

REFERENCES



REFERENCES

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APPENDIX

LIST OF SOLUTIONS AND BUFFERS

Cell culture

1. RPMI 1640 medium stock

RPMI 1640 powder was dissolved in distilled water (18 mΩ) and added 3.7 g of NaHCO₃, 10 ml of 10000 units/ml penicilline/10000 µg/ml streptomycin. The mixture was stirred at room temperature for 4 h and further adjusted to 1000 ml. Stock RPMI 1640 was sterilized by using vacuum filter (pore size of membrane 0.45 µm) and stored at 4 °C.

2. 0.025% trypsin/EDTA

1 ml of 0.25% trypsin and 1 ml of 25 mM EDTA were dissolved in 1x PBS. The volume was adjusted to 10 ml and filtrated by sterile filter (pore size 0.20 µm) to discard the microorganism. The solution was preserved at 4 °C.

3. 1x Phosphate buffer saline (PBS)

8 g of NaCl, 0.2 g of KCl, 1.44 g of Na₂HPO₄, and 0.24 g of KH₂PO₄ were dissolved in distilled water (18 mΩ) in final volumn of 1000 ml. The solution was adjusted to pH 7.4 and further sterilized by autoclaving at 121 °C for 20 min (a pressure of 15 pound/square inch (psi)). The solution was stored at room temperature.

4. 10 mg/ml MTT stock solution

0.1 mg of MTT powder was dissolved in PBS 10 ml and following mixed until the solution is homogenous. MTT solution was filtrated by sterile filter (pore size 0.20 µm) and kept at 4 °C.

RNA isolation

1. 10xTris EDTA (TE)

Stock 10x Tris EDTA was provided by preparation 100 mM of Tris-Cl (pH 8) and 10 mM of EDTA (pH 8). Subsequently, the solutions were mixed and stored at room temperature.

2. 0.1% v/v DEPC treated water

Dissolved 250 μ l of pure diethylpyrocarbonate in sterile distilled water (18 m Ω) and adjusted the volume to 250 ml. The solution was stirred over night and stored at room temperature in darkness.

Agarose gel electrophoresis

1. %Agarose gel

Dissolved 1 g of agarose powder in 100 ml of TAE buffer and followed boiling until homogenous. The liquid agarose gel was poured to the tray and stored at room temperature for 1 h or until gel formation.

2. 50x TAE buffer

Dissolved 242 g of Tris base, 57.1 ml of glacial acetic acid and 100 ml of 0.5 M EDTA. The solution was stirred until all ingredients are mixed and adjust the volume to 1000 ml. Distilled water was added to dilute the stock solution to 1x TAE buffer before use.

Protein extraction

1. 10xTris EDTA (TE)

Stock 10x Tris EDTA was provided by preparation 100 mM of Tris-Cl (pH 8) and 10 mM of EDTA (pH 8). Subsequently, the solutions were mixed and stored at room temperature.

2. RIPAllysis buffer

5 ml of 100 mMTris (pH 7.4), 5 ml of 300 mMNaCl, 1 ml of NP-40, 250 μ l of 10% sodium deoxycholate, and 50 μ l of protease inhibitors were mixed and adjust the volume to 10 ml. Stored the solution at room temperature.

SDS-Polyacrylamide Gel Electrophoresis

1. 30% (w/v) Acrylamide

Dissolved 29 g of acrylamind powder and bisacrylamide 1 g in distilled water and adjust the volume to 100 ml. The solution was stirred over night and kept at 4°C in darkness.

2. 10% (w/v) Ammonium persulfate

Dissolved 10 g of Ammonium persulfate in distilled water. The solution was stirred until all ingredients are mixed and adjust the volume to 100 ml and kept at -20 °C until use.

3. Towbin buffer

Dissolved 14.4 g of Glycine powder and Tris 3 g in distilled water. The solution was stirred until all ingredients are mixed and adjust the volume to 800 ml and add 20% methanol before use.

4. Tris Buffered Saline (TBS)

Dissolved 12.11 g of Tris base and NaCl 87.64 g in distilled water. The solution was stirred until all ingredients are mixed and adjust the pH 7.4 before adjust the volume to 1 L stored at 4 °C.

Tissue fixative

10% neutral phosphate-buffer formalin solution

Dissolved 4 g of sodium phosphate, monobasic monohydrate, 6.5 g of sodium phosphate, dibasic anhydrous in 800 ml of distilled water (15 mΩ). Add 100 ml of 40% formaldehyde solution and adjust the volume to 1000 ml. Stored at room temperature.

Immunohistochemistry

1. 10x Phosphate buffer saline (PBS) pH 7.4

Stock 10x PBS was provided by dissolved 80 g of NaCl, 2 g of KCl, 14.4 g of Na₂HPO₄, and 2.4 g of KH₂PO₄ in 800 ml of distilled water (15 mΩ). The solution was adjusted to pH 7.4 and adjusted volume to 1000 ml with distilled water and further sterilized by autoclaving at 121 °C for 20 min (a pressure of 15 pound/square inch (psi)). The solution was stored at room temperature. Distilled water was added to dilute the stock solution to 1x PBS buffer before use.

2. PBST/ 0.1% Tween-20

Add 100 ml of 10 x PBS to 900 ml of distilled water (15 mΩ) and further add 1 ml of Tween-20 and mixed well.

3. Tris-EDTA buffer (10mM Tris-Base, 1mM EDTA Solution, 0.05% Tween 20, pH 9.0)

Dissolved 1.21 g of Tris-Base and 0.37 g of EDTA in 800 ml of distilled water (15 mΩ). The solution was adjusted to pH 9.0, then adds 0.5 ml of Tween 20 and mixed well. The solution was adjusted volume to 1000 ml with distilled water and further sterilized by autoclaving at 121 °C for 20 min (a pressure of 15 pound/square inch (psi)). The solution was stored at room temperature.

Tissue fixation and processing protocol

1. Fixation procedure

- 1.1 Wash tissue with cold PBS to remove excess blood.
- 1.2 Place tissue in fixative (10% neutral phosphate-buffer formalin solution) at room temperature for at least 24 h.

2. Tissue processing

- 2.1 After fixation, wash off fixative with PBS.
- 2.2 Cut tissue to proper size by the thickness must be thicker than 3 mm.
- 2.3 Transfer specimens to cassettes labeled with pencil.
- 2.4 Place cassettes in container of automatic processor:
 - 2.4.1 Dehydrate specimens with graded series of ethanol as followed:
 - 1) 70% ethanol, 20 min
 - 2) 95% ethanol, 20 min for 2 times
 - 3) 100% ethanol, 20 min for 2 times
 - 2.4.2 Clearing specimens with xylene 20 min for 2 times.
 - 2.4.3 Infiltrate specimens with melted paraffin 20 min for 2 times.
- 2.5 Embedding the paraffinized specimens with melted paraffin and waited for completely cooled wax and hardened. Tissue blocks can be stored at room temperature for years
- 2.6 Cut the paraffin block with microtome at 4 μM thickness.
- 2.7 Mounting the paraffin sections on the clean glass slides.
- 2.8 Place the slides with paraffin sections in 65 °C oven for 20 min to bond the tissue to the glass. Slide can be stored at room temperature.

List of materials

1. Culture medium preparation

- 1.1 Aluminium foil (Aro, Thailand)
- 1.2 Beaker (Pyrex, Germany)
- 1.3 Bottle (Duran, Germany)
- 1.4 Cylinder
- 1.5 Cellulose acetate filter (pore size 0.45 μM) (Sartorius, Germany)
- 1.6 Distilled water 18 $\text{m}\Omega$
- 1.7 RPMI 1640 media (GIBCOTM, New Zealand)
- 1.8 Fetal bovine serum (GIBCOTM, New Zealand)
- 1.9 Penicillin/streptomycin GIBCOTM, USA)
- 1.10 Sodium bicarbonate (Sigma, St Louis, MO, USA)
- 1.11 Stirrer (Variomag®, Germany)
- 1.12 Vacuum pump (TODAY'S, Rocker400, Taiwan)

2. Instrument for cell culture

- 2.1 Autoclave (Astell, England)
- 2.2 Bunsen burner (Integra Biosciences, Switzerland)
- 2.3 Cell culture incubator (Sanyo, Japan)
- 2.4 Centrifuge (Labofuge 400R, Heraeus, Germany)
- 2.5 Centrifuged tube (Corning®, Mexico)
- 2.6 Culture plate (Flacon®, USA)
- 2.7 Cryogenic vial (CryosTM, Japan)
- 2.8 Glass pipette (Precicolor HBG, Germany)
- 2.9 Biosafety cabinet (FASTER BHA72, Germany)
- 2.10 Light inverted microscope (Leica, Germany)
- 2.11 Pipette aid (Bio-Rad, USA)
- 2.12 Plastic tray
- 2.13 Plastic tip (TreffLab, Switzerland)
- 2.14 Sterile filter (Santorius, Germany)
- 2.15 Sterile syringe (Nipro, Thailand)
- 2.16 Water bath (Heto, Lab Equipment, Denmark)

3. Chemical for cell culture

- 3.1 Dimethylsulfoxide (Sigma, St Louis, MO, USA)
- 3.2 Ethanol (Merck, Germany)
- 3.3 Ethylenediaminetetraacetic acid (Sigma, St Louis, MO, USA)
- 3.4 Potassium chloride (Sigma, St Louis, MO, USA)
- 3.5 Potassium dihydrogen phosphate (Sigma, St Louis, MO, USA)
- 3.6 Sodium chloride (Sigma, St Louis, MO, USA)
- 3.7 Sodium phosphate (Amresco®, USA)
- 3.8 Trypsin (GIBCO®, Canada)

4. Toxicity test and cell viability evaluation

- 4.1 Bunsen burner (Integra Biosciences, Switzerland)
- 4.2 Centrifuged tube (Corning®, Mexico)
- 4.3 Curcumin
- 4.4 Hexahydrocurcumin
- 4.5 Distilled water 18 mΩ
- 4.6 Dimethylsulfoxide (Sigma, St Louis, MO, USA)
- 4.7 Ethanol (Merck, Germany)
- 4.8 Micropipette (Bio-Rad, USA)
- 4.9 Microplate shaker (National Labnet, USA)
- 4.10 Microtiter plate reader (Bio-Tek, Instruments, Winooski, VT, USA)
- 4.11 Multichannel pipette (Labsystems, Finland)
- 4.12 Neubauerhemocytometer (Fischer Scientific, Germany)
- 4.13 Glass pipette (Precicolor HBG, Germany)
- 4.14 Plastic tip
- 4.15 Poly D-lysine hydrobromide (Sigma, St Louis, MO, USA)
- 4.16 Trypan blue (Sigma, St Louis, MO, USA)
- 4.17 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide
(Sigma, St Louis, MO, USA)
- 4.18 96-well plate (Nunc™, Denmark)

5. RNA isolation

- 5.1 Bottle (Duran, Germany)
- 5.2 Centrifuged tube (Corning, Mexico)
- 5.3 Chloroform (Lab-scan LTD, Ireland)
- 5.4 Distilled water 18 m Ω
- 5.5 Eppendorf (Hycon, UK)
- 5.6 Ethanol (Merck, Germany)
- 5.7 Gloves (SemperGuard, Thailand)
- 5.8 Isopropanol (Lab-scan LTD., Ireland)
- 5.9 Micropipette (Bio-Rad, USA)
- 5.10 pH meter (Mettler-Toledo, Switzerland)
- 5.11 Plastic tip (Axygen®, USA)
- 5.12 Refrigerated centrifuge (D37520 Osterode, Kendro, Germany)
- 5.13 Tris (hydroxymethyl) aminomethane hydrochloride (Merck, Germany)
- 5.14 TRIzol® reagent (Invitrogen, New Zealand)
- 5.15 Vortex (Paramix D-77960, Julabo, Germany)

6. Semi-quantitative RT-PCR analysis

- 6.1 Acetic acid (Lab-scan LTD., Ireland)
- 6.2 Agarose powder (ISC Bioexpress®, Spain)
- 6.3 Ethylenediaminetetraacetic acid (Sigma, St Louis, MO, USA)
- 6.4 Ethidium bromide (Sigma, St Louis, Mo, USA)
- 6.5 Gel electrophoresis apparatus (SK bio, Japan)
- 6.6 GoTag® DNA polymerase (5u/ μ l) (Promega, USA)
- 6.7 ImProm-II™ 5x reaction buffer (Promega, USA)
- 6.8 ImProm-II™ reverse transcriptase (Promega, USA)
- 6.9 Oligodeoxythymidine (dT) 15 primer, 500 μ g/ml (Promega, USA)
- 6.10 MgCl₂ solution, 25mM (Promega, USA)
- 6.11 Nuclease-free water (Promega, USA)
- 6.12 PCR nucleotide mix, 10 mM each (Promega, USA)
- 6.13 PCR tube (Sorenson™, USA)
- 6.14 Primer of GAPDH gene (Invitrogen, Carlsbad, USA)

- 6.15 Primer of COX-1 gene (Invitrogen, Carlsbad, USA)
- 6.16 Primer of COX-2 gene (Invitrogen, Carlsbad, USA)
- 6.17 Recombinant RNasin® ribonuclease inhibitor (40 u/μl) (Promega, USA)
- 6.18 RQ1 RNase-free DNase, 1u, μl (Promega, USA)
- 6.19 RQ1 DNase 10x reaction buffer (Promega, USA)
- 6.20 RQ1 DNase stop solution (Promega, USA)
- 6.21 UV/Visible spectrophotometer (Pharmacia Biotech, Sweden)
- 6.22 Tri base (Amresco®, USA)
- 6.23 Tris-chloride (Sigma, St Louis, MO, USA)
- 6.24 Thermocycler (GeneAmp®, USA)
- 6.25 UV quartz cuvette (Starna®, UK)
- 6.26 Water bath (Deto-Lab Equipment, Denmark)
- 6.27 5x GoTaq® Flexi buffer (Promega, USA)

7. Protein extraction

- 7.1 Bottle (Duran, Germany)
- 7.2 Bovine Serum Albumin (Gibco BRL, Life Technology, Scotland)
- 7.3 β-Glycerophosphate (Calbiochem, Germany)
- 7.4 Distilled water 15 mΩ
- 7.5 Eppendorf (TreffLab, Switzerland)
- 7.6 Ethylenediaminetetraacetic acid (Sigma, St Louis, MO, USA)
- 7.7 Gloves (SemperGuard, Thailand)
- 7.8 Isopropanol (Lab-scan LTD., Ireland)
- 7.9 Methanol (AnalaR®, England)
- 7.10 Micro BCA protein assay kit (Thermo Scientific, USA)
- 7.11 Micropipette (Bio-Rad, USA)
- 7.12 NP-40 (Calbiochem, Germany)
- 7.13 Hypodermicneedle (Nipro, Thailand)
- 7.14 pH meter (Mettler-Toledo, Switzerland)
- 7.15 Plastic tip (TreffLab, Switzerland)
- 7.16 Protease inhibitor (Roche, Germany)
- 7.17 Refrigerated centrifuge (D37520 Osterode, Kendro, Germany)

- 7.18 Sodium deoxycholate (Calbiochem, Germany)
- 7.19 Sodium dodecyl sulfate (Bio basic inc., Canada)
- 7.20 Tris (hydroxymethyl) aminomethane hydrochloride (Merck, Germany)
- 7.21 Vortex (Paramix D-77960, Julabo, Germany)

8. Protein separation

- 8.1 Acrylamide (Amersham Bioscience, Sweden)
- 8.2 Ammonium persulfate (Amersham Bioscience, Sweden)
- 8.3 Bromophenole blue (Sigma, St Louis, MO, USA)
- 8.4 Casting stand with clamp (Miniprotein® System, Bio-Rad, China)
- 8.5 Isopropyl alcohol (Burdick&Jackson, Korea)
- 8.6 Powerpac basic power supply (Powerpac™ Basic, Bio-Rad, Singapore)
- 8.7 Sodium dodecyl sulfate (Bio basic inc., Canada)
- 8.8 TEMED (Bio basic inc., Canada)
- 8.9 Miniprotein Tetra cell (Miniprotein® System, Bio-Rad, China)
- 8.10 Tris (hydroxymethyl) aminomethanehydrochloride (Merck, Germany)
- 8.11 Vortex (Paramix D-77960, Julabo, Germany)

9. Western blot analysis

- 9.1 Acetic acid (Merck, Germany)
- 9.2 Blue X-Ray Film (Thermo scientific, USA)
- 9.3 Chemiluminescent HRP substrate (Immobilon™ Western, Milipore, USA)
- 9.4 Chromatography paper (Whatman®, England)
- 9.5 Electrophoresis power supply (GE, Sweden)
- 9.6 Ethylenediaminetetraacetic acid (Sigma, St Louis, MO, USA)
- 9.7 Methanol (AnalaR®, England)
- 9.8 Plate Shaker (Funny shaker, Major science, Taiwan)
- 9.9 PolyvinylideneDifluoride (AmershamHybond™-P, UK)
- 9.10 Skim milk (Morinagamilk, Japan)
- 9.11 Sodium chloride (Merck, Germany)

- 9.12 Sodium dodecyl sulfate (Bio basic inc., Canada)
- 9.13 Trans-Blot SD Semi dry electrophoretic transfer cell (Atto, Japan)
- 9.14 Tris-chloride (Sigma, St Louis, MO, USA)
- 9.15 Tween 20 (USB, USA)
- 9.16 Heat block (Bioer technology, China)

10. Detection of nuclear change

- 10.1 Eppendorf (TreffLab, Switzerland)
- 10.2 Hoechst 33258
- 10.3 Multichannel pipette (Labsystems, Finland)
- 10.4 Plastic tip (TreffLab, Switzerland)
- 10.5 Plastic tray
- 10.6 Potassium chloride (Sigma, St Louis, MO, USA)
- 10.7 Potassium dihydrogen phosphate (Sigma, St Louis, MO, USA)
- 10.8 Sodium chloride (Sigma, St Louis, MO, USA)
- 10.9 Sodium phosphate (Amresco®, USA)
- 10.10 Poly D-lysine hydrobromide (Sigma, St Louis, MO, USA)

11. Animal model preparation

- 11.1 1,2-Dimethylhydrazine (DMH) (Sigma, St Louis, MO, USA)
- 11.2 Sodium chloride (Sigma, St Louis, MO, USA)
- 11.3 Ethylenediaminetetra acetic acid (EDTA)(Sigma, St Louis, MO, USA)
- 11.4 Propylene glycol (Vidhyasom, Thailand)
- 11.5 Nembutal® (CEVA Sante Animale, Libourine, France)
- 11.6 Distilled water 18 mΩ
- 11.7 Bottle (Duran, Germany)
- 11.8 Gloves (SemperGuard, Thailand)
- 11.9 Cylinder
- 11.10 Sterile syringe (Nipro, Thailand)
- 11.11 pH meter (Mettler-Toledo, Switzerland)
- 11.12 Autoclave (Astell, England)

12. Analysis of aberrant crypt foci

- 12.1 Formaldehyde (35-40%) solution (Lab-scan®, Bangkok, Thailand)
- 12.2 Potassium chloride (Sigma, St Louis, MO, USA)
- 12.3 Potassium dihydrogen phosphate (Sigma, St Louis, MO, USA)
- 12.4 Sodium chloride (Sigma, St Louis, MO, USA)
- 12.5 Sodium phosphate (Amresco®, USA)
- 12.6 Methylene blue (Merck, Germany)
- 12.7 Microscope slides (Sail Brand, China)
- 12.8 Microscope cover glasses (Menzel-Glaser®, Germany)
- 12.9 Haemocytometer
- 12.10 Light microscopy (Nikon, Melville, NY, USA).

13. Analysis of COX-1 and COX-2 protein

- 13.1 Hydrogen peroxide 50% w/v (Merck, Germany)
- 13.2 Methanol (AnalaR®, England)
- 13.3 Bovine serum albumin (Sigma, St Louis, MO, USA)
- 13.4 Potassium chloride (Sigma, St Louis, MO, USA)
- 13.5 Potassium dihydrogen phosphate (Sigma, St Louis, MO, USA)
- 13.6 Sodium chloride (Sigma, St Louis, MO, USA)
- 13.7 Sodium phosphate (Amresco®, USA)
- 13.8 COX-2 polyclonal antibody (Cayman Chemical Co., Ann Arbor, MI, USA)
- 13.9 COX-1 monoclonal antibody Envision system/HRP (DAKO cytometry Fine life Science Co., Seoul, Korea).
- 13.10 ABC reagent (Vectastain, Burlingame, CA)
- 13.11 Modified hematoxylin solution (C.V. Laboratories, Thailand)
- 13.12 Ethanol (Merk, Germany)
- 13.13 Distilled water
- 13.14 Mounting medium (Permount®, Scientific, USA)
- 13.15 Xylene (Lab-scan®, Bangkok, Thailand)
- 13.16 Light microscopy (Nikon, Melville, NY, USA).

14. Detection of cell death (apoptosis)

- 14.1 FragEL™ DNA fragmentation Detection kit with colorimetric TdT enzyme (Calbiochem, Darmstadt, Germany)
- 14.2 Hydrogen peroxide (Merk, Germany)
- 14.3 Distilled water
- 14.4 Potassium chloride (Sigma, St Louis, MO, USA)
- 14.5 Potassium dihydrogen phosphate (Sigma, St Louis, MO, USA)
- 14.6 Sodium chloride (Sigma, St Louis, MO, USA)
- 14.7 Sodium phosphate (Amresco®, USA)
- 14.8 DAB (Vectastain, Burlingame, CA).
- 14.9 Ethanol (Merk, Germany)
- 14.10 Distilled water
- 14.11 Mounting medium (Permount®, Scientific, USA)
- 14.12 Xylene (Lab-scan®, Bangkok, Thailand)
- 14.13 Fluorescence microscopy (Nikon, Melville, NY, USA).

BIOGRAPHY



BIOGRAPHY

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