WHITEPAPER

Understanding FISH vs NGS Capabilities

EMPIRE GENOMICS
a Biocare Medical Company

BIOCARE MEDICAL

Understanding FISH vs NGS Capabilities

Introduction

Fluorescence in situ hybridization (FISH) and Next Generation Sequencing (NGS) are powerful tools used in various clinical labs and medical research domains. While they share the common goal of analyzing genetic material, they differ significantly in their approach, capabilities, and applications. Each technique provides significant relevant medical information and this whitepaper provides a comprehensive comparison of them, highlighting their respective uses, advantages, and disadvantages.

Note: This whitepaper provides a general overview of FISH and NGS. Specific applications and technical considerations may vary depending on the clinical application, research study, and assay design.

Understanding FISH and NGS

Fluorescence In Situ Hybridization (FISH) FISH is a cytogenetic technique that utilizes genetic probes labeled with fluorophores to detect and localize specific DNA sequences within a chromosome or cell. The core principle of FISH lies in the complementary base pairing between the probe and the target DNA, RNA, or mRNA sequence. Probes are typically short, single-stranded DNA, RNA, or mRNA molecules that are labeled with fluorescent dyes. When exposed to denatured chromosomal DNA, the probes hybridize to their complementary sequences, allowing for visualization under a fluorescence microscope.

Next Generation Sequencing (NGS) NGS has revolutionized biological and medical research by providing unprecedented access to genomic information, capable of sequencing millions or billions of DNA or RNA fragments simultaneously. It provides a comprehensive overview of genetic information, allowing for genome-wide analysis, gene expression profiling, and variant detection.

Benefits, Advantages, and Disadvantages

FISH

Uses:

- Detecting chromosomal abnormalities in prenatal patients
- Identifying chromosomal translocations, amplifications, and deletions associated with cancer.
- Diagnosing and classifying different leukemias and lymphomas.
- Diagnosing genetic disorders caused by chromosomal abnormalities.
- Identifying microbial or viral pathogens.

Advantages:

- Provides a clear and immediate visual representation of target sequences
- Compared to other cytogenetic techniques, FISH is relatively quick.
- Probes can be designed to target specific genetic sequences with high accuracy.
- Applicable to both fixed and fresh samples.

Disadvantages:

- Limited to a small number of target sequences per experiment, usually anywhere from one to four genetic targets.
- Labor-intensive and requires specialized expertise.
- Susceptible to false positives and negatives.

NGS

Uses:

- Identifying genetic variants associated with diseases, understanding disease mechanisms, and developing personalized medicine.
- Studying microbial genomes, identifying pathogens, and tracking disease outbreaks.
- Characterizing tumor genomes, identifying cancer-specific mutations, and developing targeted therapies.

Advantages:

- Ideal for genome-wide studies, gene expression analysis, and variant discovery.
- Enables identification of novel biomarkers and therapeutic targets.
- Applicable to a wide range of biological samples.

Disadvantages:

- High cost and computational demands.
- Requires specialized bioinformatics expertise for data analysis.
- Potential for generating large amounts of complex data and the need for data storage.

Comparative Analysis

Feature	FISH	NGS
Target	Specific DNA sequences	Genome-wide or targeted sequencing
Throughput	Low	High
Cost	Relatively low	High
Data analysis	Simple	Complex
Applications	Chromosomal abnormalities, gene amplifications, deletions	Genome sequencing, gene expression, variant analysis

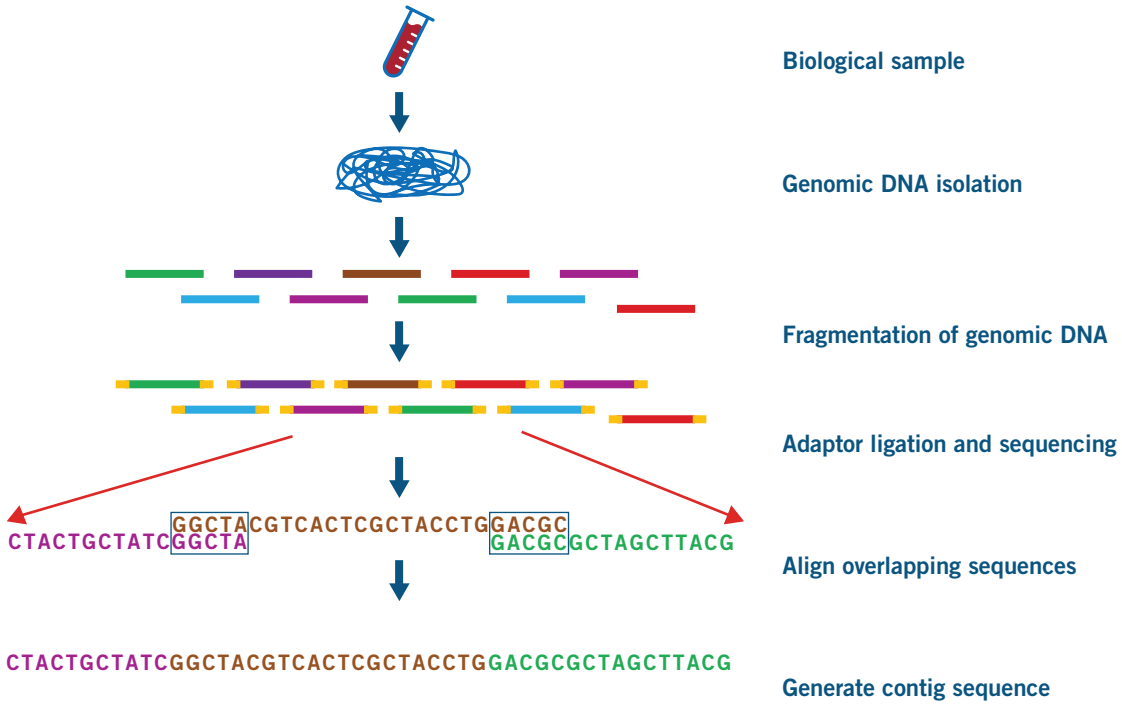
Complementary Techniques

In many cases, FISH and NGS can be used in combination to provide a more comprehensive analysis. For example, FISH can be used to validate NGS findings or to localize specific genetic alterations identified through sequencing.

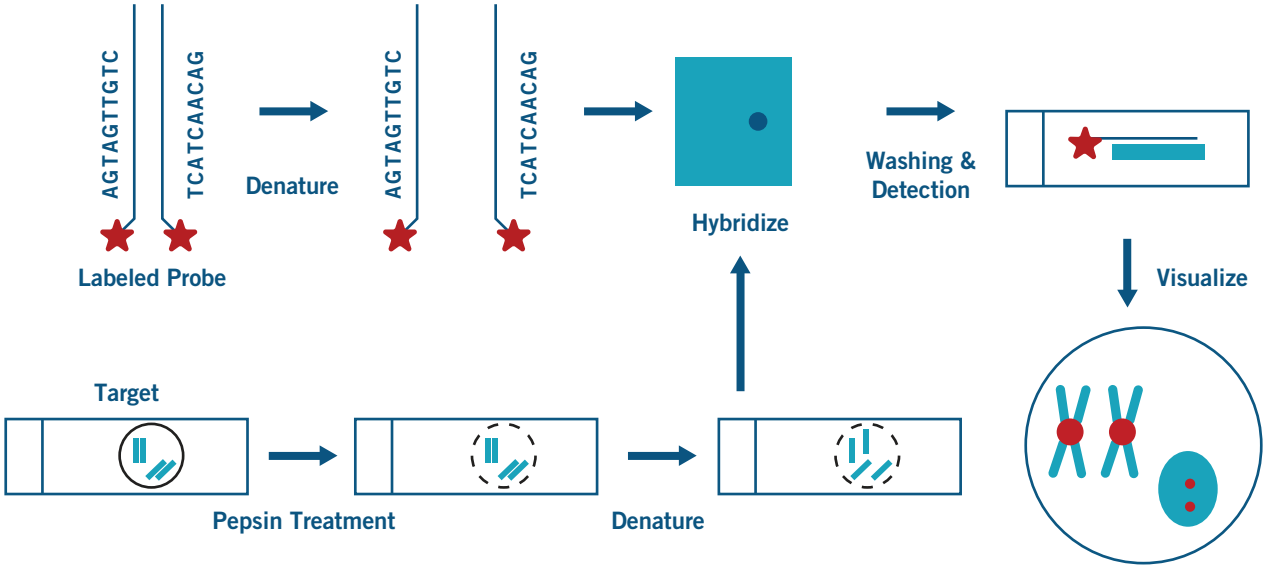
Conclusion

FISH and NGS are valuable tools with distinct strengths and weaknesses. The choice of technique depends on the specific research question, available resources, and desired outcome. By understanding the advantages and disadvantages of each method, researchers can effectively select the most appropriate approach for their studies.

Figures



Basic principle of next generation sequencing technologies[1]



FISH Protocol[2]

1. Application of Molecular and Serological Diagnostics in Veterinary Parasitology - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Basic-principle-of-next-generation-sequencing-technologies_fig4_291171327 [accessed 13 Aug 2024]
2. Wan, T. S. K., & Ma, E. S. K. (2012). The Role of Fish in Hematologic Cancer. International Journal of Hematologic Oncology, 1(1), 71–86. https://doi.org/10.2217/ijh.12.9