Title
HuMiChip: Development of a Functional Gene Array for the Study of Human Microbiomes

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**ABSTRACT**

Microbiomes play very important roles in terms of nutrition, health and disease by interacting with their hosts. Based on sequence data currently available in public domains, we have developed a functional gene-based array, human microbiome chip (HuMiChip) to monitor both organismal and functional gene profiles of normal microbiota in human hosts. In this study, we have included 322 genomes of bacterial strains from different human body sites, and 27 human gut metagenomes. First, seed sequences were identified from KEGG databases, and used to construct a seed database (seedDB) containing 139 gene families in 20 metabolic pathways closely related to human microbiomes. Second, a mother database (motherDB) was constructed with the 322 bacterial genomes and 27 metagenomes, and used for gene selection and probe design. Gene prediction for metagenomes was carried out by the MG-RAST server. In total, there are 913,192 and 2,157,747 sequences for bacterial genomes and metagenomes, respectively. Then the motherDB was searched against the seedDB using the HMMer program, and gene sequences in the motherDB that were highly homologous with seed sequences in the seedDB were used for probe design by the CommOligo software. In addition, manual inspection for the HMMer output was carried out, and keywords for each gene were designed and used. Different degrees of specific probes, including gene-specific, inclusive and exclusive group-specific probes were selected. All candidate probes were checked against the motherDB and NCBI databases for specificity. Finally, 36062 probes covering 47979 sequences were designed, and this HuMiChip is expected to be able to detect the diversity and abundance of functional genes, the gene expression of microbial communities, and potentially, the interactions of microorganisms and their hosts.

**RESULTS**

Figure 1. Major steps for construction of a comprehensive HMM functional gene array. *CommOligo* is the core program to select gene-specific, inclusive and exclusive group-specific oligonucleotide probes. The designed probes are also checked with NCBI and MotherDB for specificity using BLAST.

**REFERENCES**


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**CONCLUSIONS**

1. The developed HuMiChip contains 36062 probes covering 47979 bacterial sequences from different human body sites, targeting 19 most important pathways and 139 gene families for microbial bacteria.

2. This HuMiChip is able to detect the diversity and abundance of functional genes, the gene expression of microbial communities, especially in human gut, and potentially, the interactions of microorganisms and their hosts.
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