Exploring the Microbial World

Over the past several years, Zymo Research has devoted tremendous efforts to improving the accuracy of microbiome measurements. We created the first commercial product of microbiome standard for quality control and profiling accuracy measurement. We released the first DNA extraction kit validated unbiased for microbiome profiling. Our product, DNA/RNA Shield™, can preserve microbiome profile at ambient temperature for more than 1 year, making it a perfect medium for the cold-free collection and transportation of microbial samples. With all these innovations, we have established the most accurate microbiome sequencing services for both academic research and industry partners.

Whether you need 16S/ITS Sequencing, Metagenomic Shotgun Sequencing, Metatranscriptomic Sequencing, or another custom sequencing solution, our microbiome analysis service team can take you from any stage of your project to a comprehensive microbiome report featuring publication-ready data.

Microbiomics
Made Simple™

Visit www.zymoresearch.com/pages/zymobiomic-services for a custom microbiome service quote
Microbiome Sequencing Services
Complete Solutions for Accurate Microbiome Profiling

Sequencing Workflows

16S/ITS Amplicon Sequencing
Species level resolution for bacterial and fungal profiling

Shotgun Metagenomics Sequencing
Across kingdom identification and metabolic functional profiling

Custom Solutions for Commercial Applications

Sample Collection & Kit Design
A variety of sample collection devices & branding options available

Custom Data Reporting
Bioinformatic reports to fit your application needs

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16S/ITS sequencing uses PCR to selectively amplify certain region/genes from different bacteria or fungi and then sequence the amplicons. The taxonomy identification is achieved by comparing the amplicon sequences to reference 16S/ITS sequence databases. 16S/ITS sequencing is generally considered simpler and more cost-effective than metagenomic sequencing, and is the better choice for certain samples that contain microbes with unknown genomes (e.g. soil and water samples).

With recent innovations in bioinformatics analysis (e.g. Dada2), the 16S/ITS sequencing can achieve close to zero false positive in taxonomy identification and can differentiate even single-nucleotide variation in amplicon sequences.

What makes Zymo Research different from other service providers?

- **Quick Turnaround:** From sample collection to report in as little as 2 weeks.
- **Species Level Resolution:** We provide species level resolution in 16S sequencing while others normally restrict to genus.
- **Unbiased Microbial Lysis:** Our DNA extraction methods are validated unbiased for microbiome profiling.
- **Absolute Quantification:** 16S/ITS copy number measurement for each species at no additional charge, instead of the standard percentage measurement.

### Species-Level Resolution

By combining sequence-analysis algorithm, Dada2 and a well-curated 16S reference database, we can provide species-level resolution with regular Illumina* sequencing of different 16S regions, e.g. V3-V4, V1-V2 and V1-V3.

### Unbiased Microbial Lysis

Many service providers use DNA extraction kits that are not validated for microbiome profiling, which can result in massive skew in the final profile. Our DNA extraction step is validated unbiased using the ZymoBIOMICS Microbial Community Standard. The standard is used as a positive control in every run.

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Shotgun Metagenomic Sequencing, in comparison to amplicon sequencing (e.g. 16S sequencing), is a more comprehensive way to characterize a microbiome sample. Shotgun sequencing provides across-kingdom identification and in theory, can detect all microbes except RNA viruses.

Metagenomic approaches provide strain-level taxonomy resolution with sufficient sequencing depth. Unlike amplicon sequencing, identification of functional genes and pathways is also possible.

Shotgun Metagenomic Sequencing is now more affordable with advanced sequencing technology.

**What makes Zymo Research different from other service providers?**

- **Quick Turnaround:** Results from sample to report in as little as 3 weeks
- **Strain-Level Resolution:** High confidence strain identification through our curated reference database
- **Comprehensive Bioinformatic Analysis:** Includes bar plots, heatmaps, diversity analysis, gene family & metabolic pathway profiling, identification of virulence gene & antibiotic resistance genes, and statistical group analysis.
- **Minimize False Positive:** innovative algorithms that minimize the number of false positives

### Controlling False Positives

While Zymo Research’s pipeline detects 5 microbial species, a pipeline from Service Provider D (built on Kraken) reported 202 taxa in total. We found that majority of these taxa are false positives. One major cause of these false positives is the presence of host DNA in the sample and the use reference microbial genomes contaminated by human genome sequences.

### Results of two bioinformatics pipelines analyzing the same raw sequence data derived from a vaginal swab sample.

<table>
<thead>
<tr>
<th>Species</th>
<th>Zymo Research (%)</th>
<th>Service Provider D (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lactobacillus iners</td>
<td>48.9</td>
<td>20.3</td>
</tr>
<tr>
<td>Klebsiella michiganensis</td>
<td>46.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Candida albicans</td>
<td>1.9</td>
<td>0.1</td>
</tr>
<tr>
<td>Enterococcus faecalis</td>
<td>1.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Klebsiella oxytoca</td>
<td>0.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Coprobacillus sp.</td>
<td>-</td>
<td>48.2</td>
</tr>
<tr>
<td>Klabsiella sp.</td>
<td>-</td>
<td>6.7</td>
</tr>
<tr>
<td>Beggiatoa sp.</td>
<td>-</td>
<td>7.5</td>
</tr>
<tr>
<td>Candidatus Pelagibacter</td>
<td>-</td>
<td>4.5</td>
</tr>
<tr>
<td>(k) Bacteria sp.</td>
<td>-</td>
<td>2.6</td>
</tr>
<tr>
<td>(ο) Enterobacteriaceae</td>
<td>-</td>
<td>1.1</td>
</tr>
<tr>
<td>(ο) Enterobacteriales</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>Vibrio campbelli</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>Psychrobacillus sp. FJAT-21963</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>Vibrio agarivorans</td>
<td>-</td>
<td>0.2</td>
</tr>
<tr>
<td>Mycobacterium kansasi</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>Paeniglucosidibacter antarcticus</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>Salmonella enterica</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>181 more taxa</td>
<td>-</td>
<td>2.7</td>
</tr>
</tbody>
</table>

**Ask us about our Metatranscriptomic pipeline**

Visit [www.zymoresearch.com/pages/zymobiomic-services](http://www.zymoresearch.com/pages/zymobiomic-services) to view a sample report and request a service quote
Sample Collection & Kit Design
Simple, Safe, & Stable

Zymo Research’s comprehensive catalog offers a way to partner with a single company for all your service and product needs. With Zymo Research, a variety of sample collection devices can be seamlessly paired with customizable Direct-to-Consumer kits. With our DNA/RNA Shield™ collection reagent, samples can be safely collected, stored, and shipped at ambient temperature without worrying about their stability.

Our experienced scientists will work directly with you to implement a personalized workflow for your business needs. Working with an industry-trusted partner ensures that your customers are getting the best results and de-risks your investment.

Collect the Following Sample Types:
✓ Saliva
✓ Blood
✓ Stool
✓ Urine
✓ Vaginal
✓ Environmental

Swabs, Tubes, & Buffers for All Your Collection Needs

Ask us how we can implement your custom branding into your kits and reports!

Visit www.zymoresearch.com/pages/zymobiomic-services for a custom microbiome service quote
Custom Data Reporting
Your Results, Your Way

Customizable Data Reports  Automatically Generated Plots  Detect Pathogens, Antibiotic Resistance, etc.

Simplify NGS Data Interpretation for Your Clients

Patient: John Doe  DOB: 6/7/89
Test: Metagenomic Pathogen Detection  Ordered by: Dr. Smith

Comprehensive Microbial Analysis

Detected Pathogens

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Relative Abundance (%)</th>
<th>Absolute Abundance (p of cells)</th>
<th>Associated Disorder(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>55.0</td>
<td>$1.7 \times 10^7$</td>
<td>Bacteremia, Otitis Media, Upper Respiratory Infection, Ear Infections [1] [7]</td>
</tr>
<tr>
<td>Brevibacterium oitidis</td>
<td>37.7</td>
<td>$1.6 \times 10^6$</td>
<td>Bacteremia, Otitis Media, Ear Infections [1] [7]</td>
</tr>
</tbody>
</table>

Learn more and inquire about custom microbiome solutions at www.zymoresearch.com/pages/custom-manufacturing-solutions
The **BEAUTY** of **SCIENCE** is to Make Things **SIMPLE**®