



ZYMO RESEARCH

**Microbiomics**  
*Made Simple™*

# ZymoBIOMICS™ DNA Microprep Kit

DNA for microbiome or metagenome analyses

## Highlights

- **Validated Unbiased for Microbiome Measurements:** Unbiased cellular lysis validated using the ZymoBIOMICS Microbial Community Standard.
- **Inhibitor-Free DNA from Any Sample:** Isolate ultra-pure DNA ready for any downstream application.
- **Certified Low Bioburden:** Boost your detection limit for low abundance microbes.
- **Simple Workflow:** Simply bead-beat sample, purify via spin-column, and filter to remove PCR inhibitors. No precipitation or lengthy incubations!

Catalog Numbers:  
D4301, D4305



Scan with your smart-phone camera to  
view the online protocol/video.



[tech@zymoresearch.com](mailto:tech@zymoresearch.com)



[www.zymoresearch.com](http://www.zymoresearch.com)



Toll Free: (888) 882-9682

# Table of Contents

---

<b>Product Contents</b> .....	<b>01</b>
<b>Specifications</b> .....	<b>02</b>
<b>Product Description</b> .....	<b>03</b>
<b>Protocol</b> .....	<b>06</b>
<b>Appendices</b> .....	<b>08</b>
Sample Collection .....	<b>08</b>
Application Notes .....	<b>10</b>
Standardize Sample Preparation with ZymoBIOMICS	
Microbial Standards.....	<b>16</b>
Optimized Lysis Protocols for Bead-Beating .....	<b>19</b>
<b>Troubleshooting</b> .....	<b>20</b>
<b>Ordering Information</b> .....	<b>22</b>
<b>Complete Your Workflow</b> .....	<b>24</b>
<b>Guarantee</b> .....	<b>25</b>

# Product Contents

ZymoBIOMICS™ DNA Microprep Kit	D4301 (50 Preps.)	D4305 (50 Preps.)	Storage Temperature
ZR BashingBead™ Lysis Tubes (0.1 & 0.5 mm)	50	-	Room Temp.
ZymoBIOMICS™ Lysis Solution	40 ml	-	Room Temp.
ZymoBIOMICS™ DNA Binding Buffer	100 ml	100 ml	Room Temp.
ZymoBIOMICS™ DNA Wash Buffer 1	50 ml	50 ml	Room Temp.
ZymoBIOMICS™ DNA Wash Buffer 2	60 ml	60 ml	Room Temp.
ZymoBIOMICS™ DNase/RNase Free Water	3 ml	3 ml	Room Temp.
ZymoBIOMICS™ HRC Prep Solution	30 ml	30 ml	Room Temp.
Zymo-Spin™ III-F Filters	50	50	Room Temp.
Zymo-Spin™ II-μHRC Filters	50	50	Room Temp.
Zymo-Spin™ IC Columns	50	50	Room Temp.
Collection Tubes	200	200	Room Temp.
Instruction Manual	1	1	-

# Specifications

- **Sample Sources** – Bacterial (including endospores)<sup>1</sup>, fungal, protozoan, algal, viral, mitochondrial, and host DNA is efficiently isolated from ≤ 50 mg of mammalian feces, ≤ 100 mg soil, and 5 – 20 mg (wet weight) of bacterial/fungal cells<sup>2</sup>, biofilms, and water<sup>3</sup>.
- **Bead Beating System** – The innovative ZymoBIOMICS™ lysis system enables complete homogenization/disruption of the microbial cells walls and accurate microbial DNA analysis, free of bias. To ensure unbiased lysis, calibration of each bead-beating device is recommended by using the ZymoBIOMICS™ Microbial Community Standard (see Appendix C).
- **DNA Purity** – High quality, inhibitor-free DNA is eluted with ZymoBIOMICS™ DNase/RNase Free Water and is suitable for all downstream applications including PCR and Next-Generation Sequencing.
- **DNA Integrity** – On average, post bead beating, genomic DNA is between 15-20 kb depending on the initial quality of the sample, making it amenable to Next-Generation Sequencing platforms requiring high molecular weight DNA. For optimal DNA integrity, collect samples in DNA/RNA Shield™<sup>4</sup>.
- **DNA Recovery** – Up to 5 µg total DNA can be eluted into 20 µl (10 µl minimum).
- **Bioburden** – A single preparation is guaranteed to contain less than 3 bacterial genomic copies per µl of eluate as determined by quantitative amplification of the 16S rRNA gene when eluted using 100 µl water.
- **Equipment** – Microcentrifuge, Vortex Genie®, high speed cell disrupter (recommended).

---

1 See endospore lysis efficiency data in Appendix B.

2 This equates to approximately  $2 \times 10^8$  bacterial cells and  $2 \times 10^7$  yeast cells.

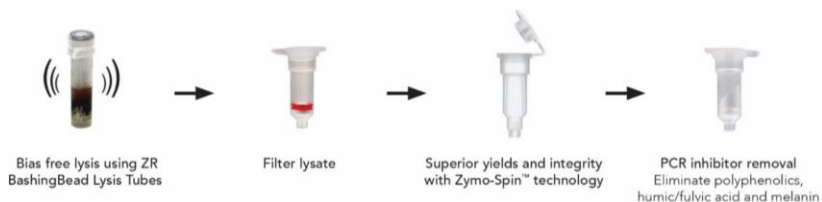
3 For water samples, filter using desired filter (not provided). Cut the filter into small pieces and place into ZR BashingBead™ Lysis Tube (0.1 & 0.5 mm). Alternatively, up to 250 µl water can be processed directly.

4 DNA/RNA Shield™ provides an accurate molecular signature of the sample at the time of collection by preserving nucleic acids at ambient temperature and inactivating organisms including infectious agents (see Appendix A).

# Product Description

The **ZymoBIOMICS™ DNA Microprep Kit** is designed for purifying DNA from a wide array of sample inputs (e.g. feces, soil, water, biofilms, etc.), that is immediately ready for microbiome or metagenome analyses. The ZymoBIOMICS™ innovative lysis system eliminates bias associated with unequal lysis efficiencies<sup>1</sup> of different organisms (e.g. Gram-negative/positive bacteria including endospores<sup>2</sup>, fungi, protozoans, algae, etc.) making it ideal for microbial community profiling. Unbiased mechanical lysis of tough microbes is achieved by bead beating with the innovative ultra-high density BashingBeads™ and validated using the ZymoBIOMICS™ Microbial Community Standard<sup>3</sup>, as shown in Figure 3. In addition, the **ZymoBIOMICS™ DNA Microprep Kit** is equipped with Zymo Research's proprietary OneStep™ PCR Inhibitor Removal technology, enabling PCR from the most PCR prohibitive environmental samples rich in humic and fulvic acids, tannins, melanin, and other polyphenolic compounds. Coupling state-of-the-art lysis technology with Zymo-Spin™ Technology results in superior yields of ultra-pure DNA ideal for all downstream applications including PCR, arrays, 16S rRNA gene sequencing, and shotgun sequencing<sup>4</sup>.

## Innovation. Pure & Simple.™



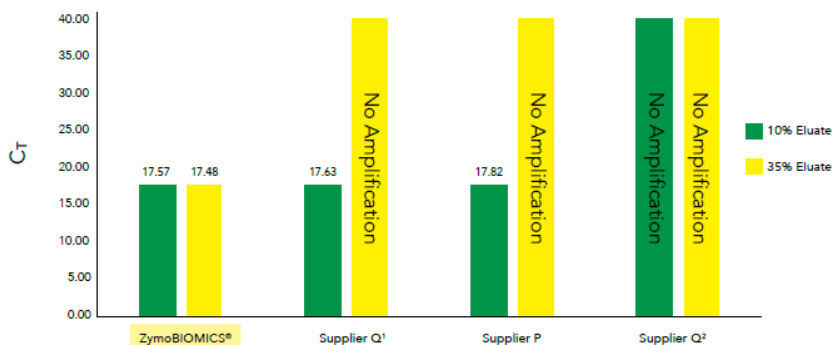
<sup>1</sup> Chemical, enzymatic, and inferior lysis matrices (beads) lead to unrealistic representation of organisms in downstream metagenomic analyses that is not reflective of actual abundance.

<sup>2</sup> See endospore lysis efficiency data in Appendix B.

<sup>3</sup> For more information on the ZymoBIOMICS™ Microbial Community Standard (D6300) & ZymoBIOMICS™ Microbial Community DNA Standard (D6305), see Appendix C.

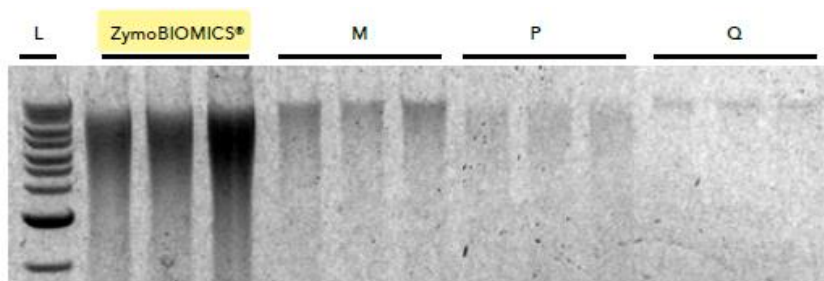
<sup>4</sup> DNA is predominately 15-20 kb and amenable to Next-Generation Sequencing techniques requiring high molecular weight DNA.

## Ultra-pure DNA from Inhibitor Rich Samples



**Figure 1.** The ZymoBIOMICS™ DNA Kit provides inhibitor-free DNA even when challenged with extremely inhibitor rich samples. Real-time PCR was used to evaluate eluates recovered using the ZymoBIOMICS™ DNA Kit, and kits from Suppliers Q<sup>1</sup>, P, and Q<sup>2</sup>. Reaction volumes consisted of either 10% or 35% of the eluate from each kit to detect the presence of PCR inhibitors. Each reaction contained 25 ng of *Brettanomyces* DNA. Delayed and/or no amplification indicates PCR inhibition from inefficient inhibitor removal.

## Superior Yields



**Figure 2.** The ZymoBIOMICS™ DNA Kit provides superior yields when compared to Suppliers M, P, and Q. 80 mg of feces was processed using each kit according to the manufacturers' recommended protocol. DNA was eluted using 100 µl ZymoBIOMICS™ DNase/RNase Free Water. 6 µl of each sample was visualized in a 1.0% (w/v) agarose/ethidium bromide gel. Samples were processed in triplicate. L is a 1Kb ladder.

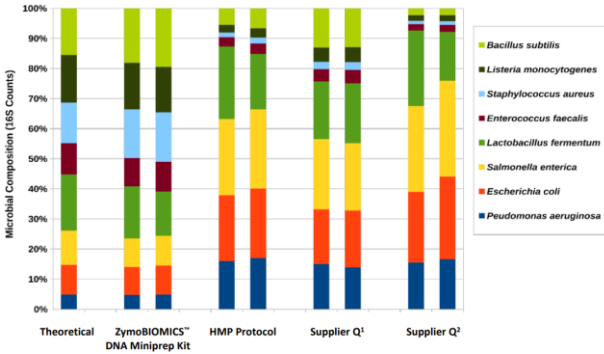
Zymo Research offers a full suite of ZymoBIOMICS™ Services for reliable, accurate microbial and metagenomic analyses.

Services include: Microbial Composition Profiling, Novel Microbe Identification, and Customizable Bioinformatics.

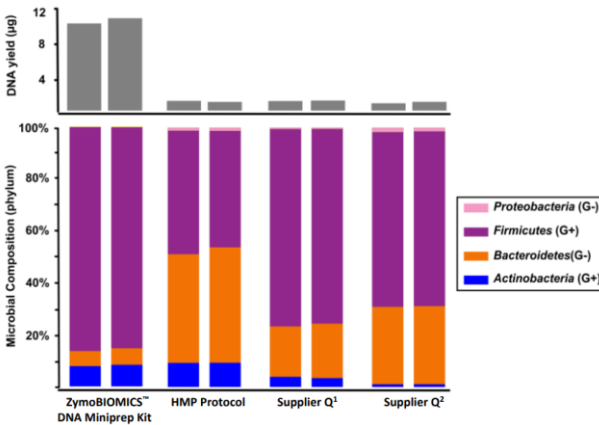
For details visit us at: <http://www.zymoresearch.com/services/metagenomics>

Or contact us at: [services@zymoresearch.com](mailto:services@zymoresearch.com)

**A) Bias Free Microbial DNA Extraction Using ZymoBIOMICS™ DNA Kit Validated with the ZymoBIOMICS™ Microbial Community Standard**



**B) Bias Free Microbial DNA Extraction Using ZymoBIOMICS™ DNA Kit From Human Stool**



**Figure 3. A) The ZymoBIOMICS™ DNA Kit provides unbiased representation of the organisms extracted from the ZymoBIOMICS™ Microbial Community Standard.** DNA was extracted from ZymoBIOMICS™ Microbial Community Standard using four different DNA extraction methods (ZymoBIOMICS™ DNA Kit, Human Microbiome Project Protocol, Supplier Q<sup>1</sup>, and Supplier Q<sup>2</sup>) and analyzed using 16S rRNA gene sequencing. 16S rRNA genes were amplified with primers targeting v3-4 region and the amplicons were sequenced on Illumina® MiSeq™ (2 x 250 bp). Overlapping paired-end reads were assembled into complete amplicon sequences. The composition profile was determined based on sequence counts after mapping amplicon sequences to the known 16S rRNA genes of the eight different bacterial species.

**B) The ZymoBIOMICS™ DNA Kit reliably isolates DNA from even the toughest to lyse Gram positive organisms, enabling unbiased analyses of microbial community compositions.** There is a significant increase in yield and Gram-positive bacterial abundance when DNA was isolated using the ZymoBIOMICS™ DNA Kit. Correlated with the results in Figure 3A, it can be concluded that unbiased DNA isolation was achieved. DNA was extracted from 200 µl of human feces suspended in PBS (10 % m/v) using four different DNA extraction methods (ZymoBIOMICS™ DNA Kit, Human Microbiome Project Protocol, Supplier Q<sup>1</sup>, and Supplier Q<sup>2</sup>) and analyzed using 16S rRNA gene sequencing. 16S rRNA genes were amplified with primers targeting v3-4 region and the amplicons were sequenced on Illumina® MiSeq™ (2 x 250 bp). Overlapping paired-end reads were assembled into complete amplicon sequences. Amplicon sequences were profiled with Qiime using Greengenes 16S rRNA gene database (gg\_13\_8).

# Protocol

1. Add sample to a **ZR BashingBead™ Lysis Tube (0.1 & 0.5 mm)**. Add 750 µl **ZymoBIOMICS™ Lysis Solution** to the tube and cap tightly.

**Note:** For samples stored in **DNA/RNA Shield™ Lysis Tubes**, do not add **ZymoBIOMICS™ Lysis Solution** and proceed to **Step 2**.

Sample Type	Maximum Input
Feces	50 mg
Soil	100 mg
Liquid Samples <sup>1</sup> and Swab Collections <sup>2</sup>	250 µl
Cells (Suspended in PBS)	5-20 mg (wet weight) (2 x 10 <sup>8</sup> bacterial and 2 x 10 <sup>7</sup> yeast cells)
Samples in DNA/RNA Shield™, <sup>3</sup>	≤ 1 ml

2. Secure in a bead beater fitted with a 2 ml tube holder assembly and process using optimized beat beating conditions (speed and time) for your device (see Appendix D)<sup>4</sup>.

**Optional Stopping Point:** After Step 2, samples can be stored for several hours at room temperature or can be stored at – 80 °C for long term storage.

3. Centrifuge the **ZR BashingBead™ Lysis Tubes (0.1 & 0.5 mm)** in a microcentrifuge at ≥ 10,000 x g for 1 minute.
4. Transfer up to 400 µl supernatant to the **Zymo-Spin™ III-F Filter** in a **Collection Tube** and centrifuge at 8,000 x g for 1 minute. Discard the **Zymo-Spin™ III-F Filter**.

**Note:** For low biomass samples (e.g. swabs, water, and air), transfer 400µl of supernatant to new **Collection Tube** and omit the use of the **Zymo-Spin III-F Filter**. Proceed to **Step 5**.

<sup>1</sup> For water samples, filter using desired filter (not provided). Cut the filter into small pieces and place into **ZR BashingBead™ Lysis Tubes (0.1 & 0.5 mm)**.

<sup>2</sup> Swabs can also be cut or broken, then placed directly in bead beating tube. For more information on processing swab samples, see Appendix B.

<sup>3</sup> Up to 1 ml of sample in **DNA/RNA Shield** can be processed directly in **ZR BashingBead™ Lysis Tube**. Adjust final volume to 1 ml with **ZymoBIOMICS™ Lysis Solution** or **DNA/RNA Shield**, if necessary.

<sup>4</sup> For optimal lysis efficiency and unbiased profiling all bead beater devices beyond those validated by Zymo Research should be calibrated using the **ZymoBIOMICS™ Microbial Community Standard**. See Appendix C.



5. Add 1,200  $\mu\text{l}$  of **ZymoBIOMICS™ DNA Binding Buffer** to the filtrate in the Collection Tube from Step 4. Mix well.
6. Transfer 800  $\mu\text{l}$  of the mixture from Step 5 to a **Zymo-Spin™ IC Column** in a Collection Tube and centrifuge at 10,000 x *g* for 1 minute.
7. Discard the flow through from the Collection Tube and repeat Step 6.
8. Add 400  $\mu\text{l}$  **ZymoBIOMICS™ DNA Wash Buffer 1** to the Zymo-Spin™ IC Column in a new Collection Tube and centrifuge at 10,000 x *g* for 1 minute. Discard the flow-through.
9. Add 700  $\mu\text{l}$  **ZymoBIOMICS™ DNA Wash Buffer 2** to the Zymo-Spin™ IC Column in a Collection Tube and centrifuge at 10,000 x *g* for 1 minute. Discard the flow-through.
10. Add 200  $\mu\text{l}$  **ZymoBIOMICS™ DNA Wash Buffer 2** to the Zymo-Spin™ IC Column in a Collection Tube and centrifuge at 10,000 x *g* for 1 minute.
11. Transfer the **Zymo-Spin™ IC Column** to a clean 1.5 ml microcentrifuge tube and add 20  $\mu\text{l}$  (10  $\mu\text{l}$  minimum) **ZymoBIOMICS™ DNase/RNase Free Water** directly to the column matrix and incubate for 1 minute. Centrifuge at 10,000 x *g* for 1 minute to elute the DNA<sup>5</sup>.  
6.
12. Place a **Zymo-Spin™ II- $\mu\text{HRC}$  Filter** in a new Collection Tube and add 600  $\mu\text{l}$  **ZymoBIOMICS™ HRC Prep Solution**. Centrifuge at 8,000 x *g* for 3 minutes.
13. Transfer the eluted DNA (Step 11) to a prepared **Zymo-Spin™ II- $\mu\text{HRC}$  Filter** in a clean 1.5 ml microcentrifuge tube and centrifuge at exactly 16,000 x *g* for 3 minutes.

The filtered DNA is now suitable for PCR and other downstream applications.

---

<sup>5</sup> In some cases a brown-colored pellet may form at the bottom of the tube after centrifugation. Avoid this pellet when collecting the eluted DNA.

<sup>6</sup> If fungi or bacterial cultures were processed; the DNA is now suitable for all downstream applications.

# Appendices

## Appendix A

### Sample Collection

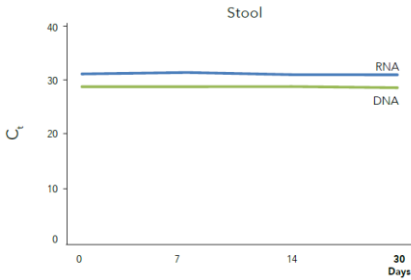
For high quality reproducible microbiomics data, **DNA/RNA Shield™** is recommended for sample collection to avoid bias or erroneous results due to compositional changes from nucleic acid degradation or microbial growth. DNA/RNA Shield™ provides an unbiased molecular snapshot of the sample at the time of collection by preserving nucleic acids at ambient temperature and inactivating organisms including infectious agents. Samples can be stored and transported easily and safely with DNA/RNA Shield™ and is ideal for applications such as PCR, 16S rRNA gene sequencing, and shotgun metagenomic sequencing. DNA/RNA Shield™ can preserve nucleic acids in nearly any sample including feces, soil, saliva, blood, and tissues.

**DNA/RNA Shield™ - Lysis Tube (Microbe)** – Simply add sample, seal, and store at ambient temperature. The Lysis Tube is immediately ready for bead beating, thereby streamlining the collection to extraction transition. (Cat. No. **R1103**)

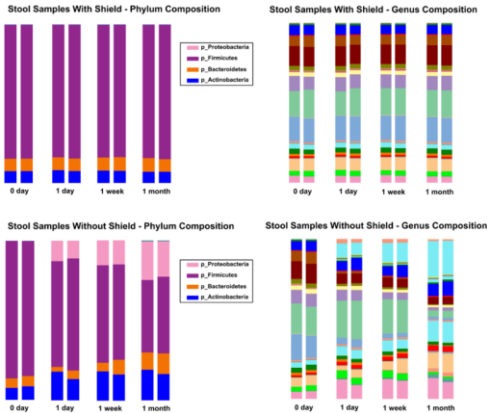
**DNA/RNA Shield™ – Fecal Collection Tube** – The collection device is specifically designed for easy collection and stabilization of feces. Includes a scoop built for collecting 1 gram of feces (or any other sample such as saliva or soil). (Cat. No. **R1101**)

**DNA/RNA Shield™ – Swab Collection Tube** – Easy collection of biological samples; swab has breakable tip to allow for easy sample collection and removes the need to dispose of a potentially biohazardous swab material. (Cat. No. **R1106 & R1107**).

## A) DNA/RNA Shield™ Preserves Nucleic Acids at Room Temperature



## B) DNA/RNA Shield™ Preserves Microbial Composition at Room Temperature



## C) DNA/RNA Shield™ Inactivates Pathogens for Safe Transport and Storage

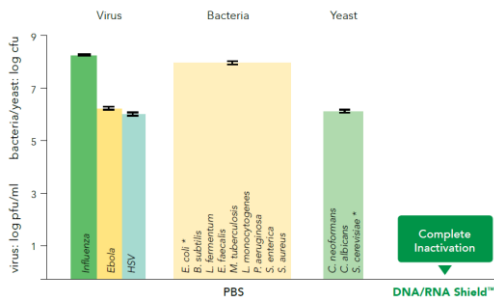


Figure 4.

**A) Nucleic acids in stool are effectively stabilized in DNA/RNA Shield™ at room temperature.** Graph shows spike-in DNA and RNA controls from stool purified at the indicated time points and analyzed by (RT)qPCR. Controls: HSV-1 and HIV (AcroMetrix™, Life Technologies).

**B) Microbial composition of stool is unchanged after one month at ambient temperature with DNA/RNA Shield™.** Stool samples suspended in DNA/RNA Shield™ and stored at room temperature were compared to stool without preservative for one month. They were sampled at the indicated time points and processed with ZymoBIOMICS™ DNA Kit. The extracted DNA was then subjected to microbial composition profiling via 16S rRNA gene targeted sequencing. Graphs show both phylum composition (left) and genus composition (right). Samples stored with DNA/RNA Shield™ had a constant microbial composition while the samples stored without shifted dramatically.

**C) Viruses, bacteria and yeast are effectively inactivated by DNA/RNA Shield™.** Samples containing the infectious agent (viruses, bacteria, yeast) were treated with DNA/RNA Shield™ or mock (PBS) treated for 5 minutes. Titer (PFU) was subsequently determined by plaque assay. Validated by: Influenza A - D. Poole and Prof. A. Mehle, Department of Medical Microbiology and Immunology, University of Wisconsin, Madison; Ebola (Kikwit) - L. Avena and Dr. A. Griffiths, Department of Virology and Immunology, Texas Biomedical Research Institute; HSV-1/2 - H. Oh, F. Diaz and Prof. D. Knipe, Virology Program, Harvard Medical School; E. coli, L. fermentum, B. subtilis, S. cerevisiae - Zymo Research Corporation).

## Appendix B

### Application Notes

#### **DNA/RNA Shield™ Lysis Tubes (Microbe)** (Cat. No. R1103)

1. Collect sample directly into the **DNA/RNA Shield™ Lysis Tube (Microbe)**.
2. Directly proceed to Step 2 of the protocol (page 6) and bead beat in the DNA/RNA Shield™ Lysis Tube (Microbe) according to provided recommendations.
3. Proceed with the remaining protocol as written.

#### **DNA Viruses**

For unbiased metagenomics analysis of viruses, incorporating a Proteinase K digestion prior to bead beating is recommended.

1. Following Step 2 (page 6) add 5% (v/v) of **Proteinase K** (Cat. No. D3001-2-5) to the lysate within the **ZR BashingBead™ Lysis Tubes (0.1 & 0.5 mm)** and incubate for 30 minutes at 55°C.
2. Proceed to Step 3 (page 6) and continue with the remaining protocol as written.

#### **Cheese and Protein Rich Biofluids (e.g. Milk, Sputum, Saliva, Spinal Fluid, Blood, and Serum)**

1. Add  $\leq 0.4$  g of cheese or  $\leq 200$   $\mu$ l of biofluid to the **ZR BashingBead™ Lysis Tubes (0.1 & 0.5 mm)**. Add 750  $\mu$ l of **ZymoBIOMICS™ Lysis Solution**.
2. Add 20  $\mu$ l of **Proteinase K** (20  $\mu$ g/ $\mu$ l) (cat. no. D3001-2-5) to the ZymoBIOMICS™ Lysis Tubes (0.1 & 0.5 mm) and incubate for 30 minutes at 55°C.
3. Continue to Step 2 (page 6) and proceed with the protocol as written.

#### **Plant Tissue** (Leaves and other plant material)

Plant tissues such as leaves and roots contain DNA sources within the host tissue that can overwhelm 16S rRNA gene targeted sequencing (from both mitochondria & chloroplast). Microbes must be removed from the plant surface to exclude host tissue from the bead beating process.

(A) *Plant tissue – Centrifugation of cells*

1. Suspend plant tissue in isotonic solution (e.g. PBS) and gently sonicate or vortex briefly.
2. Remove plant tissue from solution and centrifuge at 15,000 x g for 10 minutes to pellet the cells.
3. Without disturbing the pellet, slowly decant or pipette out the supernatant, leaving behind 100 – 300 µl of pellet.
4. Add **ZymoBIOMICS™ Lysis Solution** to the cells to a final volume of 1 ml and mix to resuspend. Transfer the mixture to the **ZR BashingBead™ Lysis Tubes (0.1 & 0.5 mm)** and proceed to Step 2 (page 6).

(B) *Plant tissue – Filtration of cells*

1. Place plant tissue in a submerging volume of PBS inside of a conical tube and gently sonicate or vortex briefly. Remove plant tissue from liquid volume.
2. Filter liquid using a 0.22 µm filter (not provided).
3. Cut the filter and place directly into the **ZR BashingBead™ Lysis Tubes (0.1 & 0.5 mm)** and proceed to Step 1 (page 6).

(C) *Plant root – Lysis of surface microbes*

1. Cut root into small pieces and place directly into **ZR BashingBead™ Lysis Tubes (0.1 & 0.5 mm)** with 750 µl of **ZymoBIOMICS™ Lysis Buffer**.
2. Lysis should be performed with a lower speed bead beating device (e.g. vortex adapter for 20 minutes) to avoid the host tissue contamination.
3. Continue to Step 3 (page 6) and proceed with the remaining protocol as written.

## **Water/Air Samples**

1. Filter samples using desired filter (not provided) prior to Step 1 (page 6).
2. Cut the filter into small pieces and place them inside the **ZR BashingBead™ Lysis Tubes (0.1 & 0.5 mm)** and add 750 µl of **ZymoBIOMICS Lysis Solution**.
3. Continue to Step 2 (page 6) and proceed with the remaining protocol as written.

## Lytic Enzymes

Lytic enzymes, such as Lysozyme, Lysostaphin, MetaPolyzyme, etc. can be used with this kit using the following:

### (A) *Enzymatic lysis followed by bead beating:*

1. Perform enzymatic digestion under manufacturer's recommended conditions (temperature/time/concentration).

**Note:** *If sample is stored in DNA/RNA Shield, perform the following:*

- a. Centrifuge sample at  $\geq 10,000 \times g$  for 1 minute.
- b. Transfer supernatant to a **ZR BashingBead Lysis Tube (0.1 & 0.5 mm)**, to be used in Step 2, below.
- c. Re-suspend pellet in a buffer suitable for enzymatic treatment (ex. PBS or other isotonic solution).

2. Transfer the digestion mixture to a **ZR BashingBead™ Lysis Tube (0.1 & 0.5 mm)**.
3. Add 750  $\mu$ l **ZymoBIOMICS™ Lysis Solution**.

**Note:** *For samples in DNA/RNA Shield, raise to a final volume of 1 ml with DNA/RNA Shield.*

4. Proceed to Step 2 (page 6) and continue with the remaining protocol as written.

### (B) *Enzymatic lysis only (no bead beating):*

1. Perform enzymatic digestion under manufacturer's recommended conditions (temperature/time/concentration).

**Note:** *If sample is stored in DNA/RNA Shield, perform the following:*

- a. Centrifuge sample at  $\geq 10,000 \times g$  for 1 minute.
- b. Transfer supernatant to a clean microcentrifuge tube, to be used in Step 2.
- c. Re-suspend pellet in a buffer suitable for enzymatic treatment (ex. PBS or other isotonic solution).

2. Raise the volume of sample to 400  $\mu$ l with **ZymoBIOMICS™ Lysis Solution**.
3. Continue to Step 4 (page 6) and proceed with the remaining protocol as written.

## Hair, Feather, and Nail Samples:

1. To  $\leq 25$  mg sample, add 90  $\mu$ l Water, 90  $\mu$ l **Solid Tissue Buffer (Blue)** (Cat. No. D4068-2-6), 10  $\mu$ l 1M DTT, and 10  $\mu$ l **Proteinase K** (Cat. No. D3001-2-5) in a microcentrifuge tube.
2. Mix thoroughly or vortex 10-15 seconds and then incubate the tube at 55°C overnight.
3. Transfer lysate to a **ZR BashingBead™ Lysis Tube (0.1 & 0.5 mm)** and then add 750  $\mu$ l **ZymoBIOMICS™ Lysis Solution**.
4. Continue to Step 2 (page 6) and proceed with the remaining protocol as written.

## Tissue and Insect Samples

Tissue and Insect samples can be processed three different ways, depending on the sample type and the equipment available. The recommendations are listed next to the options below:

### (A) *Proteinase K - Tissue*

1. Add up to 15 mg of tissue to a 1.5 ml microcentrifuge tube, then add a solution of 95  $\mu$ l water, 95  $\mu$ l **Solid Tissue Buffer (Blue)** (Cat. No. D4068-2-6) and 10  $\mu$ l **Proteinase K** (Cat. No. D3001-2-5). Incubate for at least 1 hour at 55° C or until tissue clarifies (samples can be incubated overnight without affecting DNA quality).
2. Transfer digestion to a **ZR BashingBead™ Lysis Tube (0.1 & 0.5 mm)** and add 750  $\mu$ l of **ZymoBIOMICS™ Lysis Solution**.
3. Proceed to Step 2 (page 6) and continue with the protocol as written.

### (B) *Bead beating - Tissue and Insect*

1. Add up to 15 mg of tissue/insect sample in a **ZR BashingBead™ Lysis Tube (2.0 mm)** (Cat. No. S6003-50) with 750  $\mu$ l of **ZymoBIOMICS™ Lysis Solution**.
2. Secure in a bead beater fitted with a 2 ml tube holder assembly and process at maximum speed for  $\geq 5$  minutes.

**Note:** Processing time will vary based on sample input and bead beater. Times may be as little as 5 minutes when using high-speed cell disrupters (FastPrep® - 24) or as long as 40 minutes when using lower speeds (e.g., Vortex Genie®).

3. Transfer the entire lysate to the **ZR BashingBead™ Lysis Tube (0.1 & 0.5 mm)**, proceed to Step 2 (page 6), and continue with protocol as written.

### (C) *Mortar & Pestle - Tissue and Insect*

1. Homogenize up to 15 mg tissue/insect sample with a mortar and pestle while submersed in liquid nitrogen.
2. Transfer the entire sample into the **ZR BashingBead™ Lysis Tube (0.1 & 0.5 mm)** and add 750  $\mu$ l of **ZymoBIOMICS™ Lysis Solution**.
3. Proceed to Step 2 (page 6) and continue with the protocol as written.

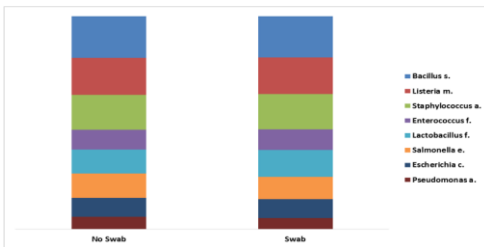
## Samples Collected with Swabs

### (A) Directly process swab

1. Directly break swab at breakpoint or cut the swab into a **ZR BashingBead Lysis Tube (0.1 & 0.5 mm)**.
2. Proceed to Step 1 (page 6) and continue with the protocol as written.

### (B) Indirectly process swab

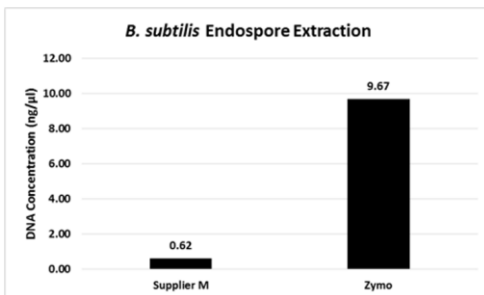
1. Vortex the swab in the **ZR BashingBead™ Lysis Tube (0.1 & 0.5 mm)** with 750  $\mu$ l of **ZymoBIOMICS™ Lysis Solution** for 30 seconds to transfer the microbes into solution.
2. Remove the swab and proceed to bead beating in Step 2 (page 6).



**Figure 5.** Phylum composition of a simulated microbial community when bead beating was performed with and without the presence of a Puritan HydraFlock® sterile flocked collection device placed in a ZR BashingBead Lysis Tube and processed at maximum speed (6.5 m/s) for 5 minutes. The extracted DNA was then subjected to microbial composition profiling via 16S rRNA gene targeted sequencing. Experiment was performed in technical duplicates.

## Bacterial Endospore Lysis

ZymoBIOMICS DNA Kit is capable of effectively lysing bacterial endospores, and also achieves higher yield when compared to competition.



**Figure 6.** DNA Extractions were performed using the ZymoBIOMICS® DNA Kit and DNeasy PowerSoil with  $6 \times 10^8$  *B. subtilis* CFU. DNeasy PowerSoil recovered 0.62 ng/ $\mu$ l DNA, while the ZymoBIOMICS® DNA Kit was capable of recovering 9.67 ng/ $\mu$ l in a 50  $\mu$ l elution volume. Extractions were performed in triplicate and quantified via Qubit.



## Urine

### (A) Pelleting cells from fresh/frozen urine

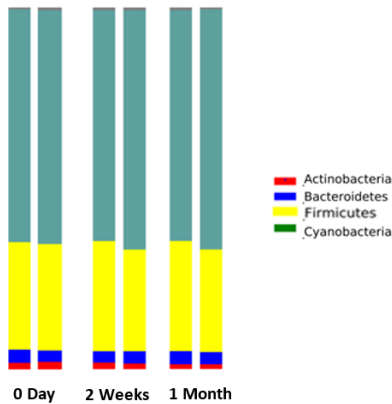
1. Pellet the bacterial cells by centrifuging the urine at 15,000 x g for 10 minutes.
2. Without disturbing the pellet, slowly decant or pipette out the supernatant, leaving behind 100 – 400 µl of pellet.
3. Add **ZymoBIOMICS™ Lysis Solution** to a final volume of 800 µl and then transfer the mixture to a **ZR BashingBead™ Lysis Tube (0.1 & 0.5 mm)**. Proceed to Step 2 (page 6) and continue with the protocol as written.

### (B) Pelleting cells from stabilized urine

1. Add 70 µl **Urine Conditioning Buffer** (Cat. No. D3061-1-140) for every 1 ml of urine and mix well by vortexing.

**Note:** Urine stabilized by the Urine Conditioning Buffer can be stored for up to 1 month at ambient temperature. When samples are ready to be processed, mix well by vortexing, and proceed to Step 2.

2. Centrifuge at 3,000 x g for 15 minutes.
3. Without disturbing the pellet, slowly decant or pipette out the supernatant, leaving behind 100 – 400 µl of pellet.
4. Add **ZymoBIOMICS™ Lysis Solution** to a final volume of 800 µl and then transfer the mixture to a **ZR BashingBead™ Lysis Tube (0.1 & 0.5 mm)**. Proceed to Step 2 (page 6) and continue with the protocol as written.



**Figure 7.** Phylum composition of urine preserved in Urine Conditioning Buffer™ (UCB™), which preserves the microbial composition of urine with simulated stool contamination for a month at room temperature. Urine with UCB™ added (Zymo Research, D3061-1-160) was stored at room temperature and analyzed over a month period. At the indicated time points (0 Days, 2 weeks, and 1 month), DNA was extracted using the ZymoBIOMICS™ DNA Kit. The extracted DNA was then subjected to microbial composition profiling via 16S rRNA gene targeted sequencing. Experiment was performed in technical duplicates.

## Appendix C

### Standardize Sample Preparation with ZymoBIOMICS™ Microbial Community Standards

The **ZymoBIOMICS™ Microbial Community Standard (Cat. No. D6300)** is a mock microbial community of defined and well characterized composition making it the perfect control for all microbiome profiling and metagenomics analyses.

It is ideal for assessing bias of DNA extraction methods since it contains three easy-to-lyse Gram-negative bacteria (e.g. *Escherichia coli*), five tough-to-lyse Gram-positive bacteria (e.g. *Listeria monocytogenes*), and two tough-to-lyse yeasts (e.g. *Saccharomyces cerevisiae*).

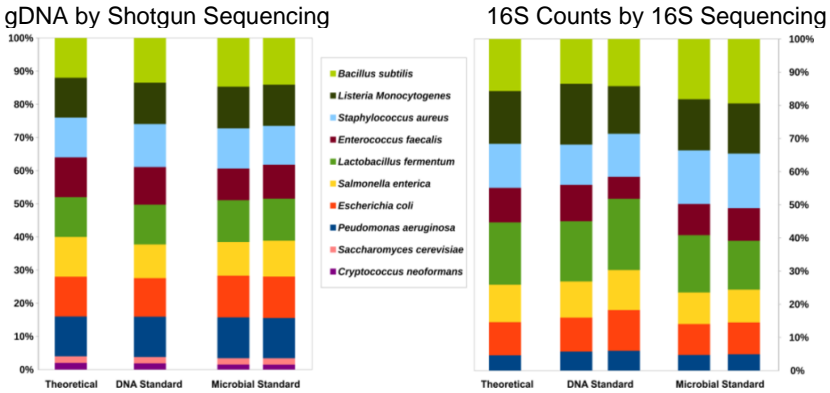
#### **Bead Beating Device Calibration Protocol:**

Zymo Research suggests calibrating bead beating devices with the ZymoBIOMICS™ Microbial Community Standard in order to ensure bias free microbial extraction. For lysis on the Vortex Genie®, we suggest a time course ranging from 10-45 minutes with the vortex at maximum speed. For high speed cell disruptors such as for MP FastPrep®-24 we suggest a time course at maximum speed with a range of 3-10 minutes. The resulting DNA should be evaluated by quantifying DNA yield and changes in microbial profile at each time point. The bead beating time that yields a profile that closely matches the theoretical composition should become standard operating procedure for the bead beating device.

**ZymoBIOMICS™ Microbial Community DNA Standard (Cat. No. D6305)** is a mixture of genomic DNA extracted from pure cultures of eight bacterial and two fungal strains. Genomic DNA from each culture was quantified before mixing. The ZymoBIOMICS™ Microbial Community Standard allows for assessment of bias from library preparation, sequencing, and bioinformatics analysis.

It serves perfectly as a microbial standard for benchmarking the performance of microbiomics or metagenomics analyses, including those provided by a 3<sup>rd</sup> party.

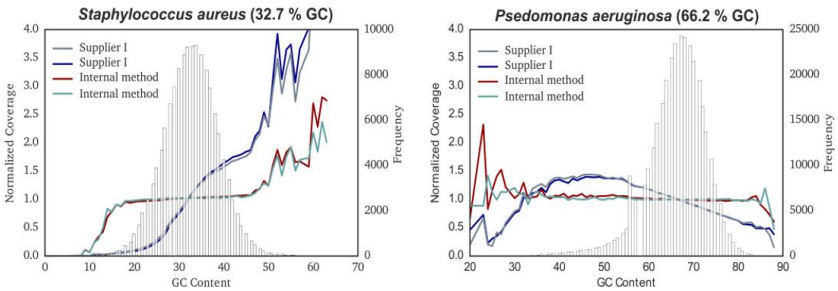
## Accurate composition for reliable use to evaluate shotgun seq. and 16S rRNA seq.



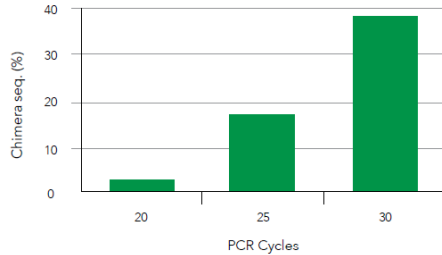
Species	Avg. GC (%)	Gram Stain	gDNA Abun. (%)
<i>Pseudomonas aeruginosa</i>	66.2	-	12
<i>Escherichia coli</i>	56.8	-	12
<i>Salmonella enterica</i>	52.2	-	12
<i>Lactobacillus fermentum</i>	52.8	+	12
<i>Enterococcus faecalis</i>	37.5	+	12
<i>Staphylococcus aureus</i>	32.7	+	12
<i>Listeria monocytogenes</i>	38.0	+	12
<i>Bacillus subtilis</i>	43.8	+	12
<i>Saccharomyces cerevisiae</i>	38.4	Yeast	2
<i>Cryptococcus neoformans</i>	48.2	Yeast	2

**Figure 8.** Characterization of the microbial composition of the two ZymoBIOMICS™ standards with shotgun metagenomic sequencing (left panel) and 16S rRNA gene targeted sequencing (right panel). The measured composition of the two standards agrees with the theoretical/designed composition. “DNA Standard” represents ZymoBIOMICS™ Microbial Community DNA Standard (DNA version) and “Microbial Standard” represents ZymoBIOMICS™ Microbial Community Standard (cellular version). Genomic DNA composition by shotgun sequencing was calculated based on counting the amounts of raw reads mapped to each genome. 16S composition by 16S rRNA gene targeted sequencing was calculated based on counting the amount of 16S raw reads mapped to each genomes.

## A) Use ZymoBIOMICS™ Microbial Standards for assessing GC-Bias in Shotgun Metagenomics



## B) Perfect for tracking PCR Chimera in 16S rRNA Gene Sequencing



**Figure 9.**

- A)** Library preparation for shotgun metagenomic sequencing was performed in two different ways: one by supplier I and one by an in-house method. Shotgun sequencing was performed on Illumina® MiSeq™ with paired-end sequencing (2 x 150 bp). Raw reads were mapped to the 10 microbial genomes to evaluate the potential effect of GC content on sequencing coverage. Normalized coverage was calculated by normalization by the average sequencing coverage of each genome.
- B)** PCR chimera increases with PCR cycle number in the library preparation process of 16S rRNA gene targeted sequencing. 20 ng ZymoBIOMICS™ Microbial Community Standard was used as a template. The PCR reaction was performed with ZymoBIOMICS™ PCR Premix and with primers that target v3-4 region of 16S rRNA gene. Chimera rate in percentage was determined with Uchime and using the 16S rRNA gene of the 8 bacterial strains in the standard as reference PCR.

# Appendix D

## Optimized Lysis Protocols for Bead-Beating

The following conditions with different mechanical lysis machines were validated with minimum bias using the **ZymoBIOMICS™ Microbial Community Standard**.

1

### Vortex Genie® with 2 ml BashingBead™ Tubes

Recommended for ease of use and accessibility

Use Microtube Adaptor (Scientific Industries, Inc. Cat. No. S5001-7)

1. 40 minutes of continuous bead beating (max of 18 tubes per adaptor)

2

### Bertin Precellys® Evolution with 2 ml BashingBead™ Tubes

Recommended for ease of use and ultra-high speed

1. 1 minute on at 9,000 rpm
2. 2 minutes rest
3. Repeat cycle 4 times for a total of 4 minutes of bead beating

3

### MP Fastprep®-24 with 2 ml BashingBead™ Tubes

Maximum of 20 tubes. The weight of >20 tubes may cause a system error

1. 1 minute on at max speed
2. 5 minutes rest
3. Repeat cycle 5 times for a total of 5 minutes of bead beating

4

### Omni Bead Ruptor® Elite with 2 ml BashingBead™ Tubes

1. 1 minute on at 6 m/s
2. 5 minutes rest
3. Repeat cycle 3 times for a total of 3 minutes of bead beating

5

### Biospec Mini-BeadBeater-16 with 2 ml BashingBead™ Tubes

1. 1 minute at maximum speed
2. 5 minutes rest
3. Repeat cycle 5 times for a total of 5 minutes of bead beating

6

### Biospec Mini-BeadBeater-96 with 2 ml BashingBead™ Tubes

1. 5 minutes on at Max RPM
2. 5 minutes rest
3. Repeat cycle 4 times for a total of 20 minutes of bead beating

7

### Biospec Mini-BeadBeater-96 with 96 well BashingBead™ Lysis Rack

1. 5 minutes on at Max RPM
2. 5 minutes rest
3. Repeat cycle 8 times for a total of 40 minutes of bead beating

X

### TissueLyser II

No tested conditions yielded accurate profiles. This device is not validated by Zymo Research for microbiome research.

X

### TissueLyser LT

No tested conditions yielded accurate profiles. This device is not validated by Zymo Research for microbiome research.

X

### Retsch Mixer Mill MM 400

No tested conditions yielded accurate profiles. This device is not validated by Zymo Research for microbiome research.

## Troubleshooting

For **Technical Assistance**, please contact 1-888-882-9682 or E-mail [tech@zymoresearch.com](mailto:tech@zymoresearch.com).

Problem	Possible Causes and Suggested Solutions
---------	---

<b>Background Contamination</b>	<ul style="list-style-type: none"><li>• Clean workspace, centrifuge, and pipettes with 10% bleach to routinely to avoid contamination.</li><li>• Use of kit in exposed environment without proper filtration. Check pipettes, pipette tips, microcentrifuge tubes, workspace, etc. for contamination.</li><li>• Make sure bags of columns and buffer bottles are properly sealed for storage. Use of these outside a clean room or hood can result in contamination.</li></ul>
---------------------------------	--



---

**Low DNA Yield**Lysis Methods

- Refer to Appendix D for validated bead beating devices and parameters.
- Bead beating devices that oscillate in a single dimension (only vertically or only horizontally) have been observed to inefficiently lyse very recalcitrant species. Devices that oscillate three-dimensionally or in a figure-8 motion often lyse microbes efficiently.

Incomplete Debris Removal

- For high density samples, ensure lysate is centrifuged properly to pellet insoluble debris following bead beating. Ensure that none of the debris is transferred to the **Zymo-Spin™ III-F Filter** in the next step.

Input

- If the lysate does not pass through the column or is extremely viscous, use less input material. Too much sample input can cause cellular debris to overload the column and insufficient flow.
- Consult the Sample Input Table on Page 6 for information on your particular input limit based on sample.

**Low DNA Yield**  
(cont.)

Binding Step

- Ensure that the **ZymoBIOMICS™ DNA Binding Buffer** is completely mixed with lysate before loading onto the column. Improperly mixed samples can lead to poor DNA recovery.

Elution Procedure

- Ensure the **ZymoBIOMICS™ DNase/RNase Free Water** hydrates the matrix for at least 1 minute before centrifugation.
- To increase yields, heat the **ZymoBIOMICS™ DNase/RNase Free Water** to 60°C before use. Additionally, users can reload the eluate onto the column matrix, incubate at room temperature for 3 minutes, and centrifuge again to increase yield without further dilution.

# Ordering Information

Product Description	Catalog No.	Size
ZymoBIOMICS™ DNA Microprep Kit	D4301	50 Preps.
ZymoBIOMICS™ DNA Microprep Kit (Lysis Matrix Not Included)	D4305	50 Preps.
ZymoBIOMICS™ DNA Miniprep Kit	D4300T	5 Preps.
ZymoBIOMICS™ DNA Miniprep Kit	D4300	50 Preps.
ZymoBIOMICS™ DNA Miniprep Kit (Lysis Matrix Not Included)	D4304	50 Preps.
ZymoBIOMICS™-96 DNA Kit (Includes BashingBead™ Lysis Rack)	D4303	2 x 96 Preps.
ZymoBIOMICS™-96 DNA Kit (Includes BashingBead™ Lysis Tubes)	D4309	2 x 96 Preps.
ZymoBIOMICS™-96 DNA Kit (Lysis Matrix Not Included)	D4307	2 x 96 Preps.
ZymoBIOMICS™-96 Magbead DNA Kit (Includes BashingBead™ Lysis Rack)	D4302	2 x 96 Preps.
ZymoBIOMICS™-96 Magbead DNA Kit (Includes BashingBead™ Lysis Tubes)	D4308	2 x 96 Preps.
ZymoBIOMICS™-96 Magbead DNA Kit (Lysis Matrix Not Included)	D4306	2 x 96 Preps.

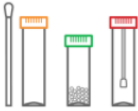


Individual Kit Components	Catalog No.	Amount
ZR BashingBead™ Lysis Tubes (0.1 & 0.5 mm)	S6012-50	50 Tubes
ZymoBIOMICS™ Lysis Solution	D4300-1-40	40 ml
ZymoBIOMICS™ DNA Binding Buffer	D4300-2-100	100 ml
ZymoBIOMICS™ DNA Wash Buffer 1	D4300-3-50	50 ml
ZymoBIOMICS™ DNA Wash Buffer 2	D4300-4-60	60 ml
ZymoBIOMICS™ DNase/RNase Free Water	D4302-5-10	10 ml
Zymo-Spin™ IC Columns	C1004-50	50 Pack
Zymo-Spin™ III-F Filters	C1057-50	50 Pack
OneStep™ PCR Inhibitor Removal Kit	D6030	50 Preps.
Collection Tubes	C1001-50 C1001-500 C1001-1000	50 Pack 500 Pack 1,000 Pack

Sample Collection	Catalog No.	Amount
DNA/RNA Shield™ - Lysis Tube (Microbe)	R1103	50 Pack
DNA/RNA Shield™ – Fecal Collection Tube	R1101	10 Pack
DNA/RNA Shield™ – Swab and Collection Tube	R1106 R1107	10 Pack 50 Pack
DNA/RNA Shield™	R1100-50 R1100-250	50 ml 250 ml

# Explore Other Microbiome Products

- ✓ To collect and transport samples at ambient temperatures:



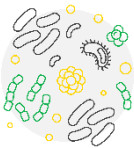
DNA/RNA Shield™ and Collection Devices	
1X Reagent #R1100	For sample lysis and stabilization of DNA/RNA
2X Concentrate #R1200	Reagent concentrate (2X) for use with liquids at 1:1 ratio
Fecal Collection Tube #R1101	15 mL container (prefilled with 9 mL DNA/RNA Shield™). Direct collection of up to 1g or 1 mL stool
Collection Tube w/ Swab #R1106	12 x 80 mm screwcap container filled with 1 mL DNA/RNA Shield™ and sterile swab for specimen collection

- ✓ Streamlined workflows with comprehensive bioinformatics analysis and publication-ready plots and figures:



ZymoBIOMICS™ Services	
Targeted Sequencing Service 16S #Q2001	With DNA Extraction
Targeted Sequencing Service 16S #Q2012	Without DNA Extraction
Targeted Sequencing Service ITS #Q2003	With DNA Extraction
Targeted Sequencing Service ITS #Q2003	Without DNA Extraction

- ✓ Microbial standards and references for profiling quality control, benchmarking, positive controls, and to assess performance of entire microbiomic/metagenomic workflows:



ZymoBIOMICS™ Standards and Reference Materials	
Microbial Community Standard #D6300	Contains 8 bacteria and 2 yeasts for QC and method optimization
Microbial Community DNA Standard #D6305	Contains 8 bacteria and 2 yeasts DNA for bioinformatics optimization
Gut Microbiome Standard #D6331	Contains 21 different human gut strains for method benchmarking
Fecal Reference with TruMatrix™ Technology #D6323	Contains real human fecal material for benchmarking and improved data reproducibility



## **100% satisfaction guarantee on all Zymo Research products, or your money back.**

Zymo Research is committed to simplifying your research with quality products and services. If you are dissatisfied with this product for any reason, please call 1(888) 882-9682.

---

Integrity of kit components is guaranteed for up to one year from date of purchase. Reagents are routinely tested on a lot-to-lot basis to ensure they provide the highest performance and reliability.

This product is for research use only and should only be used by trained professionals. It is not for use in diagnostic procedures. Some reagents included with this kit are irritants. Wear protective gloves and eye protection. Follow the safety guidelines and rules enacted by your research institution or facility.

<sup>™</sup> Trademarks of Zymo Research Corporation, © Registered Trademarks of Zymo Research Corporation  
Other trademarks: Vortex Genie® (Scientific Industries, Inc.), FastPrep® (MP Biomedicals), Precellys® (Bertin Technologies, Inc.), Illumina® MiSeq<sup>™</sup>, (Illumina Inc.), AcroMetrix<sup>™</sup>, Qubit® (Thermo Fisher Scientific Inc.), DNeasy® (Qiagen), Hydralock® (Puritan Medical Products), Bead Ruptor<sup>®</sup> (Omni International)



ZYMO RESEARCH

The **BEAUTY** of **SCIENCE** is to Make Things **SIMPLE**®



[tech@zymoresearch.com](mailto:tech@zymoresearch.com)



[www.zymoresearch.com](http://www.zymoresearch.com)



Toll Free: (888) 882-9682