Regional Perspective on Use of Whole Genome Sequencing for Food Safety

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Overview

Next Generation Sequencing (NGS)

- Increasing trend in SEA, particularly in Malaysia → food safety and public health research

- Limited application in governmental agencies and food industry
Application of Next Generation Sequencing

Food / Environmental samples

1. targeted sequencing of the hypervariable regions of SSU rRNA gene
2. High-throughput sequencing

Metagenomics

Whole-Genome Sequencing (WGS)

-- Salmonella spp.
-- Listeria monocytogenes
-- Vibrio parahaemolyticus
-- Vibrio cholerae
-- Shigella spp.

Transcriptomics

Metatranscriptomics

Pure isolates

NGS Application in SEA and Malaysia

• Web of Science (WoS)
• TITLE: (Whole Genome) OR TITLE: (Metagenome) OR TOPIC: (Next Generation Sequencing)
• Refined by: DOCUMENT TYPES: (ARTICLE)
• Timespan: 2006-2016.
• Indexes: SCI-EXPANDED, ESCI.

Total record = 16,376 articles

Global 15,984 articles (98%)
SEA 392 articles (2%)

• Myanmar (1%)
• Cambodia (2%)
• Indonesia (4%)
• Philippines (6%)
• Vietnam (7%)
• Thailand (21%)
• Singapore (39%)
• Malaysia (20%)

Total record = 16,376 articles
NGS Projects registered with Genome OnLine Database (GOLD)


Research Area of recorded articles as defined by WoS

Top 15 International Collaborator of NGS Articles from SEA

Top 15 Funding Agencies of NGS Projects from SEA
Centers with NGS facility registered with Genome OnLine Database (GOLD)


Centers with NGS Facility in Malaysia

• Malaysia Genome Institutes (MGI)
• University of Malaya
• National University of Malaysia
• Universiti Putra Malaysia
• University of Science Malaysia
• Monash University Malaysia
• Ministry of Health Malaysia (International Food Safety Training Centre)

Challenges of Promoting NGS Application for Food Safety in SEA and developing countries

- Estimated establishment cost of NGS facility in developed countries → USD100K – 700K
- Estimated establishment cost of NGS facility in developing countries → at least 2-3x higher
- Shipment and customs, taxes, exchange rate, profit margin
- Lack of maintaining and operational cost
  • annual service and maintenance, cost of reagents and kits

Challenges

- High cost of establishing and maintaining
- Limited funding
- Limited skilled/professional personnel
- Poor internet access
- Low quality of outsourcing services
- Lack of motivation/driving factors
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Challenges

- Cost to conduct WGS is high relative to research funding provided in SEA
- In Malaysia, research funding per project generally ranged from RM100k – 300k
- WGS outsource → RM2-3k/bacterial genome (with 100x coverage)
- Food industry ????

- Need trained personnel with knowledge in biology, chemistry and bioinformatics
- Limited expertise in bioinformatics

- Genomic data download and manipulation require fast and stable internet connections
- Stability and speed of internet in SEA is generally below average
Challenges

- High cost of establishing and maintaining
- Limited funding
- Limited skilled/professional personnel
- Poor internet access
- Low quality of outsourcing services
- Lack of motivation/driving factors

Genomic data download and manipulation require fast and stable internet connections

- Stability and speed of internet in SEA is generally below average
- Also, the cost of internet access is relatively high in SEA

Almost all NGS projects are research basis conducted by academicians

- Application of NGS in food industry is limited
- Unaware of NGS and its benefit and application in food industry
- High cost
Challenges

- Lack of access to NGS facility → outsourcing
- Various quality outsource service
- Outsource company send samples to overseas company for NGS service
  - Improper handing during transportation
  - Long service timing (1-3 months)
  - High failure rate
  - Expensive

Strategies

- Research funding
  - Collaboration between academics and food industry
- International collaboration and partnership
  - Training of expertise
  - Funding
- User friendly bioinformatics system/platform
- Clear guidelines

International Efforts to Promote NGS Application in Food Industry

Microbiological Food Safety Task Force Expert Group
“The Use of Next-Generation Sequencing (NGS): Translation into Practice”

To prepare guidelines on NGS application for microbiological food safety in food manufacturing

Experts and representatives from:
- FDA
- FAO
- CDC
- Food industry (Nestle, Unilever, Danone, Pepsi Co., Arla Foods, Merieux, Mondelez Europe, Fuji Oil)
- Academicians (Japan, Europe, Malaysia)

Conclusion