Sample Preparation

Crushing Lysis Efficiency. Nothing Resists FastPrep®.

FastPrep® systems, lysing matrix and kits provide the most usable DNA, RNA and proteins from tough, dirty or tiny samples.

Fast and easy, everytime.

Find it at **fishersci.com**

fisher scientific
part of **Thermo Fisher Scientific**

Sample Preparation

MP Bio, the leader in sample preparation, provides a complete range of high quality products for all steps of your research experiments. From lysis and extraction through purification of DNA, RNA and proteins, we offer the best solutions to achieve excellent and reliable results for your applications. FastPrep systems deliver high yields of DNA, RNA and protein from even the most resistant sample types in 40 seconds or less.

FastPrep homogenizers pulverize samples through simultaneous beating of specialized lysing matrix beads. Interchangeable adapters allow unique flexibility in terms of sample size (2 mL to 250 mL as well as 96 deep well plates) and temperature (ambient or cryogenic conditions). FastPrep systems can quickly and efficiently process routine and resistant samples, including plant, root, soil, waste water, skin, tissue, seeds, and feces. FastPrep instruments, combined with the widest selection of industry leading lysing matrix materials and complete isolation kits, offer a complete solution for processing even the most difficult samples.

Drawing on years of manufacturing and laboratory experience, MP Bio provides a premium and complete workflow solution for molecular biology research studies. The product range includes sample homogenization and lysis tools, DNA and RNA extraction and purification kits, PCR enzymes and mastermixes, as well as transformation kits, gel electrophoresis and hybridization products.

The FastPrep family is a comprehensive laboratory solution that optimizes the lysis, grinding, or homogenization process from virtually any sample type. Mechanical lysis disrupts cells and tissues for the isolation of DNA, RNA, proteins, metabolites, and other small molecules, and eliminates the need for chemicals, enzymes, and detergents, which can inhibit some downstream processes. FastPrep instruments, Lysing Matrix tubes, and kits work together to deliver rapid, consistent, and efficient lysis and homogenization, resulting in high yields of purified nucleic acid or protein. A benchtop instrument utilizing bead-beating technology, the FastPrep provides complete and quantitative lysis of difficult and routine samples and is suitable in all applications that require grinding, lysing, or homogenization.

Examples of sample types include, but are not limited to:

- **Plant –** Stems, roots, leaves, buds, flowers, fruits, and seeds
- **Animal –** Animal and human samples, including bone, tumors, and skin
- **Soil –** Eubacterial spores and endospores; gram positive bacteria; yeast; algae; nematodes; fungi; clay, sandy, silty, peaty, chalky, and loamy soil samples
- **Bacteria –** Gram-positive, gram-negative, eubacterial spores, and endospores
- **Feces –** Complex fecal matrices
- **Yeast –** Cells and spores

MP Bio offers genomic DNA and total RNA extraction and purification kits and reagents that are optimized to provide maximum yield, purity and integrity from any sample.

MP Bio Extraction and Purification Kits offer the following benefits:

- **Rapid and reproducible sample lysis and purification**
- **Closed lysing matrix tubes to prevent cross-contamination**
- **Increased yields of high-quality DNA and RNA**
- **Integrity and size of DNA and RNA are retained**
- **Ready-to-use nucleic acids for downstream applications**

FastPrep-24™ 5G

Most Advanced Lysis, Homogenization and Grinding System Applicable for Genomics, Proteomics, or Other Chemical Studies and Analysis.

MOST VERSATILE
Often Imitated,
Never Replicated

QuickPrep-3 adapter
included with instrument

The FastPrep-24 5G instrument is a versatile sample disruption device that provides the ultimate in speed and performance for the lysis of biological or inorganic samples.

A completely self-contained system, the FastPrep-24 5G instrument eliminates the risk of cross-contamination and time-consuming clean-up associated with manual lysis methods.

Samples and buffers are simply added to a Lysing Matrix tube containing specialized Lysing Matrix particles. Select your sample type from the Recommended Programs menu, push start, and in 40 seconds or less, your samples are completely lysed. The FastPrep-24 5G also allows for up to 12 custom assays to be manually programmed and saved.

Specifications	
Interface	Touch Screen Interface
Programmable Assays	Up to 12 Manual Assays Saved to Memory
Pre-Defined Assays	73 Pre-Defined and Optimized Assay Programs
Time Range	1 to 120 seconds in 1 second Increments
Speed Range	4 to 10 m/sec in 0.5 m/sec Increments
Cycles	1 to 9 Cycles
Pause Time	1 to 300 Second Pause Between Cycles in 1 Second Increments (Default: 300 Seconds)
Data Export	Via USB
Acceleration	< 2 Seconds to Maximum Speed
Deceleration	< 2 Seconds to Stop
Dimensions	Height: 490 mm; Base: 472 mm x 385 mm (Elliptic Shape)
Weight	23.6 kg (52 lb)
Power Requirement	120 VAC/60 Hz, 500W; 230 VAC/50 Hz, 500 W
Maximum Sound Level	< 70 dB

The heartbeat of the 5G is a microprocessor control interfaced to a touch screen display. The large, 7-inch HD monitor allows assay parameters to be set with the touch of a button. Hi-def graphics and intuitive software make programming the 5G fast and simple, while high-tech exterior graphics add to the sleek and sophisticated design of the instrument.

Product Name	Cat. No.
FastPrep-24™ 5G instrument	11-600-5500

Grind, Homogenize and Lyse Any Sample in 40 Seconds or Less

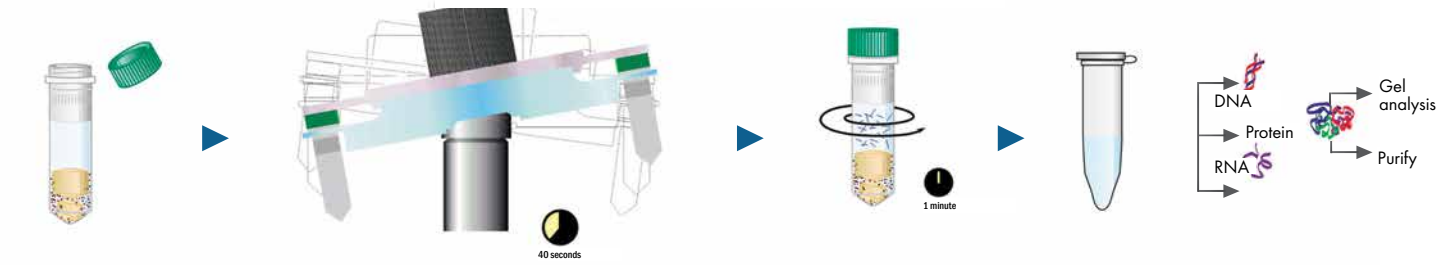
FastPrep-24™ *Classic*

- Consistent results
- Reliable
- Flexible
- Affordable
- 8,500 Citations
- High yields
- Power to homogenize resistant samples with ease

QuickPrep-1 adapter included with instrument

- Interchangeable adapters for flexibility in sample size and cryogenic lysis capability: 24 x 2 mL, 48 x 2 mL, 24 x 4.5 mL, 6 x 15 mL, 12 x 15 mL, or 2 x 50 mL
- High reproducibility with precise setting of lysis time and speed
- Eliminate cross contamination with single-use lysing matrix tubes
- Save up to 5 pre-set speed/time parameters
- Complete purification kits with Lysing Matrix available

FastPrep Workflow



1. Prepare lysis tube
2. Process with FastPrep Instrument
3. Centrifuge to pellet debris
4. Transfer cleared lysate

Specifications	
Time	1-60 seconds in 1 second increments
Speed	4.0 - 6.5 m/sec in 0.5 m/sec increments
Acceleration	<2 seconds to max speed
Deceleration	<2 seconds to stop
Standard temperature operating range	4-40 °C (39-104 °F)
Dimensions	Height - 465 mm, Oval Base - 437 x 332 mm
Weight	17.5 kg (45 lb)
Power requirements	90-250 V AC, 50/60 Hz, 1,200 W

Product Name	Cat. No.
FastPrep-24™ instrument	MP116004500

FastPrep-96™

Grinding, Lysis and Homogenization with the High-Throughput FastPrep-96™ System

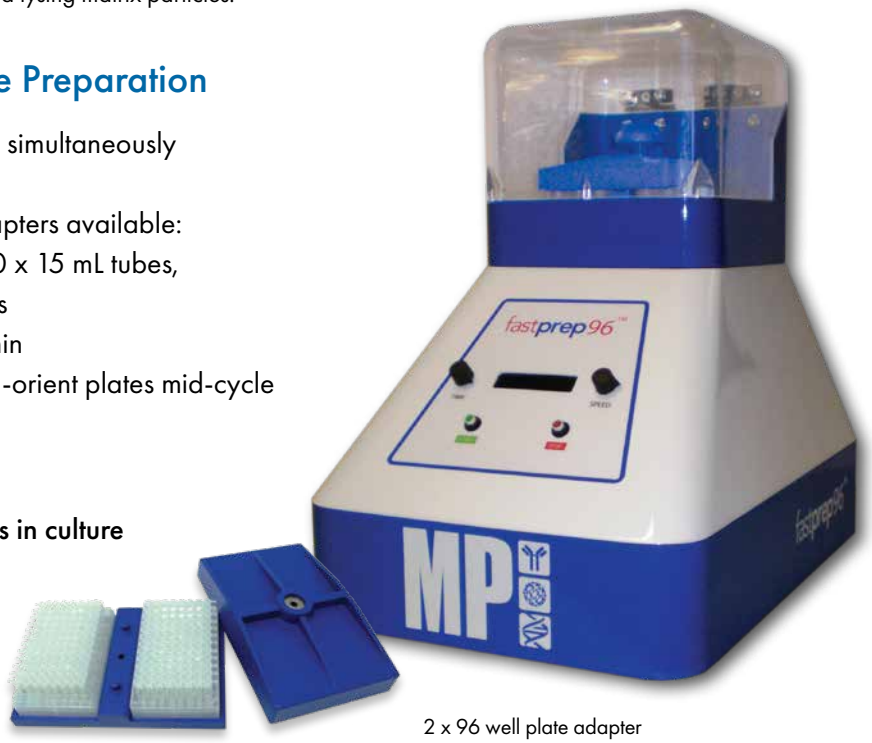
The FastPrep-96 system delivers high-throughput sample homogenization, grinding and lysis with the highest efficiency, quality and reproducibility. Perform your DNA, RNA, protein and small molecule extractions from the most difficult, dirty, tough, large or tiny samples. With the highest power settings available, FastPrep-96 utilizes high-speed linear motion to disrupt any tissues or cells thoroughly through the simultaneous beating of specialized lysing matrix particles.

The Ultimate in High-Throughput Sample Preparation

- **High Throughput** – Process up to 192 samples simultaneously in 2 x 96 deep well plates
- **Exceptional Versatility** – Interchangeable adapters available: 96 x 2 mL tubes, 48 x 4.5 mL tubes, 20 x 15 mL tubes, 8 x 50 mL tubes, and 2 x 250 mL flasks
- **Fast Processing Speed** – 1800 Oscillations/min
- **True Linear Motion** – Eliminates the need to re-orient plates mid-cycle

Efficiently Lyse:

- **Human and animal tissues, tumors, bones, cells in culture**
- **Bacteria (gram + or -)**
- **Yeast, fungi, spores**
- **Plants, seeds, roots, leaves**
- **Feces, soil, sediment**
- **Food samples**



2 x 96 well plate adapter included with instrument

Specifications	
Controls	Programmable run time and speed; display readout
Time Range	1-360 seconds; 1-60 seconds in 1 second increments 60 - 360 seconds in 30 second increments
Speed Range	800 - 1800 revolutions per minute (rpm) Programmable in 200 rpm increments
Acceleration	<2 seconds to maximum speed
Deceleration	<2 seconds to stop
Weight	49 kg (108 lb)
Power Requirement Over voltage Category II	110 VAC/60 Hz, 5.2 A 220 VAC/50 Hz, 2.6 A
Operating range	2-48 °C (35-100 °F) / 30-55% Humidity
Dimensions	44 cm wide x 66 cm deep x 70 cm high

Product Name	Cat. No.
FastPrep-96™ instrument	MP116010500

Super FastPrep-2™

Powerful and Portable Sample Lysis, Homogenization, and Grinding at Your Fingertips

FastPrep technology is now available in a lightweight, compact, hand-held format. An innovation in the sample lysis industry, the Super FastPrep-2™ is a portable, omni-directional bead beating system with a unique, patent-pending balanced crankshaft-slider mechanism.

When compared to traditional homogenization methods, such as vortexing, ultrasonication, rotor-stator homogenizers, grinding with a mortar and pestle, or chemical or enzymatic lysis, the Super FastPrep-2 will save hours of work. Lyse any tough or frozen sample in 5 seconds while still maintaining high yields of intact DNA, RNA and proteins.

A completely self-contained system, Super FastPrep-2 eliminates the risk of cross-contamination and time-consuming clean-up associated with manual lysis methods. Simply add sample and buffers to the Lysing Matrix tube containing specialized particles specific for your application. The ergonomic design ensures ease in loading sample tubes, which remain securely sealed during processing.

Lyse Your Samples in 5 Seconds

- **Omni-directional motion with the highest speed**
- **Handheld system for lab and field use**
- **Compatible with all FastPrep 2 mL Lysing Matrix tubes**

Specifications	
Disruption Principle	Bead Beating
Power Requirements	90-240 V for battery charger, cordless operation
Overall Length	13″
Overall Width	3.4″
Overall Height	4.6″
Weight	2.2 kg
Number of Tubes per Run	2
Size of Tube	2 mL tubes
Maximum Speed	4,400 cpm
Minimum Speed	500 cpm
Type of Motion	Reciprocating
Peak to Peak Amplitude of Motion	1.5″
Peak Acceleration	Up to 500 g
Sound at 1ft.	100 dB at 4,900 cpm 90 dB at 3,300 cpm
Typical Run Time	2-15 seconds at 3,300 cpm

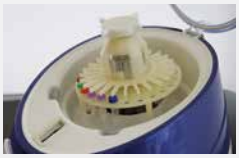
Product Name	Cat. No.
Super FastPrep-2 instrument	MP116012500

FastPrep Adapters

Adapters for FastPrep Systems are Flexible, Interchangeable, and Available for Ambient or Cryogenic Sample Types

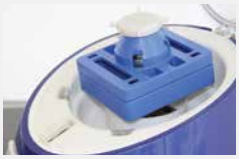
MP Bio offers the widest selection of adapters to best meet your needs in sample preparation. Our adapters allow for sample sizes ranging from 2 to 250 mL tube size and are built for durability in ambient and cryogenic conditions.

Ambient Temperature Adapters for FastPrep-24 and FastPrep-24 5G Instruments



QuickPrep™ Adapter
24 x 2 mL tubes
(included with FastPrep-24™ instrument)
Cat. No. ICN6002512

QuickPrep™ 3 Adapter
24 x 2 mL tubes
(included with FastPrep-24™ 5G instrument)
Cat. No. MP116005512



BigPrep™ Adapter
2 x 50 mL tubes

Cat. No. MP116002525

TeenPrep™ Adapter
12 x 15 mL tubes

Cat. No. ICN6002526

HiPrep™ Adapter
48 x 2 mL tubes

Cat. No. ICN6002527

TallPrep™ Adapter
24 x 4.5 mL tubes

Cat. No. MP116002540

Cryogenic Temperature Adapters for FastPrep-24 and FastPrep-24 5G Instruments

During mechanical lysis, the temperature within the tube can increase and can cause damage to the molecules in your sample.

- **Protects thermosensitive molecules** from heat degradation due to an innovative design encompassing a cooling chamber.
- **Prevents the increase of sample temperature** during the homogenization process by maintaining sample temperature at 4°C.
- **Ensures a highly effective grinding process of any sample,** even the most elastic, by making them brittle.

CoolPrep™ Adapter
24 x 2 mL tubes

Cat. No. ICN6002528

CoolTeenPrep™ Adapter
6 x 15 mL tubes

Cat. No. ICN6002530

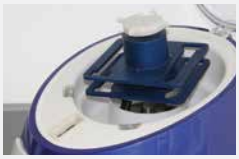
CoolBigPrep™ Adapter
2 x 50 mL tubes

Cat. No. MP116002531

FastPrep Adapters

Metal Adapters for FastPrep-24 and FastPrep-24 5G Instruments

All-Metal adapters are ideally suited for work with highly infectious, pathogenic, or other biologically hazardous samples. They withstand temperatures up to 450°C, allowing for sterilization by pyrolysis or autoclaving. Pathogens, including bacteria, viruses, fungi, parasites, viroids, and prions, can be effectively eliminated. All-Metal adapters are also safe to use with most laboratory detergents and sterilization solutions, ensuring easy care and maintenance.

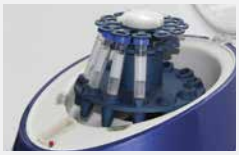


Metal BigPrep™ Adapter
2 x 50 mL tubes

Cat. No. 116002547

Metal QuickPrep™ Adapter
24 x 2 mL tubes

Cat. No. MP116002545



Metal TeenPrep™ Adapter
12 x 15 mL tubes

Cat. No. 116002546

FastPrep-96™ Adapters

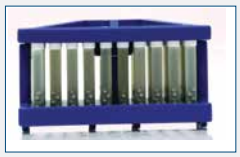
FastPrep-96™ offers the widest variety of adapters (2 x 96 deep well plates, 96 x 2 mL, 48 x 4.5 mL, 24 x 15 mL, 8 x 50 mL and 2 x 250 mL flasks) and a simple, accurate, closed loop control of lysing power and speed. All this and more make the FastPrep-96™ the perfect solution for all of your high volume sample preparation needs.

BigFlex™ Adapter
8 x 50 mL tubes

Cat. No. MP116010550

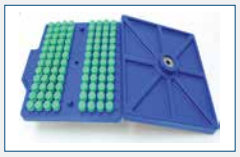
TeenFlex™ Adapter
20 x 15 mL tubes

Cat. No. MP116010560



TallFlex™ Adapter
48 x 4.5 mL tubes

Cat. No. MP116010580

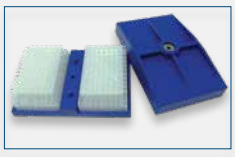


QuickFlex™ Adapter
96 x 2 mL tubes

Cat. No. MP116010570

LargeFlex™ Adapter
2 x 250 mL tube

Cat. No. MP116010590



Well Plate Adapter
2 x 96 deep well plates
(included with FastPrep-96™ instrument)
Cat. No. NC1490728

ConeFlex™ Legacy Adapter

The ConeFlex™ Legacy Adapter allows any existing FastPrep-24™ adapters to be used on the FastPrep-96™ instrument.

ConeFlex™ Adapter
Adapter

Cat. No. MP116010595

Lysing Matrix

FastPrep® Lysing Matrix makes difficult-to-lyse samples easy. No matter how tough or resistant your samples are, our bead beating tubes will effectively disrupt cell walls, providing the highest yields of nucleic acids and proteins in a matter of seconds. Lysing Matrix tubes from MP Bio are highly reproducible with no cross-contamination. All Lysing Matrix tubes are standard sizes and fit just about any homogenizer on the market. We offer a wide variety of lysing beads and matrices to fit all sample types and applications.

- **Optimal cell disruption for any sample**
- **Size and composition optimized according to sample type**
- **No cross contamination with closed Lysing Matrix tubes**
- **Available in 2 mL, 4.5 mL, 15 mL, 50 mL tubes or 96 well plates**
- **Fit any high-speed bead-beating homogenizers**
- **Validated worldwide with 3,000+ Lysing Matrix specific publications**

FastPrep® Lysing Matrix tubes range from low to high impaction, breaking down any sample type whether the cell walls are hard or soft. Sample types include, but are not limited to, human, animal, and plant tissues; microorganisms like bacteria, yeast and fungi; soil; feces; plus insects and worms.

Impact-resistant Lysing Matrix tubes with beads are available in 2 mL, 4.5 mL, 15 mL, 50 mL and 96-well format sizes and contain a wide variety of materials to meet your lysing, grinding, and homogenization needs. All matrix particles are produced to the highest quality standards to ensure optimum performance. The lysing matrix particles are then dispensed into the Lysing Matrix tubes under a rigorous set of proprietary conditions, allowing complete confidence for immediate use.

For optimal performance and results, we recommend using the Lysing Matrix tubes in conjunction with our FastPrep instruments to ensure easy grinding, lysing, and homogenization of any sample type in seconds.

Lysing Matrix	Matrix Composition	Lysing Matrix	Matrix Composition
A	Garnet matrix and 1/4 inch banded sstellites	I	2 mm yellow zirconium oxide beads and 4 mm black ceramic sphere
B	0.1 mm silica spheres	J	2 mm yellow zirconium oxide beads and 1.6 mm aluminum oxide particles
C	1 mm silica spheres	K	0.8 mm zirconium silicate beads
D	1.4 mm ceramic spheres	M	1/4 inch ceramic beads
E	1.4 mm ceramic spheres, 0.1 mm silica spheres, and 4 mm glass beads	S	1/8 inch stainless steel beads
F	1.6 mm aluminum oxide particles and 1.6 mm silicon carbide particles	SS	6.35 mm stainless steel grinding balls
G	1.6 mm silicon carbide particles and 2 mm glass beads	Y	0.5 mm diameter Yttria-stabilized zirconium oxide beads
H	2 mm glass beads and 2 mm yellow zirconium oxide beads	Z	2 mm diameter Yttria-stabilized zirconium oxide beads

Lysing Matrix

Size

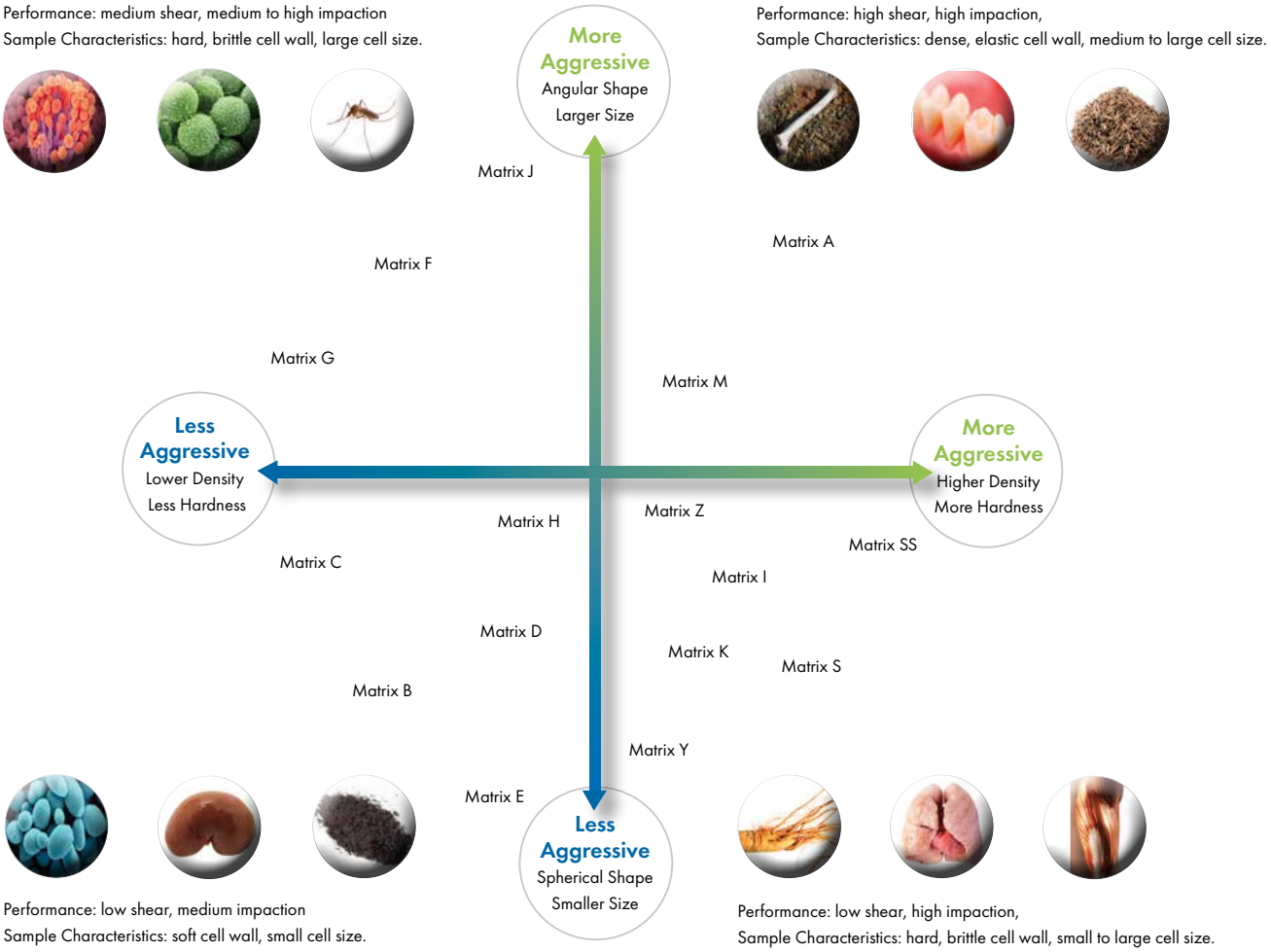
The smaller the particles used in the grinding media, the smaller the average particle size and the smaller the lowest-limiting particle size produced during pulverization. Matrix particle size should be selected based upon the size of the particles you wish to obtain in your lysate.

Shape

The shape of the grinding media is a major determining factor in how cells are disrupted. Dull media, such as spherical beads, utilize cascade impaction (hammering) as the main force for cell lysis. Sharp and angular shaped media will primarily generate mechanical shear forces (chopping and cutting) which can quickly open difficult cell walls, grind fibrous or elastic animal tissue, or crack spores or oocytes. Shear forces are preferable when isolating stable molecules such as DNA, stable proteins, structural polysaccharides and small molecules or metabolites. RNA and certain easily denatured proteins can be quickly degraded by shear forces, so care needs to be taken when using angular media. For isolation of these molecules, smooth impactor grinding media can be much more forgiving.

Hardness, Density, and Composition

The composition determines two very important qualities: hardness and density, both of which are inherent physical properties derived from the molecular composition of the matrix particle. The hardness must be greater than that of the sample being pulverized, with higher hardness values being more effective at disrupting hard and brittle cell membranes. Hardness and density values help optimize lysis efficiency while preserving the integrity of the analytes of interest.



Ready-to-Use Lysing Matrix

	Sample Type	Lysing Matrix															
	Animal & Human Tissues	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**M**	**S**	**SS**	**Y**	**Z**
Soft Tissues	Lung, Breast, Kidney, Heart, Intestine, Muscle, Spleen, Liver, Brain	•			•									•	•		•
	Skin	•			•												
	Nail													•			
Unique Samples	Tail, Ear	•												•			
	Vascular tissue	•			•												•
	Hair													•			
	Bone	•										•	•	•	•		
	Tumor	•												•			
	Mammalian cell	•			•												•
	Infected tissue (isolation of viruses or virus)												•				
	Microorganisms	A	B	C	D	E	F	G	H	I	J	K	M	S	SS	Y	Z
	Bacteria (gram + and -)	•	•				•				•						
	Yeast, Mold	•		•			•	•				•				•	
	Bacterial & Fungal spore	•	•				•	•		•	•	•			•		
	Algae	•		•				•								•	
	Virus	•	•														
	Environmental Samples	A	B	C	D	E	F	G	H	I	J	K	M	S	SS	Y	Z
	Soil, Marine sediment, Rhizosphere, Manure, Compost, Sludge, Feces, Wastewater					•		•	•	•							
	Plant Tissues	A	B	C	D	E	F	G	H	I	J	K	M	S	SS	Y	Z
	Leaf	•			•		•	•									•
	Seed	•					•	•	•	•			•	•	•		
	Root	•					•	•						•			
	Needle	•					•	•					•	•			
	Wood	•					•	•	•	•							
	Stem, Flower	•			•		•	•									•
	Insects & Worms	A	B	C	D	E	F	G	H	I	J	K	M	S	SS	Y	Z
	Tick, Fly	•			•				•	•							•
	Nematode	•		•	•												•
	Bee, Mosquito	•			•												•

Lysing Matrix Tubes

Description	Pack Size	Cat. No.
Lysing Matrix A	50 x 2 mL	MP116910050
	100 x 2 mL	MP116910100
	500 x 2 mL	MP116910500
Lysing Matrix A	25 x 4.5 mL	MP116970025
	50 x 4.5 mL	MP116970050
	100 x 4.5 mL	MP116970100
Lysing Matrix A	5 x 15 mL	MP116930005
	25 x 15 mL	MP116930025
	50 x 15 mL	MP116930050
Lysing Matrix A	10 x 50 mL	MP116950010
	50 x 50 mL	MP116950050
Lysing Matrix A	96-well Rack	MP116980001
	10 x 96-well Rack	MP116980010
Lysing Matrix B	50 x 2 mL	MP116911050
	100 x 2 mL	MP116911100
	500 x 2 mL	MP116911500
Lysing Matrix B	25 x 4.5 mL	MP116971025
	50 x 4.5 mL	MP116971050
	100 x 4.5 mL	MP116971100
Lysing Matrix B	5 x 15 mL	MP116931005
	25 x 15 mL	MP116931025
	50 x 15 mL	MP116931050
Lysing Matrix B	10 x 50 mL	MP116951010
	50 x 50 mL	MP116951050
	100 x 50 mL	MP116951100
Lysing Matrix B	96-well Rack	MP116981001
	10 x 96-well Rack	MP116981010
Lysing Matrix C	50 x 2 mL	MP116912050
	100 x 2 mL	MP116912100
	500 x 2 mL	MP116912500
Lysing Matrix C	25 x 4.5 mL	MP116972025
	50 x 4.5 mL	MP116972050
	100 x 4.5 mL	MP116972100
Lysing Matrix C	5 x 15 mL	MP116932005
	25 x 15 mL	MP116932025
	50 x 15 mL	MP116932050

Description	Pack Size	Cat. No.
Lysing Matrix C	10 x 50 mL	MP116952010
	50 x 50 mL	MP116952050
Lysing Matrix C	96-well Rack	MP116982001
	10 x 96-well Rack	MP116982010
Lysing Matrix D	50 x 2 mL	MP116913050
	100 x 2 mL	MP116913100
	500 x 2 mL	MP116913500
Lysing Matrix D	25 x 4.5 mL	MP116973025
	50 x 4.5 mL	MP116973050
	100 x 4.5 mL	MP116973100
Lysing Matrix D	5 x 15 mL	MP116933005
	25 x 15 mL	MP116933025
	50 x 15 mL	MP116933050
Lysing Matrix D	10 x 50 mL	MP116953010
	50 x 50 mL	MP116953050
	100 x 50 mL	MP116953100
	500 x 50 mL	MP116953500
Lysing Matrix D	96-well Rack	MP116983001
	10 x 96-well Rack	MP116983010
Lysing Matrix E	50 x 2 mL	MP116914050
	100 x 2 mL	MP116914100
	500 x 2 mL	MP116914500
Lysing Matrix E	25 x 4.5 mL	MP116974025
	50 x 4.5 mL	MP116974050
	100 x 4.5 mL	MP116974100
Lysing Matrix E	5 x 15 mL	MP116934005
	25 x 15 mL	MP116934025
	50 x 15 mL	MP116934050
Lysing Matrix E	10 x 50 mL	MP116954010
	50 x 50 mL	116954050
Lysing Matrix E	96-well Rack	MP116984001
	10 x 96-well Rack	MP116984010
Lysing Matrix F	50 x 2 mL	MP116915050
	100 x 2 mL	MP116915100
	500 x 2 mL	MP116915500
Lysing Matrix G	50 x 2 mL	MP116916050
	100 x 2 mL	MP116916100

Lysing Matrix Tubes

Description	Pack Size	Cat. No.
Lysing Matrix H	50 x 2 mL	MP116917050
	100 x 2 mL	MP116917100
Lysing Matrix I	50 x 2 mL	MP116918050
	100 x 2 mL	MP116918100
Lysing Matrix J	50 x 2 mL	MP116919050
	100 x 2 mL	MP116919100
Lysing Matrix K	50 x 2 mL	MP116920050
	100 x 2 mL	MP116920100
Lysing Matrix M	50 x 2 mL	MP116923050
	100 x 2 mL	MP116923100
	500 x 2 mL	MP116923500
Lysing Matrix M	25 x 15 mL	MP116939025
	50 x 15 mL	MP116939050
Lysing Matrix M	10 x 50 mL	MP116959010
	50 x 50 mL	MP116959050
Lysing Matrix S	50 x 2 mL	MP116925050
	100 x 2 mL	MP116925100
	500 x 2 mL	MP116925500
Lysing Matrix S	5 x 15 mL	MP116938005
	25 x 15 mL	MP116938025
	50 x 15 mL	MP116938050
Lysing Matrix SS	10 x 50 mL	116941010
	50 x 50 mL	MP116941050
	100 x 50 mL	MP116941100
Lysing Matrix Y	50 x 2 mL	MP116960050
	100 x 2 mL	MP116960100
	500 x 2 mL	MP116960500
Lysing Matrix Y	25 x 4.5 mL	MP116977025
	50 x 4.5 mL	MP116977050
	100 x 4.5 mL	MP116977100
Lysing Matrix Y	5 x 15 mL	MP116975005
	25 x 15 mL	MP116975025
	50 x 15 mL	MP116975050
Lysing Matrix Y	10 x 50 mL	MP116976010
	50 x 50 mL	MP116976050

Description	Pack Size	Cat. No.
Lysing Matrix Y	96-well Rack	MP116960001
	10 x 96-well Rack	MP116960010
Lysing Matrix Z	50 x 2 mL	MP116961050
	100 x 2 mL	MP116961100
	500 x 2 mL	MP116961500
Lysing Matrix Z	25 x 4.5 mL	MP116985025
	50 x 4.5 mL	MP116985050
	100 x 4.5 mL	MP116985100
Lysing Matrix Z	5 x 15 mL	MP116978005
	25 x 15 mL	MP116978025
	50 x 15 mL	MP116978050
Lysing Matrix Z	10 x 50 mL	MP116979010
	50 x 50 mL	MP116979050
Lysing Matrix Z	96-well Rack	MP116961001
	10 x 96-well Rack	MP116961010

Biopulverizer System I

Cat. No. MP116750200

The perfect starter pack for new FastPrep™ instrument owners.
Suitable for all sample types.
System I contains Lysing Matrix A, B, C, D, E.

Biopulverizer System II

Cat. No. 116850200

The perfect pack for processing difficult samples,such as skeletal muscle, pancreas, lung, heart, bone, seeds and spores.
System II contains Lysing Matrix F, G, H, I, J.

ORDER NOW!
fishersci.com/mpbiomedicals

Metal Lysing Matrix Tubes

Stainless Steel Lysing Matrix tubes are ideal for grinding, lysing, and homogenizing your most resistant samples! Constructed from 308 SS, these tubes and grinding matrix are tough enough to stand up to the most demanding mechanical punishment that can cause traditional thermoplastic tubes to crack. Our tubes are machined from premium grade billet and deliver superior strength over less expensive production methods such as deep-drawn aluminum tubes. An oblique angle conical bottom provides a better impact surface than the rounded bottoms of deep-drawn tubes.

The stainless steel threaded cap provides a leak-proof closure without the energy-robbing alternatives like plastic flange screw caps or rubber stoppers. A Teflon O-ring prevents leakage, and can be cleaned with detergent and/or autoclaving, or replaced entirely between samples. Machined knurls on the cap provide a firm grip for easy opening and closing.

Two different impactors are available, a single Stainless Steel Ball, ¼" diameter; or a Stainless Steel Cylinder, ¼" diameter x ½" length.

Applications

- **Dry grinding very tough or hard samples where heat generation can damage plastic tubes**
- **Cryogenic dry grinding where severe cold temps (dry ice or LN_2) can damage plastic tubes**
- **Milling or grinding non-biological samples where plastic contamination is of concern**
- **Sample processing with solvents or chemicals that are incompatible with plastics**

Research Areas and Sample Types

- **Environmental and Agriculture**
  Tough seeds such as dried corn, soybeans, wheat, tomato, and chile; wood, bark, roots; animal claws and hooves
- **Forensics**
  Bone, teeth, hair, fingernails, and non-biological substrates
- **Cancer and Disease**
  Tough tissues, bone, cartilage, and skin
- **Industrial**
  Non-biological, rocks and minerals, plastics and composites, printed circuit boards, wood and building materials

Description	Pack Size	Cat. No.
Metal Lysing tube, 2 mL, w/ Grinding Ball	2 Each	MP116991002
	3 Each	MP116991003
	6 Each	MP116991006
Metal Lysing tube, 2 mL, w/ Grinding Cylinder	2 Each	MP116992002
	3 Each	MP116992003
	6 Each	MP116992006

Protoplast Isolation from Yeast and Plant Cells

Biodegrading yeast cell walls is necessary for protoplasts preparation and transformation. Selecting the optimal lysing enzyme is always challenging as it needs to have maximum efficiency without hindering the regeneration of the protoplasts after transformation. Zymolyase is a combination enzyme product with a proprietary mixture of four unique lytic enzymes to easily break down various yeast cell wall components, enabling maximal yield of viable protoplasts.

With almost 3 decades of expertise in the industry and over 2,000 citations, Zymolyase from MP Bio is a time proven and quality driven product that offers:

- Highest efficiency to form almost 100% protoplasts
- Shortest time for yeast cell wall biodegradation
- Lot to lot consistency and high reproducibility
- Widely cited and highly recognized in almost 2,400 publications

Description	Size	Cat. No.
Zymolyase 100 T	250 mg	ICN320932
	500 mg	MP08320931
Zymolyase 20 T	1 g	MP08320921

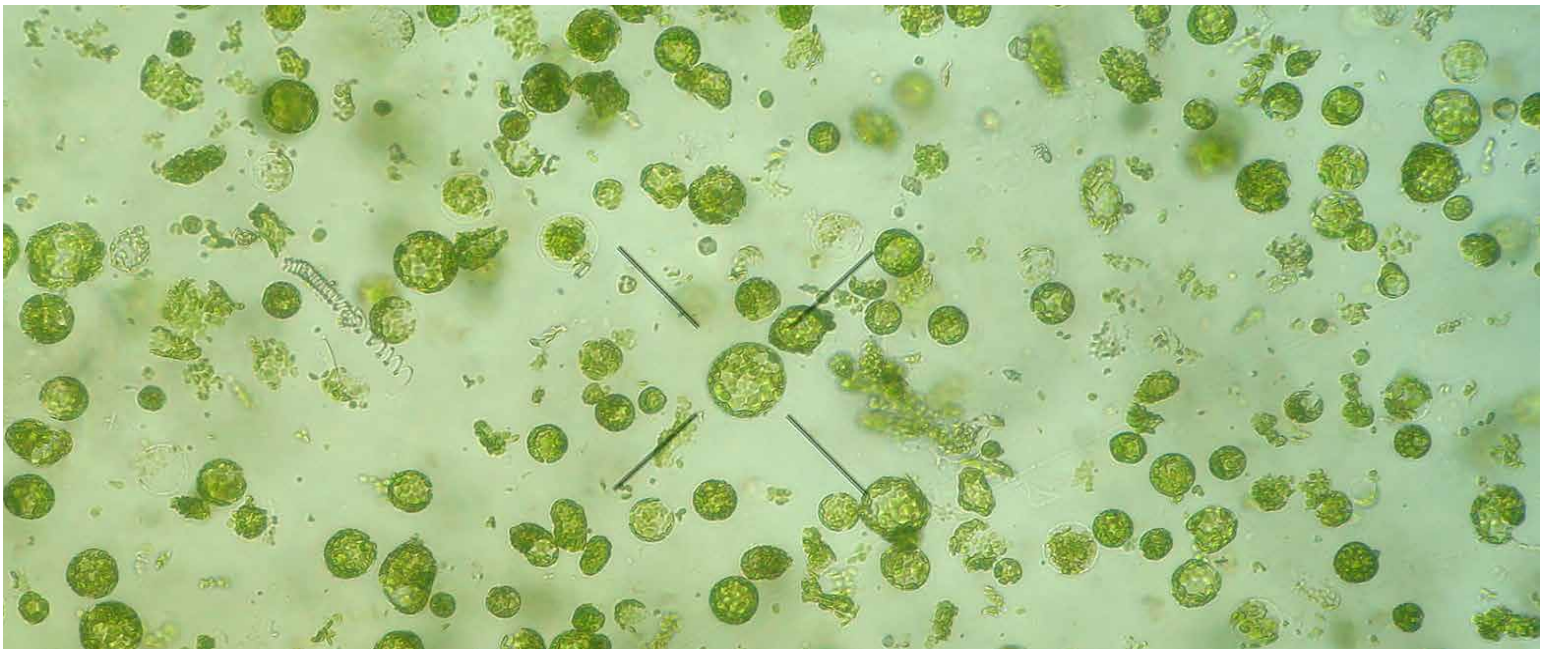
Enzymes for Plant Cell Lysis and Protoplast Formation

Plant protoplasts are plant cells which have had their cell wall removed, usually by digestion with enzymes like pectinases and cellulases. Protoplasts can be isolated from various plant tissues, such as leaves, flowers, stems, roots, and anthers. Due to the various sample sources and structure differences, it is challenging to effectively prepare plant protoplasts with high efficiency and satisfying quality for subsequent applications such as DNA transformation, plant breeding, and other uses. MP Bio has long provided high quality pectinases to support plant protoplasts. These products offer:

- High efficiency to remove cell walls
- High yield of viable protoplasts
- Robust enzymatic activities
- Optimized enzymatic components

Description	Size	Cat. No.
Pectolyase Y-23	1 g	ICN320951
Pectolyase Y-23	10 g	ICN320952

During maceration, the breakdown of pectins leads to a loss of cohesion and cell separation. Both endo-polygalacturonase or endo-pectate lyases have been reported to macerate specific tissues. Pectolyase Y-23 is a specific preparation from *Aspergillus japonicas*, containing both endo-polygalacturonases and endo-pectin lyases in high activity in addition to a maceration stimulating factor. It has found wide use and acceptance in the scientific literature. MP Bio supplies purified pectolyase Y-23 with activity greater than 1000 U/g.



Automated Nucleic Acid Purification Platform

Save time, increase reproducibility, and be cost effective. The MPure-12™ is a bench-top automated system for rapid purification of nucleic acids from a wide variety of biospecimens, including tissues, cultured cells, blood, and FFPE samples. Combined with a uniquely designed magnetic bead processing chamber, the fully integrated and easy-to-use pre-packaged reagent kits offer superior yields of nucleic acids and high-quality results at an affordable price.

- Fully automated and integrated platform that offers cost and time savings
- Reproducibility, lot-to-lot consistency, scalability, ease-of-use and convenience
- Highest quality and yield of DNA & RNA for downstream applications
- No cross-contamination of samples due to the unique platform design

MPure-12 system – 117002200

- Fully automated platform for isolation of up to 12 nucleic acid samples

MPure Blood DNA Extraction Kit – MP117022100/117022200

- Purification of genomic DNA from mammalian whole blood, peripheral blood mononuclear cells, buffy coat

MPure Tissue DNA Extraction Kit – 117022400

- Purification of genomic DNA from a variety of animal tissues, swabs and blood stains

MPure Cultured Cell DNA Extraction Kit – 117022500

- Purification of genomic DNA from cultured cells

MPure FFPE DNA Extraction Kit – 117022900

- Purification of genomic DNA from formalin fixed, paraffin-embedded tissue (FFPE) samples

MPure Total RNA Extraction Kit – 117022160

- Purification of total RNA from a variety of sample types

DNA Isolation and Purification Kits

High performance FastDNA purification kits provide ready-to-use methods for the isolation and subsequent purification of intact DNA from any source. Eluted DNA is ready for digestion, electrophoresis, PCR, and other desired applications.

FastDNA™ Kit – 116540400 and FastDNA™ SPIN Kit – MP116540600

- **Isolate genomic DNA from plant, animal, bacteria, yeast, algae, and fungi cells**
- **Process up to 200 mg of tissue or cells with the FastPrep instrument**
- **Lysing Matrix A tubes, all necessary buffers, and silica-based spin filters are included in the FastDNA SPIN Kit.**

The FastDNA SPIN Kit quickly and efficiently isolates genomic DNA from almost any sample (plant and animal tissues, cultured cells, bacteria, yeast, fungi, insects, etc). Up to 200 mg of tissue or cells are processed by the FastPrep-24 with Lysing Matrix A tubes. The kit includes 3 different lysis buffers for the homogenization of a wide variety of sample types and the released DNA is purified by a silica-based spin filter method. Purified DNA is ready for enzyme digestion, electrophoresis, PCR and any other desired application.

References:

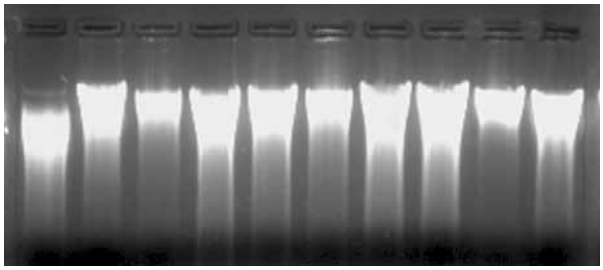
1. Hill J.E. et al (2005). Appl. Environ. Microbiol. Vol 71 : 867-875
2. Moon H. et al (2004). J. Exp. Bot. Vol 55 : 1519-1528
3. Dionisi H.M. et al (2004). Appl. Envir. Microbiol. Vol 70 : 3988-3995

Metagenomic studies involve isolation of nucleic acids from the entire biome of a given sample. Environmental or gut samples can present significant challenges in terms of sample preparation and subsequent isolation and purification. Typical soil, sludge, and fecal samples exhibit variables that can make processing procedures difficult to standardize. These variables include: complex matrices with varying mechanical and rheological properties; diverse biological materials including microorganisms, plant and animal tissue, and other cells; and innate PCR inhibitors and degrading enzymes. The FastPrep system of sample prep instruments and isolation kits simplifies these procedures through automated, quantitative mechanical lysis of even tough gram + bacterial spores and parasitic oocytes. The unique buffer chemistry flocculates and removes inhibitors and is followed by a simple, high capacity solid-phase silica "bind-wash-elute" protocol.

FastDNA™ SPIN Kit for Soil – MP116560200

- **Isolate bacterial, fungal, plant, and animal genomic DNA from soil and environmental samples**
- **Lyse difficult cells such as eubacterial spores, endospores, gram (+/-) bacteria, and yeast**
- **Process up to 500 mg of soil with FastPrep instrument**
- **Lysing Matrix E tubes, buffers, and silica-based spin filters included**

The FastDNA™ SPIN Kit for Soil is designed to efficiently isolate bacterial, fungal, plant, and animal genomic DNA from soil and environmental samples. Up to 500 mg soil are processed by a FastPrep instrument with the Lysing Matrix E tubes, which are designed to efficiently lyse all microorganisms, including difficult sources such as eubacterial spores and endospores, gram positive bacteria, and yeast. The released DNA is purified by a silica-based spin filter method and is suitable for PCR analysis and other downstream applications.



DNA from various soil samples extracted with the FastDNA SPIN Kit for Soil. 20% of the DNA isolated from 500 mg soil was loaded on a 1.2% agarose gel (0.5X TAE). Soil was taken from:
Lane 1: tomato pot; Lane 2 : sludge
Lane 3 : sandy soil; Lane 4 : under pine tree
Lane 5 : under palm tree; Lane 6 : green garden
Lane 7 : Nile Lilly pot; Lane 8 : lawn grass
Lane 9 : citrus tree; Lane 10 : avocado tree.
DNA ranges from 4-20 kb.

References:

1. Selesi D. et al (2005). Appl. Envir. Microbiol. Vol 71 : 175-184
2. Alexandrino M. et al (2004). Water Research. Vol 38 : 1340 - 1346
3. Mumy K.L. et al (2004). J. of Microbiological Methods. Vol 57 : 259 – 268

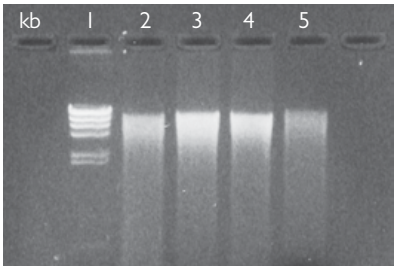
FastDNA™ 50 mL SPIN Kit for Soil – MP116560600

- Isolate bacterial, fungal, plant, and animal genomic DNA from soil and environmental samples
- Lyse difficult cells such as eubacterial spores, endospores, gram (+/-) bacteria, and yeast
- Process up to 5 g of soil with FastPrep instrument
- Lysing Matrix E tubes, buffers, and silica-based spin filters included

FastDNA™ SPIN Kit for Feces – MP116570200

- Isolate genomic DNA from fecal samples
- Process up to 500 mg of feces with FastPrep instument
- Lysing Matrix E tubes, buffers, and silica-based spin filters included

The FastDNA™ SPIN Kit for Feces is the newest addition to the evolving FastDNA™ kit family. Prompted by you, our customer, MP Bio has developed a FastDNA™ SPIN Kit designed exclusively for the isolation of genomic DNA from fecal material. With the FastDNA™ SPIN Kit for Feces, you will have everything you need to quickly and efficiently lyse any fecal sample, isolating high quality DNA for immediate use in downstream applications. Used in conjunction with our FastPrep-24 homogenization system, you will be able to completely lyse fecal samples in seconds with no pre-grinding or preparation.



DNA from fecal samples with the FastDNA™ SPIN Kit for Feces. DNA was loaded on a 1.2% agarose gel (0.5X TAE).
Lane 1: Lamda HindIII Marker
Lane 2: Bovine stool 200 ng DNA
Lane 3: Equine stool 200 ng DNA
Lane 4: Feline stool 200 ng DNA
Lane 5: Avian stool 200 ng DNA

FastDNA™ SPIN Kit for Plant and Animal Tissue – MP116540800

- Isolate genomic DNA from plant and animal tissues
- Lysing Matrix D, buffers, and silica-based spin filters included

DNA Isolation and Purification Kit Selection Guide

	Standard Throughput				
Kit	**FastDNA**	**FastDNA SPIN**	**FastDNA SPIN for Soil**	**FastDNA SPIN for Feces**	**FastDNA SPIN for Plant and Animal Tissue**
Cat. No.	116540400	MP116540600	116560200	MP116560200	MP116540800
Lysing Matrix Tube	A	A	E	E	D
Samples					
Plants	•	•			•
Animals	•	•			•
Cultured Cells	•	•			
Bacteria	•	•			
Yeast	•	•			
Algae	•	•			
Fungi	•	•			
Insects	•	•			
Soil/Environmental			•		
Feces				•	

FastDNA™-96 Kits

High-throughput FastDNA™-96 purification kits provide ready-to-use methods for the isolation and subsequent purification of intact genomic DNA from virtually any source. Samples can be lysed in approximately 60 seconds using the FastPrep-96 instrument. Eluted DNA is ready for digestion, electrophoresis, PCR, and any other desired application.

FastDNA™-96 Soil and Microbe DNA Kit – MP119696200

- Isolate genomic DNA from gram (+/-) bacteria, fungi, plant and animal tissue, algae, spores, and other soil components in approximately 50 minutes

FastDNA™-96 Fungal/Bacterial DNA Kit – MP119696300

- Isolate genomic DNA from tough-to-lyse gram (+/-) bacteria, fungi, spores, nematodes, pollen, and mammalian cells in approximately 40 minutes

FastDNA™-96 Fecal DNA Kit – MP119696400

- Isolate genomic DNA from microbes, fungi, parasites, and other fecal organisms in approximately 50 minutes

FastDNA™-96 Tissue and Insect DNA Kit – MP119696500

- Isolate genomic, viral, and mitochondrial DNA from animal tissues, cultured mammalian cells, whole blood, insects, and arthropods in approximately 40 minutes

FastDNA™-96 Plant and Seed DNA Kit – MP119696600

- Isolate genomic DNA from stems, roots, leaves, buds, flowers, fruits, seeds and other plant samples in approximately 50 minutes

DNA Isolation and Purification Kit Selection Guide

	High Throughput				
Kit	**FastDNA-96 Soil and Microbe DNA**	**FastDNA-96 Fungal/Bacterial DNA**	**FastDNA-96 Fecal DNA**	**FastDNA-96 Tissue and Insect DNA**	**FastDNA-96 Plant and Seed DNA**
Cat. No.	MP119696200	MP119696300	MP119696400	MP119696500	MP119696600
Lysing Matrix Tube	Y	Y	Y	Z	Z
Samples					
Plants					•
Animals				•	
Cultured Cells				•	
Bacteria		•			
Yeast		•			
Algae	•				
Fungi		•			
Insects				•	
Soil/Environmental	•				
Feces			•		

FastRNA™ SPIN Kits quickly and efficiently isolate high-quality, total RNA from bacterial cell culture, yeast strains, fungi, and algae in approximately 15 minutes using a specialized Lysing Matrix for cell lysis and SPIN columns for the purification process.

FastRNA™ SPIN Kit for Microbes – MP116020050

- Isolate large and small RNA species from tough-to-lyse bacterial cell cultures

FastRNA™ SPIN Kit for Yeast – MP116030050

- Isolate large and small RNA species from tough-to-lyse yeast strains, fungi and algae

FastRNA™ Pro Kits

The FastRNA™ Pro Soil-Direct and Indirect kits are designed to efficiently isolate total RNA from organic material found in soil samples or soil supernatants. FastRNA™ Pro Soil kits purify RNA in a process that removes humic substances and other inhibitors, and efficiently inactivates cellular RNases during homogenization to prevent RNA degradation. The purified RNA is suitable for RT-PCR analysis and many other downstream applications.

FastRNA™ Pro Soil-Direct Kit – MP116070050

- Extract nucleic acids from microorganisms, and other biological samples, directly from soil

FastRNA™ Pro Soil-Indirect Kit – MP116075050

- Prior to extraction of nucleic acids, separate microorganisms and other biological samples from the soil
- Permit soil incubation with growth media to amplify under-represented living organisms

The FastRNA™ Pro Kits are designed to quickly and efficiently isolate total RNA from virtually any sample. During the homogenization step, intact total RNA is released in the proprietary RNAPro™ solution where it is immediately stabilized. The RNAPro™ solution inactivates cellular RNases during cell lysis to prevent RNA degradation. RNA is then extracted with chloroform and precipitated with ethanol. DEPC-treated water is provided for re-suspension of total RNA. High quality RNA prepared with FastRNA™ Pro Kits is ready for all downstream applications including RT-PCR, gene expression, and microarray analysis.

FastRNA™ Pro Blue Kit – MP116025050

- Isolate total RNA from gram (+/-) bacteria

FastRNA™ Pro Red Kit – MP116035050

- Isolate total RNA from yeast and fungi

FastRNA™ Pro Green Kit – MP116045050

- Isolate total RNA from plant, animal, and cultured cells

RNA Isolation and Purification Kit Selection Guide

	RNA-Stabilizing				
Kit	**FastRNA Pro Soil-Direct**	**FastRNA Pro Soil-Indirect**	**FastRNA Pro Blue**	**FastRNA Pro Red**	**FastRNA Pro Green**
Cat. No.	MP116070050	MP116075050	MP116025050	MP116035050	MP116045050
Lysing Matrix Tube	E	E	B	C	D
Samples					
Plants					•
Animals					•
Cultured Cells					•
Bacteria			•		
Yeast				•	
Fungi				•	
Soil/Environmental	•	•			

DNA Purification from PCR Reactions and Agarose Gels

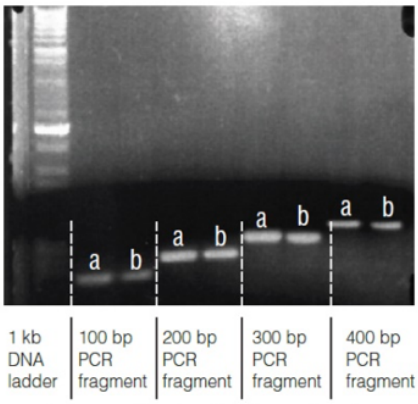
GENECLEAN kits are a proven technology for DNA purification from PCR reactions and agarose gels. Patented GENECLEAN technology simplifies the process of purifying DNA into three easy steps: BIND, WASH and ELUTE. Ethanol precipitation is never required.

GENECLEAN Turbo Kits

GENECLEAN Turbo Kits use a GENECLEAN Turbo Cartridge system designed to simplify the purification process. This system contains a special silica embedded membrane and buffer system optimized for the purification of DNA.

Benefit from the many advantages offered by these kits:

- **High column capacity –** binds up to 10 µg of DNA
- **High yields –** DNA recovery is up to 95%
- **Fast –** 12 samples are processed in 15 minutes
- **Effective –** purified DNA performs well in downstream applications
- **Complete –** kits contain all required columns and solutions



a. before purification b. after purification

Purification of PCR fragments from solution with the GENECLEAN Turbo Kit

GENECLEAN Turbo for PCR Kit – For purification of PCR products ranging from 100 bp to 10 kb

Description	Size	Cat. No.
GENECLEAN Turbo for PCR Kit	50 preps	MP111103200
	100 preps	MP111103400
	300 preps	MP111103600

GENECLEAN Turbo Kit – For purification of DNA fragments from 100 bp to 300 kb from TAE or TBE buffered agarose gels or solutions

Description	Size	Cat. No.
GENECLEAN Turbo Kit	50 preps	MP111102200
	100 preps	MP111102400
	300 preps	111102600

GENECLEAN SPIN Kit

For purification of DNA fragments from 200 bp to 300 kb from TAE or TBE buffered gels or solutions. The GENECLEAN SPIN Kit includes a bulk slurry form of the patented silica matrix that allows for customization and flexibility with respect to the scale of purification required and spin filters whose usage prevents silica particle carry-over into cleaned DNA.

Description	Size	Cat. No.
GENECLEAN SPIN Kit	50 preps	111101200
	100 preps	111101400
	300 preps	111101600

Protein Isolation and Purification Kits

The FastPROTEIN products employ a powerful, patented technology for the rapid lysis of yeast and bacteria. Used in conjunction with any FastPrep instrument, these products offer the fastest way to release expressed proteins from the host organism. FastPROTEIN Kits are perfect for analyzing protein expression conditions using gel analysis. Samples are enclosed during the quick lysis step, thus preventing cross-contamination or sample loss. Total proteins isolated with the FastPROTEIN matrices are native and can be used for a variety of applications including SDS-PAGE, western blotting, immunoprecipitation, gel mobility shift assays, and enzyme activity analysis.

FastPROTEIN™ Blue Matrix – MP116550400

- Isolate and purify proteins from gram (+/-) bacteria

FastPROTEIN™ Red Matrix – MP116550600

- Isolate and purify proteins from yeast cells

7X Cleaning Solutions

The laboratory detergent researchers have trusted for over 50 years!

- Effective, water-soluble and eco-friendly cleaning solutions with no etch to glass or plastic labware at any concentration
- ES 7X is a completely eco-friendly solution
- Nontoxic for tissue and cell cultures
- Eliminate interfering fluorescence residues for flow cytometry
- No need for pH adjustment at any concentration
- Easy and safe to use, no gloves needed, gentle on skin
- Easy to store – 1 gallon of 7X concentrate can make up to 100 gallons of cleaning solution

Description	Size	Cat. No.
7X Laboratory Detergent	1 gal	ICN7667093
7X Laboratory Detergent	4 x 1 gal	ICN7667094
7X-O-Matic Solution, Machine Wash	4 x 1 gal	ICN7667494
7X-PF Cleaning Solution, Environment-Safe	4 x 1 gal	ICN7667194
7X-PF Cleaning Solution, Environment-Safe	1 gal	ICN7667193

FastPrep-24 5G System: an ultra-high performance sample preparation method for the reliable detection of pathogens in food and feed samples.

Comparison Study

FastPrep-24 5G™

Efficient preparation of food and feed samples, comprising sampling and homogenization for microbiological testing, food authentication and GMO testing, are essential components of food control. Procedures involving vortexing or manual grinding have often proved inadequate.

Several forms of mechanical homogenization methods available in the market have been evaluated. The outcome of these studies revealed that efficiency, ease of handlings, and high throughput capabilities makes the FastPrep-24 5G system the first choice for successful food safety tests.

The FastPrep-24 5G system is indeed the newest innovation in bead beaters and produces the fastest lysis of even the most difficult samples. It uses a unique, optimized motion to disrupt cells through the multidirectional, simultaneous beating of specialized Lysing Matrix beads on the sample material. The FastPrep-24 5G is the only available homogenizer with 11 interchangeable adapters designed for high-throughput applications, large volume samples, and cryogenic lysis.

A wide variety of specialized Lysing Matrix tubes containing beads of different material, size and shape have been tailored to guarantee a thorough homogenization of any sample.

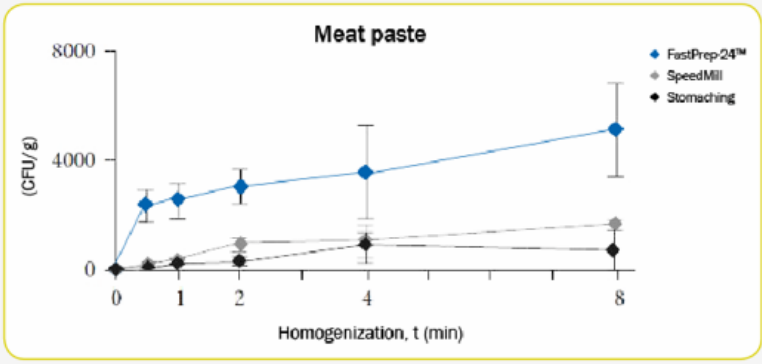
Rodhe A. *et al.*[1] carried out a systematic comparison of different homogenization approaches, namely, stomaching, sonication, and milling by FastPrep-24 or SpeedMill for pathogen isolation and conventional detection by cultivation for processed and unprocessed meat products.

Results

The FastPrep-24 homogenization method gives the best results with high reproducibility for detection of surface food contamination.

For inner-matrix contamination, long treatments are required and only FastPrep-24, as a large-volume homogenizer, produced consistently good recovery rates, extracting seven times more pathogen after 8 minutes homogenization compared to stomaching (figure 1).

The FastPrep-24 has also been shown to be a valuable homogenization tool in other applications like the authentication of fish in commercial canned products[2] and the identification of a large number of microorganisms involved in the production of wine[3].



Homogenization of inner-matrix contamination. *Release of Salmonella from whole cross sections of internally contaminated meat paste after pretreatment by FastPrep-24™, stomaching, and SpeedMill for 0, 30 s and 1, 2, 4, and 8 mins was monitored.*

1. Rodhe A. et al., BioMed Research International - Vol 2015 (2015), Article ID 145437, 8 pages
2. Infante C. et al., Food Research International - Vol 39 (2006), 1023–1028
3. Marzano M. et al., PLoS ONE - Vol 11(6) (2016), doi:10.1371/journal.pone.0157383

An effective solution to grind lung tissue without cross contamination

User Testimonial

FastPrep-96™

Bioanalysis facilities supporting drug development can encounter many challenges associated with the analysis of biological materials.

Lung tissue from toxicological studies, for example, can present challenges with small sample volumes, particularly for rat and mouse, if only a portion of the tissue is made available for analysis. Lung tissue is also an extremely elastic matrix, which can be difficult to homogenize effectively. In addition, there is a significant risk for cross contamination between samples when using mechanical homogenizers, which is a very time-consuming process.

To avoid cross contamination and produce homogeneous samples, Neil Adcock* and his laboratory found that using the FastPrep-96™ (MP Biomedicals, CA, USA) was an effective solution. With the FastPrep-96, Adcock's samples could each be homogenized in a separate sample preparation, thus avoiding cross-contamination, and in a fraction of the time required for mechanical homogenizers.

> "...In order to avoid cross-contamination and produce homogeneous samples we have found in our laboratories an effective solution in the FastPrep-96™ (MP Biomedicals, CA, USA) where each sample is homogenized in a separate sample preparation tube in a fraction of the time required for mechanical homogenizers."
>
> – *Neil Adcock*

*Bioanalysis for the development of respiratory drugs: what are the challenges?
Bioanalysis (2014) 6(9), 1143–1145; www.future-science.com

FDA Validated Molecular Method to Detect *C. cayetanensis* in Food Samples

Vegetables

CASE STUDY

Almeria S. ; da Silva A.J. ; Blessington T. ; Cloyd T.C. ; Cinar H.N., Durigan M. ; Murphy H.R.

Evaluation of the U.S. Food and Drug Administration validated method for detection of *Cyclospora cayetanensis* in high-risk fresh produce matrices and a method modification for a prepared dish

Food Microbiology (2018) Vol 76 : 497–503

Overview

- **Keyword:** *Cyclospora cayetanensis*, Fresh produce, Prepared dish, qPCR
- **Aim of the study:** Evaluate the performance of the FDA method for detection of *C. Cayetanensis* in fresh produce items
- **Application:** qPCR
- **Sample name:** Carrots, basil, parsley, cabbage & carrot mix
- **Sample type:** Fresh and prepared produce
- **Material:** FastDNA™ SPIN Kit for Soil, FastPrep-24™ instrument
- **Buffer:** Sodium Phosphate Buffer and MT Buffer (from the FastDNA™ Spin Kit for Soil)

Protocol and Parameters

1. Add up to 850 µL of pooled pellet collected after the washing procedure of infected food samples to a Lysing Matrix tube containing the mix of beads of Lysing Matrix E (1.4 mm ceramic beads, 0.1 mm silica beads and one 4 mm glass bead)
2. Add 122 µL MT buffer
3. Add 978 µL Sodium Phosphate Buffer. Screw on cap securely.
4. Transfer the samples to the FastPrep-24™ bead beater and homogenize at a setting of 6.5 m/s (approximately 4000 rpm) for 60 seconds. Immediately remove the sample holder containing the tubes from the instrument and place on ice for 3 minutes. Return the sample holder to the bead beater and repeat the bead beating and the incubation on ice as above.
5. Remove the tubes from the sample holder and centrifuge at 14,000 × g for 15 minutes.
6. Transfer the supernatant to a clean 2 mL tube. Add 250 µL PPS and mix by inverting by hand 10 times.
7. Centrifuge at 14,000 × g for 5 minutes then transfer supernatant to a clean 15 mL Falcon tube containing 1.0 mL of resuspended Binding Matrix.
8. Place on a rotator or invert by hand for 2 minutes and then allow silica matrix to settle for 3 minutes. Centrifuge the 15 mL tubes briefly at 1000 × g for 1 minute in a swinging bucket rotor.
9. Remove and discard a total of 1.4 mL of supernatant from each tube in two 700 µL aliquots.
10. Resuspend the matrix in the remaining supernatant and transfer approximately 700 µL to a SPIN Filter in a catch tube. Centrifuge at 14,000 × g for 1 minute. Empty the catch tube and add any remaining resuspended mixture to the SPIN Filter and spin as before. Empty the catch tube again.
11. Add 500 µL prepared SEWS-M to each filter. Gently resuspend each by pipetting up and down.

Continued on next page

CASE STUDY

Protocol and Parameters - *cont.*

12. Centrifuge at 14,000 × g for 1 minute. Empty catch tube and replace.
13. Centrifuge at 14,000 × g for 2 minutes to dry the matrix. Discard the catch tube and replace with a new catch tube.
14. Air dry the filter for 5 minutes at room temperature.
15. Add 75 µL DES to the matrix in the spin filter. Resuspend the Binding Matrix by gently stirring with a small pipet tip. Incubate for 5 minutes in a heat block at 55°C.
16. Centrifuge at 14,000 × g for 1 minute to recover the eluted DNA and then discard the SPIN Filter.
17. Store the DNA samples at 4°C for up to 2 days or at -20- or -80 °C for longer term prior to performing the Real-Time PCR detection step.

Conclusion

The FastPrep-24™ homogenizer used in combination with the FastDNA™ SPIN Kit for Soil is shown to be an effective method for the lysis of *C. cayetanensis* oocysts from infected food matrices and isolation of their DNA. The extracted DNA was used successfully in real-time PCR assays that were able to detect as few as 5 oocysts in 25 g of food samples.

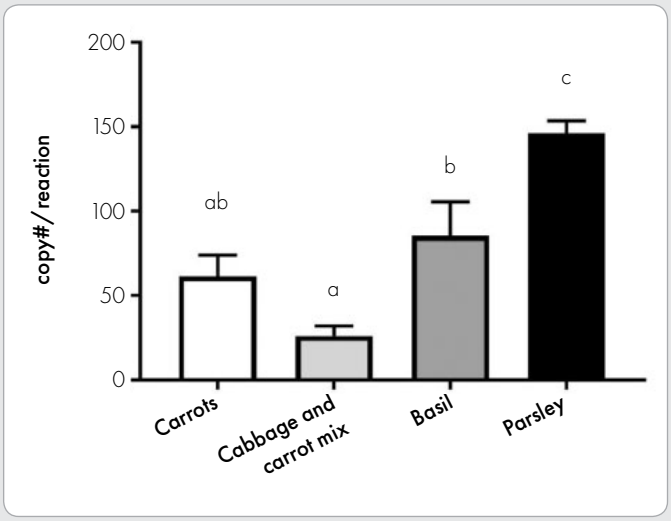


Figure 1.

Comparison of mean copy number of the 18S rRNA gene determined per qPCR reaction (2 µL of DNA/reaction) in carrots, cabbage and carrots mix, parsley, and basil after seeding samples with 200 *Cyclospora cayetanensis* oocysts. Arbitrary letters a, b and c, were indicated over columns. Different letters over the columns indicate statistically significant differences among matrices ($P < 0.05$). Significant differences were observed between cabbage and carrots mix samples compared to both basil and parsley samples, and in parsley compared to all other matrices. No significant differences were observed between carrots and cabbage and carrots mix or between carrots and basil. The standard error is represented by error bars.

Optimized Methodology for Sequential Extraction of RNA and Protein from Small Human Biopsies

Skin Tissue

CASE STUDY

Berglund S.R. ; Schwietert C.W. ; Jones A.A. ; Stern R.L. ; Lehmann J. ; Goldberg Z.

Optimized Methodology for Sequential Extraction of RNA and Protein from Small Human Skin Biopsies.

Journal of Investigative Dermatology (2007) Vol 127 : 349–353

Introduction

Skin tissue, although easily accessible, is difficult to process owing to its natural resistance to mechanical shearing and high levels of RNase and proteases. Currently, these complications result in degraded RNA samples with variable yield. We have developed a method for sequential extraction of high quality RNA and protein from a single 3 mm full thickness skin punch biopsy.

Two extraction techniques were used to disrupt the biopsy samples, homogenization, and bead beating

Overview

- **Keyword:** Tissue biopsy, clinical samples, RNA extraction, protein extraction
- **Aim of the study:** Optimization of RNA and protein extraction from skin tissue
- **Application:** Western blot & RNA quality analysis
- **Sample name:** Tissue biopsy
- **Sample type:** Human skin biopsies from a 3 mm punch
- **Material:** FastPrep® instrument, Lysing Matrix D tubes
- **Buffer:** Guanidine Thiocyanate lysis buffer

Protocol and Parameters

1. Add the 19 mg of skin sample to a Lysing Matrix D tube.
2. Add 1 mL of a guanidine thiocyanate lysis buffer (5.1 M guanidine thiocyanate, 50 mM sodium citrate, 50 mM EDTA, 0.5% β-mercaptoethanol).
3. Homogenize in the FastPrep instrument for 3 x 40 s at a speed setting of 6.0 m/s. Place the tubes on ice for 5 minutes between each run.
4. Centrifuge at 14,000 x g for 5-10 minutes to pellet debris.
5. Proceed with the RNA and protein extraction protocol.

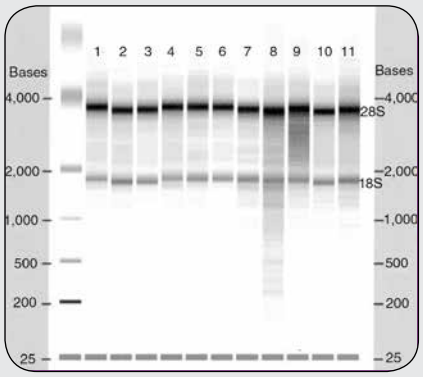
CASE STUDY

Results

High Quality RNA Isolation with FastPrep instrument
RNA 2100 Bioanalyzer analysis of FastPrep samples

The RNA was run on an Agilent 2100 Bioanalyzer (Agilent, Palo Alto, CA) using the RNA 6000 Pico LabChip kit to determine the quality of the samples. The 28S and 18S ribosomal bands show a greater than 2:1 ratio and the calculated RNA ribosomal integrity numbers of the samples ranged from 8.4 to 8.9, verifying a high quality RNA.

Gel image for 11 RNA samples.



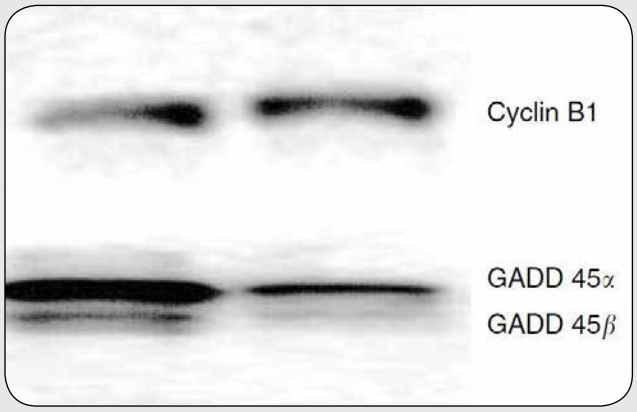
Higher RNA & protein yield obtained with FastPrep instrument
RNA and protein quantification

For each method of tissue disruption, the quantity and quality of RNA (as an OD 260/280 ratio), and the quality of protein is shown. The RNA was quantified using a Nanodrop spectrometer and the protein content was determined using a Bradford-based assay. For RNA, an OD 260/280 of 2.0 is optimal.

	RNA average quantity per biopsy (µg)	RNA average 260/280 ratio	Protein average quantity per biopsy (µg)
FastPrep® bead-beater	1.4 (± 0.4 µg)	2.0 (± 0.05)	170 (± 50 µg)
Polytron Homogenizer	0.8 (± 0.4 µg)	1.8 (± 0.11)	90 (± 40 µg)

Quality assessment of extracted protein
Western blots using biopsy sample protein

Approximately 10-15 mg of protein from two different biopsy samples processed with the FastPrep instrument (Qbiogene, Irvine, CA) were used to determine the quality of western blotting. The top panel was probed with mouse anti-GADD 45. The GADD 45 used (Santa Cruz Biotechnology Inc., Santa Cruz, CA) recognizes both the alpha and beta subunits of the protein.



Conclusion

Sample variability and exposure to exogenous contamination were reduced using the FastPrep bead beating instrument, which allows processing up to 24 samples very quickly. This method yields 1-2 µg of RNA and 150 mg of protein, which is usable in many sensitive downstream applications including microarray, quantitative real-time PCR, two-dimensional gel electrophoresis, and western blot analysis.

Skim Milk Drastically Improves the Efficacy of DNA Extraction from Andisol, a Volcanic Ash Soil

Soil

CASE STUDY

Takada-Hoshino Y. ; Matsumoto N.

Skim milk drastically improves the efficacy of DNA extraction from Andisol, a volcanic ash soil.

Japan Agricultural Research Quarterly (2005) Vol 39 : 247- 252

Introduction

The challenge with extractions from soil is isolating DNA or RNA without contamination by humic acids or other PCR inhibitors. Effective, efficient sample preparation is critical for succcessful downstream results. DNA extraction from Andisol, a volcanic ash soil, is known to be very difficult because this soil has a complex matrix, including allophane as a clay mineral. Soil properties such as high clay content contribute to high adsorption of DNA to soil particles.

Overview

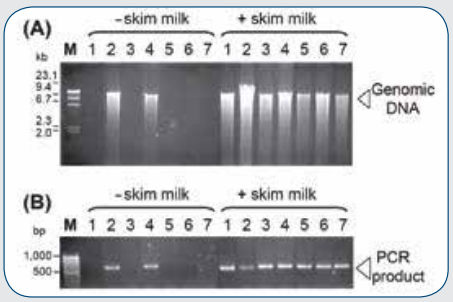
- **Keyword:** Environmental DNA, microbial community analysis, molecular methods, unculturable microorganisms.
- **Aim of the study:** Improvement of DNA extraction from volcanic ash soil
- **Application:** PCR
- **Sample name:** Andisol
- **Sample type:** Volcanic ash soil
- **Material:** FastPrep-24™ instrument, FastDNA™ SPIN Kit for Soil, skim milk (carrier minimizing adsorption of nucleic acids to soil)

Protocol and Parameters

1. Add the soil sample together with or without 40 mg skim milk per gram of soil to a Lysing Matrix E tube.
2. Add 978 µL sodium phosphate buffer to the sample in the Lysing Matrix E tube.
3. Add 122 µL MT Buffer.
4. Homogenize in a FastPrep instrument for 40 seconds at a speed setting of 6.0.
5. Centrifuge at 14,000 x g for 5-10 minutes to pellet debris.
6. Follow the FastDNA™ SPIN Kit for Soil protocol for DNA purification from the homogenate.

Conclusion

DNA could successfully be extracted from Andisol soil samples with the FastDNA Spin Kit for Soil and the addition of 40 mg of skim milk per gram of soil sample. PCR products of the expected size were amplified from all extracts with skim milk. Resultant extracts were suitable for PCR and no other purification procedures were needed.



Detection of *Kudoa septempunctata* 18S Ribosomal DNA in Patient Fecal Samples from Novel Food-Borne Outbreaks Caused by Consumption of Raw Olive Flounder.

Feces

CASE STUDY

Harada T ; Kawai T ; Jinnai M ; Ohnishi T ; Sugita-Konishi Y ; Kumeda Y.

Detection of *Kudoa septempunctata* 18S Feces Ribosomal DNA in Patient Fecal Samples from Novel Food-Borne Outbreaks Caused by Consumption of Raw Olive Flounder (*Paralichthys olivaceus*)

Journal of Clinical Microbiology (2012) Vol 50 : 2964–2968

Introduction

A method to detect *K. septempunctata* 18S ribosomal DNA in fecal samples of outbreak patients using an efficient real-time PCR method. A spiking experiment was performed to assess whether a previously developed real-time PCR assay was applicable to detect *K. septempunctata* in feces. Simultaneously, three commercially available kits were compared to determine relative extraction efficacy of *K. septempunctata* DNA.

Overview

- **Keyword:** Food-borne disease, Parasites identification, Human feces, qPCR, *K. septempunctata*
- **Aim of the study:** Identification of a standard method for DNA extraction from fecal parasites
- **Application:** Quantitative PCR
- **Sample name:** Human fecal sample
- **Sample type:** Feces
- **Material:** FastDNA™ SPIN Kit for Soil containing Lysing Matrix E, QIAamp® DNA Stool Mini Kit, UltraClean™ Fecal DNA Kit
- **Buffer:** Provided with each of the three commercial DNA extraction kits

Protocol and Parameters

To compare the amount of *K. septempunctata* (parasites) DNA extracted using the three kits.

1. 200 mg of each sample and 200 µL of DNA elution buffer were used during the extraction procedure for each kit.
2. Extracted DNA was stored at -20°C until use.

Conclusion

The FastDNA SPIN Kit for Soil proved to be the best DNA extraction method providing the highest PCR amplification.

The FastPrep technology gives higher yields and increases detection limit threshold of PCR. FastDNA SPIN Kit for Soil is the most efficient method for extracting parasite DNA from fecal samples.

Determination of Virus Titers in Lungs of Influenza A Virus Infected Mice.

Bodewes R. ; Kreijtz J. H. C. M. ; Baas C. ; Geelhoed-Mieras M.M. ; de Mutsert G. ; van Amerongen G. ;
van den Brand J. M. A. ; Fouchier Ron A. M.; Osterhaus A . D. M. E. ; Rimmelzwaan G.F.

Vaccination against Human Influenza A/H3N2 Virus prevents the induction of heterosubtypic immunity against lethal infection with Avian Influenza A/H5N1 virus.

PLoS ONE (2009) Vol 4 : e5538

Introduction

Various virology institutes reported a new method for the isolation of intact virus particles from infected animal tissues for studies of pathogenic viruses (ex: avian Influenza A viruses, i.e H5N1) and development of vaccines. This simple and reproducible method allows accurate measuring of the viral load in tissues, following the spread of the virus in mouse organs, and assessing the effect of vaccination.

Overview

- **Keyword:** Virus isolation, influenza A virus, infected animal tissues, pathogenic viruses
- **Aim of the study:** Isolation of intact viruses from infected animal tissues
- **Application:** Virus titration
- **Sample name:** Mouse lung tissue
- **Sample type:** Tissue
- **Material:** FastPrep-24™ instrument, 2 mL lysing matrix tubes containing ¼ inch ceramic beads
- **Buffer:** Hank's balanced salt solution containing 0.5% lactalbumin, 10% glycerol, 200 U/mL penicillin, 200 µg/mL streptomycin, 100 U/mL polymyxin B sulfate, 250 µg/mL gentamycin, and 50 U/mL nystatin.

Protocol and Parameters

1. Snap freeze the weighed lung of a mouse (100-150 mg) in a Lysing Matrix M tube and store at -70°C.
2. Add 1 mL of ice-cold buffer to the Lysing Matrix M tube.
3. Homogenize the tissue with a FastPrep-24 instrument for 20 seconds at a speed setting of 4.0 m/s.
4. Incubate the tube on ice for 2 minutes.
5. Homogenize the tissue a second time with a FastPrep-24 instrument for 20 seconds at 4.0 m/s.
6. Add 0.5 mL of medium to the Lysing Matrix tube and centrifuge 1 minute at 10,000 rpm to pellet the tissue debris.
7. Transfer the supernatant containing the virus particles to a new microcentrifuge tube.
8. Infect MDCK cells with quintuplicated 10-fold serial dilutions of the supernatants as previously described (1).
9. HA activity of the culture supernatants collected 5 days post inoculation are used as indicator of infection. Titers are calculated according to Spearman-Karber's method 3.

Conclusion

The FastPrep system, together with Lysing Matrix M tubes (2 mL tubes containing one ¼ inch ceramic bead), were successfully used to homogenize infected tissues and release intact viral particles as a first step of this experimental procedure.

PBP2a Mutations Causing High-Level Ceftaroline Resistance in Clinical Methicillin-Resistant *Staphylococcus aureus* Isolates.

Bacteria

CASE STUDY

Long S.W. ; Olsen R.J. ; Mehta S.C. ; Palzkill T. ; Cernoch P.L. ; Perez K.K. ; Musick W.L. ; Rosato A.E. ; Musser J.M.

PBP2a mutations causing high-level ceftaroline resistance in clinical methicillin-resistant *Staphylococcus aureus* isolates.

Antimicrobial Agents and Chemotherapy (2014) Vol 58 : 6668–6674

Introduction

Identifying and understanding antibiotic resistance mechanism in clinical isolates of *Staphylococcus aureus* in human specimens.

Overview

- **Keyword:** Genome sequencing, antibiotic resistance, clinical isolates, ceftaroline
- **Aim of the study:** Understanding antibiotic resistance mechanism in clinical isolates of *Staphylococcus aureus*.
- **Application:** Genome sequencing
- **Sample name:** Patient expectorated sputum & blood
- **Sample type:** Fluid
- **Material:** FastPrep-96™ instrument, Lysing Matrix B tubes
- **Buffer:** Tryptic soy broth

Protocol and Parameters

1. Patient isolates were grown on tryptic soy agar supplemented with 5% sheep blood.
2. Five of the isolates grew from expectorated sputum. The sixth isolate was obtained from an aerobic blood culture bottle.
3. Genomic DNA was isolated from multiple colonies grown overnight in tryptic soy broth.
4. The cells were lysed using Lysing Matrix B in a FastPrep-96 instrument.

Conclusion

The use of the high-throughput FastPrep-96 homogenizer in combination with Lysing Matrix B tubes allows high quality DNA extraction for genome sequencing analysis of ceftaroline-resistant methicillin-resistant *Staphylococcus aureus* (MRSA). Genome sequencing results confirm a previously undescribed high-level antibiotic resistance mechanism in clinical isolates of MRSA.

What is the most effective Lysing Matrix to use on *Mycobacterium tuberculosis* specimens like infected sputum samples?

Lysing Matrix B tubes (0.1 mm silica beads) are designed for a thorough lysis of *Mycobacterium tuberculosis* bacteria with the FastPrep instrument and are commonly used by tuberculosis research centers.

DNA isolation of *Mycobacterium tuberculosis*

Walker, T. M.; Lalor, M. K.; Broda, A.; Ortega, L. S.; Morgan, M.; Parker, L.; Churchill, S.; Bennett, K.; Golubchik, T.; Giess, A. P.; Del Ojo E.C.; Jeffery, K. J.; Bowler, I. C. J.W. ; Laurenson, I. F.; Barrett, A.; Drobniewski, F.; McCarthy, N. D.; Anderson, L.F.; Abubakar, I.; Thomas, H. L.; Monk, P.; Smith, E. G.; Walker, A .S.; Crook, D. W.; Peto, T. E .A.; Conlon, C. P.

Assessment of *Mycobacterium tuberculosis* transmission in Oxfordshire, UK, 2007–12, with whole pathogen genome sequences: an observational study

Lancet Respir Med (2014) Vol 2 : 285–292

RNA isolation of *Mycobacterium tuberculosis*

Keren I ; Minami S ; Rubin E ; and Lewis K.

Characterization and Transcriptome Analysis of *Mycobacterium tuberculosis* Persisters.

mBio (2011). 2(3) : e00100-11

What is the best method to isolate DNA from *Ascochyta rabiei* and *Botrytis cinerea* fungus in plant crops?

For fungal DNA isolation from infected plant samples, it is best to use the FastDNA SPIN Kit (including Lysing Matrix A tubes, Cat. No. MP116540600). These tubes will efficiently grind plant tissues and lyse fungal cells.

Will samples freeze during the homogenization with CoolPrep sample holders, considering they are in direct contact with dry ice?

To prevent sample freezing when using the CoolPrep sample holder, it is recommended to add up to, but not more than, 50 g dry ice to the well tray base. Grinding the dry ice first, before processing the sample, can also help prevent sample freezing.

To grind the dry ice, place it in the empty CoolPrep sample holder. Cover the sample holes with tape to keep the dry ice from spilling out during the run. Run the CoolPrep sample holder and dry ice in the FastPrep instrument. This step will make it easier to place the Lysing Matrix tubes in the adapter and it will help avoid the direct contact of dry ice pellets with the Lysing Matrix tubes.

Is it possible to use the FastPrep-24 system for lysing samples (plant/animal) while not disrupting bacteria?

FastPrep instruments are designed for the isolation of intact bacteria from infected samples. It is recommended to use Lysing Matrix tubes containing only large beads. Lysing Matrix M, containing ¼ in ceramic beads, is dedicated to this application.

As a buffer, we suggest to use PBS buffer as described in the publication below:

Tukhvatulin A.I. ; Gitlin I.I. ; Shcheblyakov D.V. ; Artemicheva N.M. ; Burdelya L.G. ; Shmarov M.M. ; Naroditsky B.S. ; Gudkov A.V. ; Gintsburg A.L. ; Logunova D.Y.

Combined Stimulation of Toll-Like Receptor 5 and NOD1 Strongly Potentiates Activity of NF-B, Resulting in Enhanced Innate Immune Reactions and Resistance to Salmonella enterica and serovar Typhimurium Infection.

Infect. Immun. (2013) Vol 81(10) : 3855.

What is the appropriate procedure to decontaminate Metal Lysing Matrix tubes?

It is advised to clean the stainless steel tubes and beads with a mild detergent and warm water followed by a clean water rinse.
Tubes, as well as caps and beads, can then be autoclaved under standard conditions : 30 min at 121 °C.
After several uses, it is recommended to replace the teflon O-ring.

What is the best Lysing Matrix for extracting RNA and proteins from adipose tissue?

Best Lysing Matrix tubes to efficiently grind adipose tissues for RNA and protein extraction are Lysing Matrix D tubes (Cat. No. MP116913100, tubes containing 1.4 mm ceramic beads).

Protein isolation from adipose tissue

Spradley F.T. ; Palei A.C. ; Granger J.P.

Obese melanocortin-4 receptor-deficient rats exhibit augmented angiogenic balance and vasorelaxation during pregnancy.

Physiol Rep (2013) Vol 1 (4), e00081

KimS.J. ; Chae S. ; Kim H. ; Mun D.G. ; Back S. ; Choi H.Y. ; Park K.S. ; Hwang D. ; Choi S.H. ; Lee S.W.

A Protein Profile of Visceral Adipose Tissues Linked to Early Pathogenesis of Type 2 Diabetes Mellitus.

Molecular & Cellular Proteomics (2014) Vol 10 : 811-822.

RNA isolation from adipose tissue

Kolak M. ; Gertow J. ; Westerbacka J. ; Summers S.A. ; Liska J. ; Franco-Cereceda A. ; Oresic M. ; Yki-Järvinen H. ; Eriksson P. ; Fisher R.M.

Expression of ceramide-metabolising enzymes in subcutaneous and intra-abdominal human adipose tissue.

Lipids in Health and Disease (2012) Vol 11 : 115-126

Is it possible to simultaneously isolate DNA and RNA from environmental samples with the Fast-Prep system?

Simultaneous extraction and purification of DNA and RNA from tropical soils from Madagascar following a cascade scheme involving the FastDNA SPIN Kit for Soil, for DNA isolation, and the RNaid Kit, for RNA extraction, has been described by Tournier E. et al.

Tournier E. ; Amenc L. ; Pablo A.L. ; Legname E. ; Blanchart E. ; Plassard C. ; Robin A. ; Bernard L.

Modification of a commercial DNA extraction kit for safe and rapid recovery of DNA and RNA simultaneously from soil, without the use of harmful solvents.

MethodsX 2 (2015) 182–191

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