machine type and needs of user. Please take note that temperature variations occur between different thermocyclers, therefore, the annealing temperature in the sample profile below is given as a range. It will be necessary to determine the optimal temperature for your individual thermocycler. An example of a time-temperature profile for the positive control PCR reaction optimized for Perkin Elmer machine types 480, 2400, and 9600 is provided below:

Temperature	Time	Cycles
96°C	1 min	2X
58-60°C	4 min	
94°C	1 min	28-35X
58-60°C	2 min	
70°C	10 min	1X
25°C	soak	

**Note:** A 2-step PCR thermocycle profile was found to be more effective than a 3-step PCR thermocycle profile for MPCR amplification. For 2-step PCR, use 94-95°C for denaturation and 58-60°C for annealing and extension. The 72°C step is omitted.

### 4. Agarose Gel Electrophoresis:

To fractionate the MPCR DNA product electrophoretically, mix 10µl of the MPCR product with 2µl 6X loading buffer. Run the total 12µl alongside 10 µl of DNA marker\* from the MPCR kit on a 2 % agarose gel containing 0.5 mg/ml ethidium bromide. Electrophorese and photograph. (Hint: Best results are obtained when the gels are run slowly at less than 100 volts).

\* DAN Marker contains linear double stranded DNA bands of 1,000; 900, 800, 700; 600; 500; 400; 300; 200; and 100 base pairs (bp).

# TROUBLESHOOTING

## 1. MPCR AMPLIFICATION

Observation	Possible Cause	Recommended Action
1.1. No signal or missing some bands during amplification even using positive control provided in kit.	1.1a. The annealing temperature in the thermocycler is too high. 1.1b. Dominant primer dimers.	1.1a. Decrease PCR annealing temperature 3-5°C gradually. 1.1b. Use any one of "Hot Start" PCR procedures.
1.2. Too many nonspecific bands.	1.2a. The annealing temperature in the thermocycler is too low. 1.2b. Pre-PCR mispriming. 1.2c. cDNA is interfering with MPCR	1.2a. Increase PCR annealing temperature 3-5°C gradually. 1.2b. Use any one of "Hot Start" PCR procedures. 1.2c. Clean cDNA with Phenol/ Chloroform. 1.2d. Use Maxim's 3M™-MPCR Kit.
1.3. No difference in gene expression among treatments	1.3a. PCR amplification of this specific gene has passed the exponential phase. 1.3b. Variation in sample preparation, RT reaction and amounts of input cDNA.	1.3a. Decrease PCR cycle number or decrease the input cDNA. 1.3b. Run a parallel PCR with a house-keeping gene to eliminate variables.

## PRECAUTIONS AND STORAGE

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### Storage

1. Store all MPCR Kit components at -20°C. Under these conditions components of the kit are stable for 1 year.
2. Isolate the kits from any sources of contaminating DNA, especially amplified PCR product.
3. Do not mix MPCR kit components that are from different lots. Each lot is optimized individually.

## REFERENCES

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