

April 2006

Qproteome™ Mitochondria Isolation Handbook

For purification of mitochondria from
eukaryotic cells



WWW.QIAGEN.COM

Trademarks: QIAGEN[®], Qproteome[™], (QIAGEN Group); Benzonase[®] (Merck KGaA, Germany), Coomassie[®] (ICI [Imperial Chemical Industries] Organics Inc.); Nanosep[®] (Pall Corporation).

Registered names, trademarks, etc. used in this document, even when not specifically marked as such, are not to be considered unprotected by law.

1037215 © 2006 QIAGEN, all rights reserved.

Contents

Kit Contents	4
Storage	4
Quality Control	4
Safety Information	4
Product Use Limitations	5
Product Warranty and Satisfaction Guarantee	5
Technical Assistance	5
Introduction	6
Principle and Procedure	6
Protocols	
■ Isolation of Mitochondria from Eukaryotic Cell Lysates	9
■ Acetone Precipitation of Protein Fractions	12
Troubleshooting Guide	12
QIAGEN Distributors	15

Kit Contents

Qproteome Mitochondria Isolation Kit	Cat. no. 37612
Number of preps	12
Lysis Buffer	3 x 10 ml
Disruption Buffer	35 ml
Mitochondria Storage Buffer	100 ml
Mitochondria Purification Buffer	20 ml
Protease Inhibitor Solution (100x)	2 x 300 μ l

Storage

Lysis Buffer should be stored at -20°C upon arrival. All other buffers and Protease Inhibitor Solution (100x) should be stored at $2-8^{\circ}\text{C}$.

Quality Control

In accordance with QIAGEN's ISO-certified Total Quality Management System, Qproteome Kits are tested against predetermined specifications to ensure consistent product quality.

Safety Information

When working with chemicals, always wear a suitable lab coat, disposable gloves, and protective goggles. For more information, please consult the appropriate material safety data sheets (MSDSs). These are available online in convenient and compact PDF format at www.qiagen.com/ts/msds.asp where you can find, view, and print the MSDS for each QIAGEN kit and kit component.

24-hour emergency information

Emergency medical information in English, French, and German can be obtained 24 hours a day from:

Poison Information Center Mainz, Germany, Tel: +49-6131-19240

Product Use Limitations

Qproteome Kits are intended for research use only. Prior to using them for other purposes, the user must validate the system in compliance with the applicable law, directives, and regulations.

All due care and attention should be exercised in the handling of the products. We recommend all users of QIAGEN products to adhere to the NIH guidelines that have been developed for recombinant DNA experiments, or to other applicable guidelines.

Product Warranty and Satisfaction Guarantee

QIAGEN guarantees the performance of all products in the manner described in our product literature. The purchaser must determine the suitability of the product for its particular use. Should any product fail to perform satisfactorily due to any reason other than misuse, QIAGEN will replace it free of charge or refund the purchase price. We reserve the right to change, alter, or modify any product to enhance its performance and design. If a QIAGEN product does not meet your expectations, simply call your local Technical Service Department or distributor. We will credit your account or exchange the product — as you wish. Separate conditions apply to QIAGEN scientific instruments, service products, and to products shipped on dry ice. Please inquire for more information.

A copy of QIAGEN terms and conditions can be obtained on request, and is also provided on the back of our invoices. If you have questions about product specifications or performance, please call QIAGEN Technical Services or your local distributor (see inside back cover).

Technical Assistance

At QIAGEN we pride ourselves on the quality and availability of our technical support. Our Technical Service Departments are staffed by experienced scientists with extensive practical and theoretical expertise in molecular biology and the use of QIAGEN® products. If you have any questions or experience any difficulties regarding Qproteome Kits or QIAGEN products in general, please do not hesitate to contact us.

QIAGEN customers are a major source of information regarding advanced or specialized uses of our products. This information is helpful to other scientists as well as to the researchers at QIAGEN. We therefore encourage you to contact us if you have any suggestions about product performance or new applications and techniques.

For technical assistance and more information please call one of the QIAGEN Technical Service Departments or local distributors (see inside back cover).

Introduction

Proteomic analysis of organelles or specific groups of proteins is a powerful strategy for the discovery of proteins that are involved in specific cellular functions or disease. Targeted enrichment of specific groups of proteins or subcellular organelles reduces the complexity of samples and simplifies such approaches.

As they are the organelles in animal and plant cells in which oxidative phosphorylation takes place, mitochondria are the site of energy production in eukaryotic cells. In tissues that require large amounts of energy (e.g., skeletal muscle, kidney, or the pancreas), there are noticeably more mitochondria than in tissues with lower energy requirements. Mitochondria are compartmentalized by an outer and highly folded inner membrane. The inner membrane encloses the mitochondrial matrix, which contains the enzymes that take part in the Krebs respiratory cycle. The molecules that perform electron transfer and ATP synthesis are located on folds (cristae) on the inner surface of the inner membrane.

Due to their fundamental importance in biochemistry, mitochondria are a subject of intense research. Mitochondrial dysfunction can lead to serious and debilitating medical conditions, such as cancer, infertility, diabetes, heart diseases, blindness, deafness, kidney disease, liver disease, stroke, and migraine. Mitochondrial dysfunction is also involved in aging and neurodegenerative diseases such as Parkinson's and Alzheimer's disease.

Principle and Procedure

After washing, cells are suspended in Lysis Buffer, which selectively disrupts the plasma membrane without solubilizing it, resulting in the isolation of cytosolic proteins. Plasma membranes and compartmentalized organelles, such as nuclei, mitochondria, and the endoplasmic reticulum (ER), remain intact and are pelleted by centrifugation. The resulting pellet is resuspended in Disruption Buffer, repeatedly passed through a narrow-gauge needle (to ensure complete cell disruption), and recentrifuged to pellet nuclei, cell debris, and unbroken cells. The supernatant (which contains mitochondria and the microsomal fraction) is recentrifuged to pellet mitochondria. After removal of the supernatant, mitochondria are washed and resuspended in Mitochondria Storage Buffer.

For high-purity preparations, the mitochondria pellet is resuspended in Mitochondria Purification Buffer and carefully pipetted on top of layers of Purification Buffer and Disruption Buffer. During a subsequent separation, mitochondria migrate through the liquid to form a band at the Purification Buffer/Disruption Buffer interface. The band is removed and the high-purity mitochondria are pelleted in Mitochondria Storage Buffer.

The procedure has been used successfully with several different mammalian cell lines, including HeLa, Cos7, NIH, and HEK293. Depending on the cell line, the yield from a single fractionation procedure is 20–80 μg protein from 5×10^6 cells. For some downstream applications, concentration of fractions may be necessary. A protocol for protein concentration using acetone precipitation can be found on page 12.

High-Purity Mitochondrial Preparations Free of Contaminating Proteins

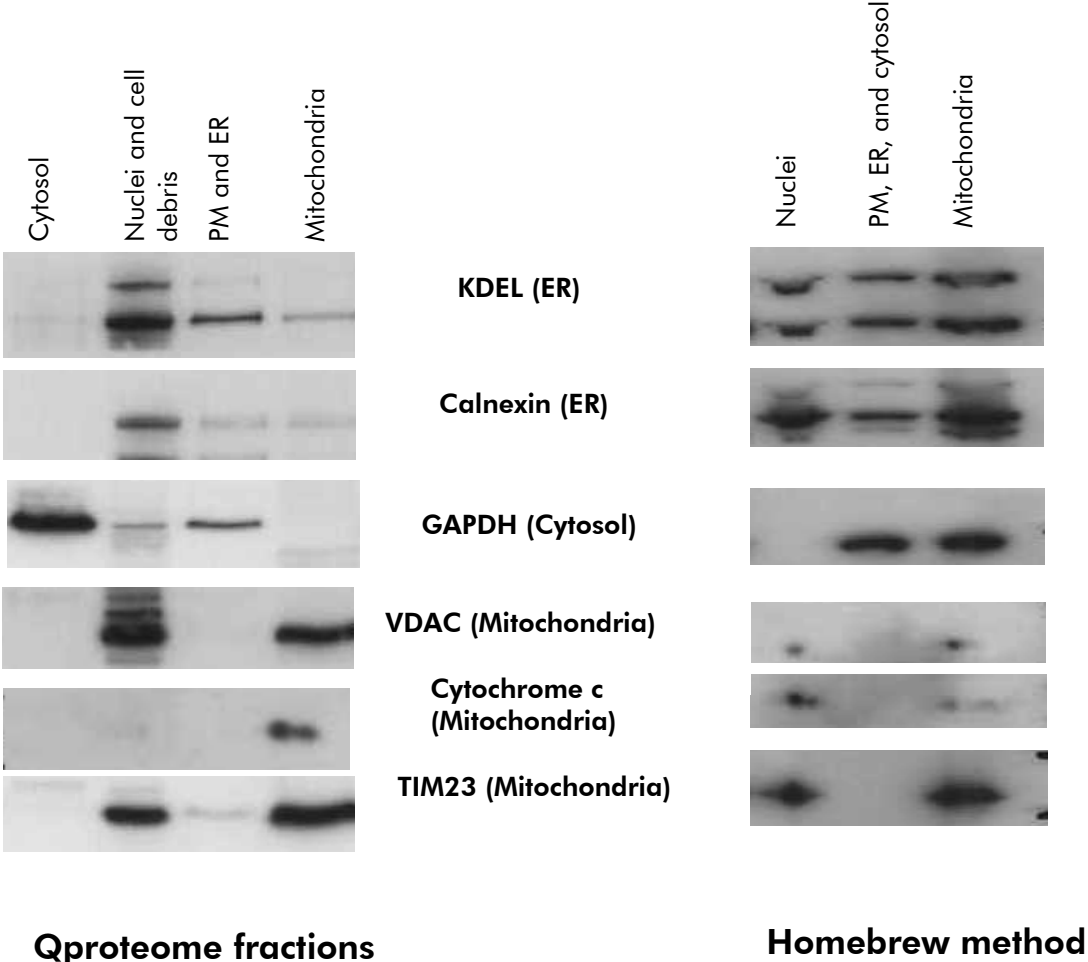
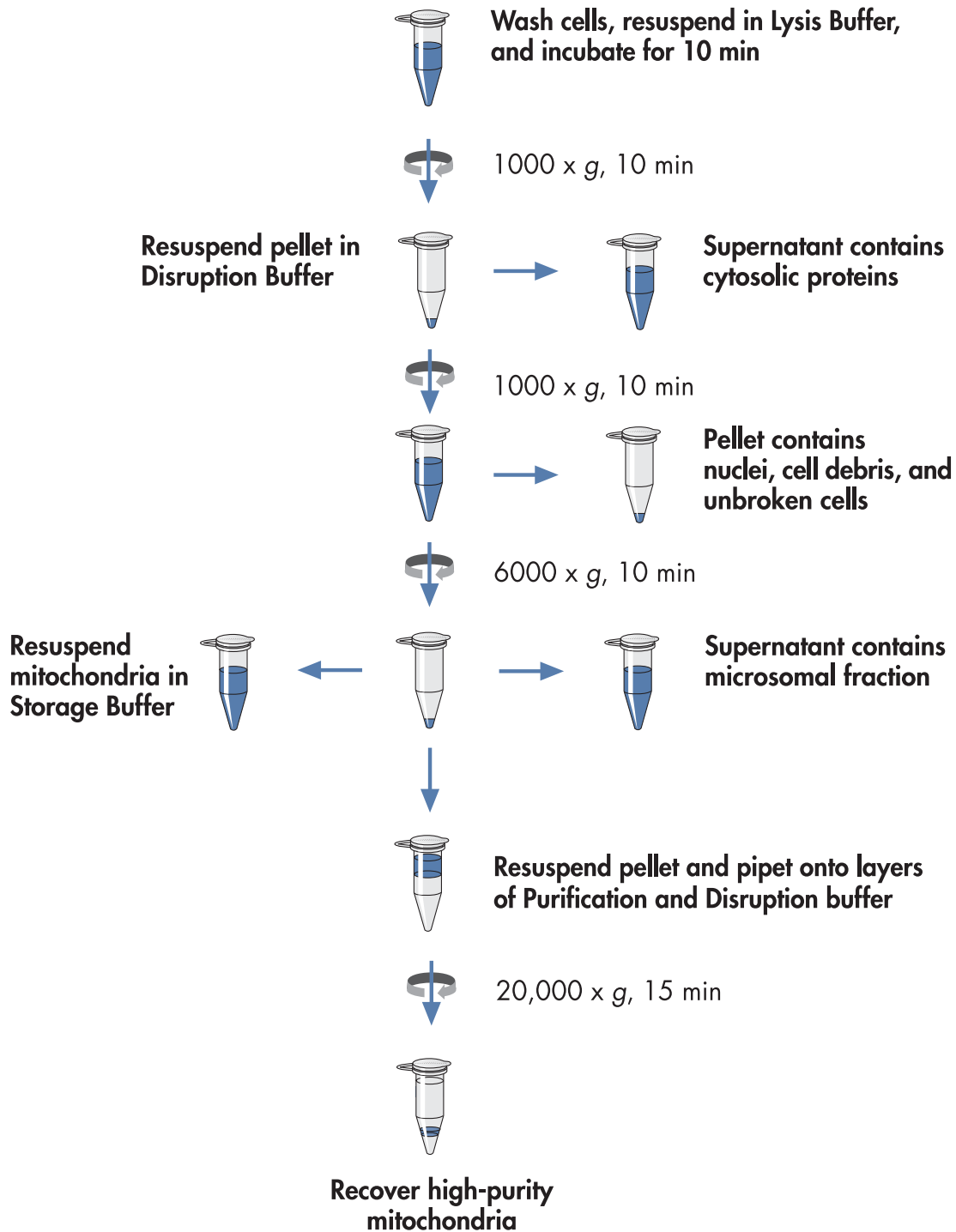


Figure 1 Mitochondria were prepared using either the Qproteome Mitochondria Isolation Kit or a “homebrew” method based on differential centrifugation. Western blots of mitochondrial preparations probed with antibodies specific for organelle-/cell-compartment specific marker proteins. **PM**: plasma membrane; **ER**: endoplasmic reticulum.

Qproteome Mitochondria Isolation Procedure



Protocol: Isolation of Mitochondria from Eukaryotic Cell Lysates

This protocol is suitable for processing 5×10^6 to 2×10^7 cells. **Note:** The buffers contain components that may interfere with protein quantification assays. A precipitation step (e.g., using acetone, see page 12) to remove interfering substances may be required to accurately determine protein concentrations.

Equipment and reagents be supplied by the user

- 0.9% (w/v) sodium chloride solution
- End-over-end shaker
- Blunt-ended needle (26 or 21 gauge) and syringe (1 ml or 2 ml volume) for cell disruption and homogenization for example 26g x 23; 0.45 x 23
- Optional: Acetone stored at -20°C

Important notes before starting

- All steps are performed at 4°C . Use pre-cooled buffers. Separated protein fractions should be snap-frozen in liquid nitrogen and stored at -80°C .
- For downstream applications (e.g., SDS-PAGE analysis) elution fractions should be pooled and concentrated (e.g., by acetone precipitation).

Things to do before starting

- Immediately before use, supplement Lysis Buffer and Disruption Buffer with 1/100 volume of Protease Inhibitor Solution (100x) (i.e., if using 2 ml Disruption Buffer, add 20 μl Protease Inhibitor Solution [100x]).

Procedure

- 1. Transfer a cell suspension containing approximately 5×10^6 to 2×10^7 cells into a 15 ml conical tube and centrifuge at $500 \times g$ for 10 min at 4°C . Carefully remove and discard the supernatant.**
- 2. Wash the cells using 1 ml 0.9% sodium chloride solution.**
- 3. Resuspend the cell pellet in 1 ml ($< 1 \times 10^7$ cells) or 2 ml ($\geq 1 \times 10^7$ cells) ice-cold Lysis Buffer by pipetting up and down using a 1 ml pipette tip. Incubate for 10 min at 4°C on an end-over-end shaker.**
Ensure that Protease Inhibitor Solution has been added to Lysis Buffer.
- 4. Centrifuge the lysate at $1000 \times g$ for 10 min at 4°C .**
- 5. Carefully remove the supernatant.**
This fraction primarily contains cytosolic proteins.

- 6. Resuspend the cell pellet in 1.5 ml ice-cold Disruption Buffer by pipetting up and down using a 1 ml pipette tip. Complete cell disruption by using a blunt-ended needle and a syringe (not provided). Draw the lysate slowly into the syringe and eject with one stroke. Repeat 10 times.**

Ensure that Disruption Buffer has been supplemented with Protease Inhibitor Solution.

- 7. Centrifuge the lysate at 1000 x g for 10 min at 4°C and carefully transfer the supernatant to a clean 15 ml tube.**

The pellet contains nuclei, cell debris, and unbroken cells. If desired, proteins can be re-extracted from the cell pellet by repeating steps 6 and 7 using 500 μ l ice-cold Disruption Buffer. The supernatants from each extraction should be combined before the next step.

- 8. Carefully transfer the supernatant(s) into a fresh microcentrifuge tube and centrifuge at 6000 x g for 10 min at 4°C.**

- 9. Carefully remove the supernatant.**

The pellet contains mitochondria. The supernatant constitutes the microsomal fraction.

For standard preparations, proceed with step 10a. For high-purity mitochondria, proceed with step 10b.

Standard preparations

- 10a. Wash the mitochondrial pellet from step 10 with 1 ml Mitochondria Storage Buffer by carefully pipetting up and down using a 1 ml pipette tip. Centrifuge at 6000 x g for 20 min at 4°C.**

- 11a. Resuspend the mitochondrial pellet in Mitochondria Storage Buffer or a buffer of choice for further analysis.**

High-purity preparations

- 10b. Resuspend the pellet from step 10 in 750 μ l Mitochondria Purification Buffer by carefully pipetting up and down using a 1 ml pipette tip. Pipet 750 μ l Mitochondria Purification Buffer into a 2 ml microcentrifuge tube and slowly pipet 500 μ l Disruption Buffer under the Mitochondria Purification Buffer. Carefully pipet the mitochondrial suspension on top of the Mitochondria Purification Buffer layer (see Figure 2).**

Due to their different viscosities, Disruption Buffer and Mitochondria Purification Buffer do not readily mix, allowing them to be layered.

11b. Centrifuge at 20,000 x g for 15 min at 4°C.

A band of mitochondria will form in the lower part of the tube.

12b. Carefully remove 1.5 ml of the supernatant without removing the banded mitochondria.

Save the supernatant for further analysis.

13b. Carefully remove the mitochondria band and transfer to a new test tube.

Note: When working with fewer than 1×10^7 cells it may be difficult to see the band of mitochondria. In this case, remove the remaining 500 μl . Do not disturb the clear pellet at the bottom of the tube.

14b. Dilute the suspension from step 13b with 1.5 ml Mitochondria Storage Buffer and centrifuge at 8000 x g for 10 min at 4°C.

15b. Remove 1.5 ml of the supernatant and dilute the remaining suspension with 1.5 ml Mitochondria Storage Buffer and centrifuge at 8000 x g for 10 min at 4°C.

16b. Repeat step 15b until the mitochondria form a pellet at the bottom of the tube.

Note: This procedure must be repeated until the mitochondria form a pellet at the bottom of the tube. The pellet is usually very soft. Take care when removing the supernatant that the pellet is not lost or disrupted.

17b. Resuspend the mitochondrial pellet in Mitochondria Storage Buffer or in a buffer of choice for further analysis.

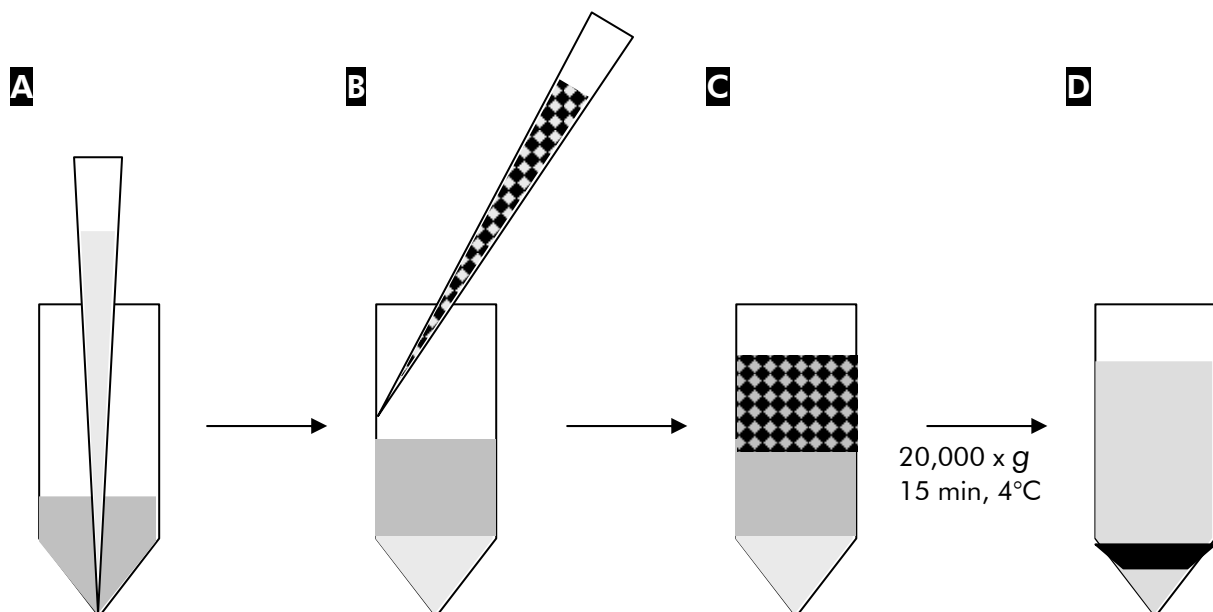


Figure 2 **A** In a 2 ml tube, 500 μl Disruption Buffer is pipetted under 750 μl Mitochondria Purification Buffer. **B**–**C** The crude mitochondria preparation from protocol step 11b is layered on top of the Mitochondria Purification Buffer. **D** After centrifugation, mitochondria are concentrated in a band towards the bottom of the tube.

Protocol: Acetone Precipitation of Protein Fractions

This protocol is suitable for concentrating and desalting protein samples for downstream applications such as 2D-PAGE.

1. **Add 4 volumes of ice-cold acetone to the protein fraction and incubate for 15 min on ice.**
2. **Centrifuge for 10 min at 12,000 x g in a pre-cooled microcentrifuge at 4°C. Discard the supernatant and wash the pellet with 1 ml 80% acetone.**
3. **Air dry the pellet.**

Do not overdry the pellet as this may make it difficult to resuspend.

Troubleshooting Guide

Comments and Suggestions

Inconsistent results in protein quantification assays

Buffers contain components that may interfere with protein quantification assays

Use a protein assay that includes a precipitation step to remove interfering substances. Alternatively precipitate a portion of the eluate using acetone and dissolve the protein pellet in a reagent suitable for your protein assay.

Low mitochondria yield despite sufficient cells in starting material

Cell disruption was not complete

Instead of a needle and syringe, use a Potter homogenizer to disrupt the cells.

Ordering Information

Product	Contents	Cat. no.
Qproteome Mitochondria Isolation Kit	Buffers and reagents for 12 high-purity mitochondrial preparations	37612
Related products		
Qprotome Mammalian Protein Prep Kit	For approximately 100 protein preparations from cultured mammalian cells: Buffer, Reagents, Protease Inhibitor Solution, Benzonase	37901
Qproteome Plasma Membrane Protein Kit	Buffers and reagents for 6 high-purity plasma membrane protein preparations	37601
Qproteome Nuclear Protein Kit	For 6 nuclear protein preparations: Buffers, Reagents, Protease Inhibitor Solution, Benzonase	37582
Qproteome Nuclear Subfractionation Kit	For 6 nuclear protein preparations: Buffers, Reagents, Nuclear protein Fractionation Columns (6), Nuclear Protein Fractionation Resin, Protease Inhibitor Solution, Benzonase	37531
Qproteome Albumin/IgG Depletion Kit	For albumin/IgG depletion of 6 serum or plasma samples: Albumin/IgG Depletion Spin Columns (6)	37521
Qproteome Murine Albumin Depletion Kit	For albumin depletion of 6 murine serum or plasma samples: Murine Albumin Depletion Spin Columns (6)	37591
Qproteome Total Glycoprotein Kit	For 6 total glycoprotein preps: Buffers, Lectin Spin Columns (6), Detergent Solution, Protease Inhibitor Solution, Collection Tubes (6 x 2 ml)	37541
Qproteome Mannose Glycoprotein Kit	For 6 mannose glycoprotein preps: ConA, GNA, and LCH Lectin Spin Columns (2 each); Buffers; Detergent Solution; Protease Inhibitor Solution; Collection Tubes (6 x 2 ml)	37551

Product	Contents	Cat. no.
Qproteome Sialic Glycoprotein Kit	For 6 sialic acid glycoprotein preps: WGA, SNA, and MAL Lectin Spin Columns (2 each); Buffers; Detergent Solution; Protease Inhibitor Solution; Collection Tubes (6 x 2 ml)	37561
Qproteome O-Glycan Glycoprotein Kit	For 6 O-glycan glycoprotein preps: ALL and PNA Lectin Spin Columns (3 each); Buffers; Protease Inhibitor Solution; Collection Tubes (6 x 2 ml)	37571
Qproteome Soluble Protein Separation Kit	For 10 soluble protein fractionations: Fractionation Buffer, Precipitation Reagents, Protease Inhibitor Solution, Benzonase	37512
Qproteome Cell Compartment Kit	For 10 subcellular fractionations: Extraction buffers, Protease Inhibitor Solution, Benzonase	37502
PhosphoProtein Purification Kit (6)	6 PhosphoProtein Purification Columns, 6 Nanosep [®] Ultrafiltration Columns, Reagents, Buffers	37101

QIAGEN Companies

Please see the back cover for contact information for your local QIAGEN office.

QIAGEN Distributors

Argentina

Tecnolab S.A.
Tel: (011) 4555 0010
Fax: (011) 4553 3331
E-mail: info@tecnolab.com.ar
Web site: www.tecnolab.com.ar

Brazil

Uniscience do Brasil
Tel: 011 3622 2320
Fax: 011 3622 2323
E-mail: info@uniscience.com
Web site: www.uniscience.com

Chile

Biosonda SA
Tel: 562 209 6770
Fax: 562 274 5462
E-mail: ventas@biosonda.cl
Web site: www.biosonda.cl

China

Gene Company Limited
Tel: (852)2896-6283
Fax: (852)2515-9371
E-mail:
Hong Kong:
info@genehk.com
Beijing:
info_bj@genecompany.com
Shanghai:
info_sh@genecompany.com
Chengdu:
gene@public.cd.sc.cn
Guangzhou:
info_gz@genecompany.com

Croatia

INEL Medicinska Tehnika d.o.o.
Tel: (01) 2984-898
Fax: (01) 6520-966
E-mail:
inel-medicinska-tehnika@zg.htnet.hr

Cyprus

Scientronics Ltd
Tel: 02-357 22 765416
Fax: 02-357 22 764614
E-mail:
a.sarpetsas@biotronics.com.cy

Czech Republic

BIO-CONSULT spol. s.r.o.
Tel/Fax: (420) 2 417 29 792
E-mail: info@bioconsult.cz
Web site: www.bioconsult.cz

Egypt

Clinilab
Tel: 52 57 212
Fax: 52 57 210
E-mail: Clinilab@link.net

Estonia

PEAL-Est OÜ
Tel: (051) 65 830
Fax: (07) 383 360
E-mail: langel@ut.ee

Greece

BioAnalytica S.A.
Tel: (210)-640 03 18
Fax: (210)-646 27 48
E-mail: bioanalyt@hol.gr
Web site: www.bioanalytica.gr

Hungary

Kasztel-Med Co. Ltd.
Tel: (01) 385 3887
Fax: (01) 381 0695
E-mail: info@kasztel.hu
Web site: www.kasztel.hu

India

Genetix
Tel: (011)-2542 1714
or (011)-2515 9346
Fax: (011)-2546 7637
E-mail: genetix@nda.vsnl.net.in

Israel

Westburg (Israel) Ltd.
Tel: 08-6900655
or 1-800 20 22 20 (toll free)
Fax: 08-6900650
E-mail: info@westburg.co.il
Web site: www.westburg.co.il

Korea

LRS Laboratories, Inc.
Tel: (02) 924-86 97
Fax: (02) 924-86 96
E-mail: webmaster@lrslab.co.kr
Web site: www.lrslab.co.kr

Malaysia

RESEARCH BIOLABS SDN. BHD.
Tel: (603)-8070 3101
Fax: (603)-8070 5101
E-mail: biolabs@tm.net.my
Web site: www.researchbiolabs.com

Mexico

Quimica Valaner S.A. de C.V.
Tel: (55) 55 25 57 25
Fax: (55) 55 25 56 25
E-mail: ventas@valaner.com
Web site: www.valaner.com

New Zealand

Biolab Ltd
Tel: (09) 980 6700
or 0800 933 966
Fax: (09) 980 6788
E-mail:
biosciences@nzl.biolabgroup.com
Web site: www.biolabgroup.com/nzl

Poland

Syngen Biotech Sp.z.o.o.
Tel: (071) 798 58 50 - 52
Fax: (071) 798 58 53
E-mail: info@syngen.pl
Web site: www.syngen.pl

Portugal

IZASA PORTUGAL, LDA
Tel: (21) 424 7312
Fax: (21) 417 2674
E-mail: consultasbiotec@izasa.es

Saudi Arabia

Abdulla Fouad Co. Ltd.
Tel: (03) 8324400
Fax: (03) 8346174
E-mail:
sadiq.omar@abdulla-fouad.com

Singapore

Research Biolabs Pte Ltd
Tel: 6777 5366
Fax: 6778 5177
E-mail: sales@researchbiolabs.com
Web site: www.researchbiolabs.com

Slovak Republic

BIO-CONSULT Slovakia spol. s.r.o.
Tel/Fax: (02) 5022 1336
E-mail: bio-cons@cdicon.sk
Web site: www.bioconsult.cz

Slovenia

MEDILINE d.o.o.
Tel: (01) 830-80-40
Fax: (01) 830-80-70
or (01) 830-80-63
E-mail: mediline@siol.net

South Africa

Southern Cross Biotechnology
(Pty) Ltd
Tel: (021) 671 5166
Fax: (021) 671 7734
E-mail: info@scb.co.za

Spain

IZASA, S.A.
Tel: (93) 902.20.30.90
Fax: (93) 902.22.33.66
E-mail: consultasbiotec@izasa.es

Taiwan

TAIGEN Bioscience Corporation
Tel: (02) 2880 2913
Fax: (02) 2880 2916
E-mail: taigen@ms10.hinet.net

Thailand

Theera Trading Co. Ltd.
Tel: (02) 412-5672
Fax: (02) 412-3244
E-mail: theetrad@samarit.co.th

Turkey

Medek Medikal Ürünler
ve Sağlık Hizmetleri A. S.
Tel: (216) 302 15 80
Fax: (216) 302 15 88
E-mail: makialp@med-ek.com

All other countries

QIAGEN GmbH, Germany

Australia ■ Orders 03-9840-9800 ■ Fax 03-9840-9888 ■ Technical 1-800-243-066

Austria ■ Orders 0800/28-10-10 ■ Fax 0800/28-10-19 ■ Technical 0800/28-10-11

Belgium ■ Orders 0800-79612 ■ Fax 0800-79611 ■ Technical 0800-79556

Canada ■ Orders 800-572-9613 ■ Fax 800-713-5951 ■ Technical 800-DNA-PREP (800-362-7737)

China ■ Orders 021-51345678 ■ Fax 021-51342500 ■ Technical 021-51345678

Denmark ■ Orders 80-885945 ■ Fax 80-885944 ■ Technical 80-885942

Finland ■ Orders 0800-914416 ■ Fax 0800-914415 ■ Technical 0800-914413

France ■ Orders 01-60-920-920 ■ Fax 01-60-920-925 ■ Technical 01-60-920-930

Germany ■ Orders 02103-29-12000 ■ Fax 02103-29-22000 ■ Technical 02103-29-12400

Ireland ■ Orders 1800 555 049 ■ Fax 1800 555 048 ■ Technical 1800 555 061

Italy ■ Orders 02-33430411 ■ Fax 02-33430426 ■ Technical 800 787980

Japan ■ Telephone 03-5547-0811 ■ Fax 03-5547-0818 ■ Technical 03-5547-0811

Luxembourg ■ Orders 8002-2076 ■ Fax 8002-2073 ■ Technical 8002-2067

The Netherlands ■ Orders 0800-0229592 ■ Fax 0800-0229593 ■ Technical 0800-0229602

Norway ■ Orders 800-18859 ■ Fax 800-18817 ■ Technical 800-18712

Sweden ■ Orders 020-790282 ■ Fax 020-790582 ■ Technical 020-798328

Switzerland ■ Orders 055-254-22-11 ■ Fax 055-254-22-13 ■ Technical 055-254-22-12

UK ■ Orders 01293-422-911 ■ Fax 01293-422-922 ■ Technical 01293-422-999

USA ■ Orders 800-426-8157 ■ Fax 800-718-2056 ■ Technical 800-DNA-PREP (800-362-7737)

