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MPCR Kit for Human MMP Genes Set-1
Cat No. MP-70109: 50 reactions
Cat No. MP-70106: 100 reactions

**INSTRUCTION
MANUAL**

ID-M10030
Revised May 7, 2003

*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

The matrix metalloproteinases (MMPs) are mediators of structural protein degradation during turnover of the extracellular matrix. During normal tissue remodeling such as wound healing, bone resorption, and morphogenesis, MMPs are accurately produced and precisely targeted to specific extracellular substrates by a wide variety of cells. Atypical production of MMP is thought to contribute to progression of many destructive diseases, such as arthritis and chronic ulcerations, and disease-related processes, such as inflammatory tissue destruction and remodeling. Overexpression of MMPs also may play important roles in tumor metastasis and invasion, and angiogenesis.

MMPs are synthesized as zymogens. Activation is achieved by autoactivation or other proteinases. Early studies suggest that mast cell-derived neutral proteases such as trypsin and chymase activated MMPs. These studies also demonstrated that trypsin activated only pMMP3 which in turn was able to activate pMMP-9 (1).

A major goal of the wound healing process is the restoration of functional connective tissue. During normal wound repair controlled proteolysis is needed for cell migration, angiogenesis, and matrix remodeling. This requires the deposition and accumulation of collagenous and noncollagenous matrix molecules as well as the restructuring of extracellular matrix (ECM) by MMPs. Using *in situ* hybridization and immunohistochemistry, investigators have found that MMP-1, MMP-3 and MMP-10 were expressed in keratinocytes bordering both acute and chronic wounds. Unlike MMP-1, signal for MMP-13 was not detected in keratinocytes but exclusively in fibroblasts deep in the ulcer bed of chronic wounds. These results suggested that MMP-1 production is important for cell migration and that MMP-13 plays a role in matrix remodeling (Saarialho-Kere UK).

MMPs have also been implicated in the pathogenesis of various inflammatory diseases of the central nervous system. Evidence is accumulating that several MMPs might be involved in the pathogenesis of meningitis. MMP3 and MMP13 mRNAs have been shown to be selectively upregulated in experimental meningococcal meningitis. In contrast, mRNA levels for MMPs 2, 7, 10, and 11 remained unchanged. These data suggests that MMP3 and MMP13 may contribute to the pathogenesis of this infectious disease of the central nervous system (2).

MMPs are also involved in tumor invasion and metastasis (3). MMP-7 is one matrix metalloproteinase that

plays a critical role in tumor invasion, and is often expressed in gastrointestinal cancers MMP-13 was originally identified in breast carcinomas and subsequently detected during fetal ossification and in arthritic processes. With tumor progression, the number of different MMPs that can be detected tends to increase. Also the relative levels of individual MMP family member tends to increase with tumor progression. Although a major function of MMPs in metastasis is to facilitate the breakdown of ECM, MMPs also play a significant role in regulating angiogenesis. Successful angiogenesis is dependent upon extracellular proteolysis provided by MMPs.

Cytokines, growth factor, hormones, oncogenes, and tumor promoters play important roles in the transcriptional regulation for most of the MMP family members. In addition, there is evidence for regulation at the level of mRNA stability. Analysis of the temporal and spatial distribution of RNA expression can provide researchers with important clues about the function of these cytokines within their own systems (4). Northern Blot and RNase Protection Assay are the most widely used procedures for determining the abundance of a specific mRNA in a total or poly(A) RNA sample. RT-MPCR provides an alternate and accurate method to detect multiple gene expression by amplifying all the genes under the same conditions (5, 6, 7). Variations in RNA isolation, initial quantitation errors or tube-to-tube variations in RT and PCR can be compensated by including a house-keeping gene, such as GAPDH or beta-actin, in MPCR. Alternatively, a parallel RT-PCR using the same cDNA, PCR conditions and primers for one of house-keeping genes may be run to offset any variations (6, 7). Differences in gene expression can be determined by normalizing its expression against beta-actin or GAPDH expression.

This matrix metalloproteinase (MMP) genes superfamily Set-1 MPCR kit has been designed to detect the expression of human MT-MMP-1, MMP-#3, #7, #13, Trypsin and GAPDH genes. The PCR primers have similar T_m and no obvious 3'-end overlap to enhance multiple amplification. The 500 bp (GAPDH), 416 bp (MMP#13), 351 bp (MMP#3), 282 bp (MMP#7), 223 bp (MT-MMP#1), and 184 bp (Trypsin) PCR products can be generated from human RNA or the positive control, which is included in this kit. Therefore, this MMPs MPCR kit provides a quick and simple method to analyze human MT-MMP-1, MMP-#3, #7, #13, and Trypsin genes expression, and normalize their expression against GAPDH expression.

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}P , which is incorporated into the PCR products and then assayed for radioactivity (9).

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 (10), 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 (11).

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

MPCR (Multiplex Polymerase Chain Reaction)

- √ Non-isotope method with high sensitivity
0.1-1 μg total RNA per MPCR
- √ Whole process takes only a few hours
- √ 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.)
- √ Non-specific products can be eliminated by using probes and southern hybridization.
- √ Ready-to-use

RPA (RNase Protection Assay)

- √ Isotope or Non-Isotope methods
1-20 μg total RNA per RPA assay
- √ Whole process takes two days
- √ Detect Multiple Genes Simultaneously & Quantitatively
- √ Signal can be quantified directly from gel
- √ Non-specific signal can be generated by either low stringent conditions or high-secondary-structure template.
- √ 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:

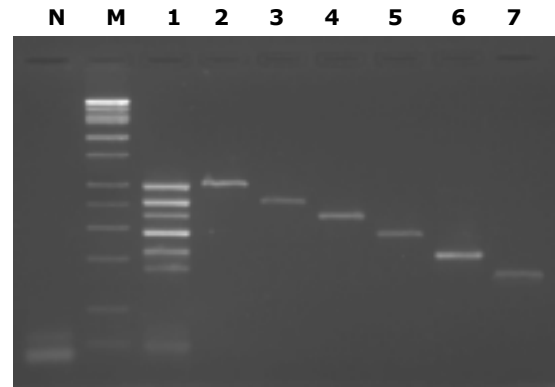
- 50X 50 μ L reaction kits
- 100X 50 μ L reaction kits

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 N: PCR using hMMP1G Primers without positive (Negative)
 Lane 1: PCR using hMMP1G Primers with 1X positive
 Lane 2: PCR using Human GAPDH Primers
 Lane 3: PCR using Human MMP-13 Primers
 Lane 4: PCR using Human MMP-3 Primers
 Lane 5: PCR using Human MMP-7 Primers
 Lane 6: PCR using Human MMP-1 Primers
 Lane 7: PCR using Human Human Trypsin Primers
 M: DNA M.W. Marker

MPCR PRIMER INFORMATION

Product Code	Gene	5'/3' Tm	Amplicon Size	Accession No.	Intron Span	Genomic Size
hMMP1G-MMP1	Human MT-MMP-1	68°C/70°C	223bp	U41078	yes	710bp
hMMP1G-MMP3	Human MMP-3	66°C/66°C	351bp	J03209	yes	1789bp
hMMP1G-MMP7	Human MMP-7	70°C/67°C	282bp	Z11887	yes	2890bp
hMMP1G-MMP13	Human MMP-13	68°C/73°C	416bp	X75308	yes	4811bp
hMMP1G-TRP	Human Trypsin	69°C/71°C	184bp	M33494	no	184bp
hMMP1G-GAP	Human GAPDH	66°C/65°C	500bp	M33197	yes	2533bp

KIT COMPONENTS

MP-70109

50X50 μ L MPCR reaction kit
Store all reagents at -20°C

Product Code	Kit Component	Amount
hMMP1G-B001	2X hMMP1G MPCR Buffer (containing chemicals, enhancer, stabilizer and dNTPs)	1250 μ l
hMMP1G-C001	10X hMMP1G Pos. Control	50 μ l
hMMP1G-P001	10X hMMP1G MPCR Primers	250 μ l
MRB-0014	DNA M.W. Marker (100bp Ladder)	100 μ l
MRB-0011P	ddH ₂ O (DNase free)	2.0 ml
	Instruction Manual	

MP-70106

100X50 μ L MPCR reaction kit
Store all reagents at -20°C

Product Code	Kit Component	Amount
hMMP1G-B001	2X hMMP1G MPCR Buffer (containing chemicals, enhancer, stabilizer and dNTPs)	1250 μ l X2
hMMP1G-C001	10X hMMP1G Pos. Control	50 μ l X2
hMMP1G-P001	10X hMMP1G MPCR Primers	250 μ l X2
MRB-0014	DNA M.W. Marker (100bp Ladder)	100 μ l X2
MRB-0011P	ddH ₂ 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°C , 70°C and 95°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 mM) or Oligo(dT) (50 mM).
NOTE: The hexamer and Oligo(dT) RT reactions may be run simultaneously.
6. Incubate tube(s) at 70°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	130U/ μl	$0.5\mu\text{l}$
5 X RT buffer	250mM Tris-HCl (pH8.3) 375mM KCl, 15mM MgCl_2 , 50mM DTT	$10\mu\text{l}$
dNTPs	1mM each	$20\mu\text{l}$
MMLV RT	250U/ μl	$1\mu\text{l}$

8. Incubate the RT mixture at 37°C for 60 minutes.
9. Then, heat RT mixture at 95°C for 10 minutes and quickly chill on ice. This will help to eliminate the RT enzyme interference of MPCR reaction later.
10. Add another **$50 \mu\text{l}$** water or 0.1X 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.

NOTE: Please do not use excess amount of cDNA. The salt from RT reaction may interfere the performance of MPCR.

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/µl)
5.0µl	Specimen cDNA or 10X Control cDNA from kit
14.5µl	H ₂ O
50.0µl	Mineral Oil (optional)

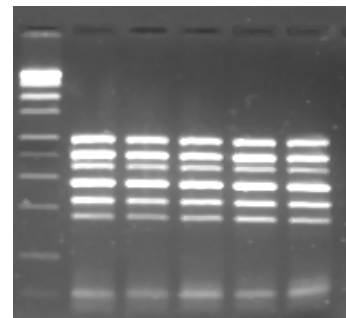
- *: ³²P dNTPs may be used here to achieve higher sensitivity and better quantitation. 5-10 µCi [³²P]dCTP (3000 Ci/mmmole) should be used here per MPCR. Keep final dNTPs concentration same as without ³²P-dNTPs.
- B. EDTA concentration in test sample must not exceed 0.5 mM because Mg⁺⁺ concentration in MPCR Buffers is limited to certain ranges. Additional Mg⁺⁺ 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 58-60°C*	1 min 4 min	2X
94°C 58-60°C*	1 min 2 min	28-35X
70°C	10 min	1X
25°C	soak	

55 58 61 64 67°C



*The performance of MPCR kit against annealing temperatures. The above gel picture is an illustration of different annealing temperatures on MPCR kit MP-70106.

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.	1.1a. Decrease PCR annealing temperature 3-5°C gradually.
	1.1b. Dominant primer dimers.	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.	1.2a. Increase PCR annealing temperature 3-5°C gradually.
	1.2b. Pre-PCR mispriming.	1.2b. Use any one of "Hot Start" PCR procedures.
	1.2c. cDNA is interfering with MPCR	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.	1.3a. Decrease PCR cycle number or decrease the input cDNA.
	1.3b. Variation in sample preparation, RT reaction and amounts of input cDNA.	1.3b. Run a parallel PCR with a house-keeping gene to eliminate variables.

PRECAUTIONS AND STORAGE

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

1. Lees M et al 1994 Eur J Biochem 223(1):171-7.
2. Kieseier BC et al 1999 Brain 122(Pt 8): 1579-1587.
3. MacDougall JR, Matrisian LM Cancer Metastasis Rev 1995 Dec;14(4): 351-362.
4. Parra, B. et. al., (1997) Virology 233 (2), 260-270.
5. Kumar, A. et al., (1997) Science 278, 1630-1632.
6. Sawa, A. et al., (1997) Proc. Natl. Acad. Sci. USA 94: 11669-11674.
7. Chamberlain, J.S. et al., In: *The polymerase chain reaction*. Mullis K, Ferre F and Gibbs R, eds. Birkhauser Boston Press, 38-46, 1994.
8. Chumakov, K.M. (1994) RT can inhibit PCR and stimulate primer-dimer formation. *PCR Methods and Applications*. 4: 62-64.
9. Hayashi, K., et al., (1989) Nucleic Acids Res. 17:3605.
10. Landgraf, A. et al., (1991) Analytical Biochemistry 193:231.
11. Bloch, W. (1991) Biochemistry 30:2735.