Exploitation of animal microbiomes for veterinary applications

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Overview

✓ Animals (Livestock)

✓ Microbiomes

✓ Microbiome derived compounds

✓ Exploitation for Veterinary applications
  • Case studies
Animals (Livestock)

Livestock are domesticated terrestrial animals that are raised to provide a diverse array of goods and services such as traction, meat, milk, eggs, hides, fibres and feathers.

A third of all proteins consumed by people comes from animal food sources.

For many people, animals including livestock are synonymous to living, livelihood and wellbeing.

“Microbiome” is a combination of the words “micro” and “biome”, meaning a “characteristic microbial community” in a “reasonably well-defined habitat which has distinct physio-chemical properties” as their “theatre of activity”.

The microbiome is the community of microorganisms (such as fungi, bacteria, archaea, viruses and) that exists in a particular environment.

It is often used to describe the microorganisms that live in or on a particular part of the body, such as the skin or gastrointestinal tract.
These groups of microorganisms are dynamic and change in response to a host of environmental factors, such as exercise, diet, medication and other exposures.
Animal gut: A case study of microbiome exploitation

Animal microbiomes offer a wealth of bioactive compounds for veterinary applications

Bacteria: $10^9$-$10^{10}$/mL

Protozoa: $10^4$-$10^6$/mL

Fungi: $10^3$-$10^4$/mL

Archaea (methanogens) ~ $10^4$/mL

The rumen microbiome in action
Enabling technologies for microbiome exploitation

Understand the microbiome community: who is there?

Understand the microbiome function: what do they do?

Global Rumen Census samples

Henderson et al 2015 Sci Rep 5, 14567
https://doi.org/10.1038/srep14567

Hungate Collection: 410 bacteria and archaeal genomes sequenced

The ‘UK Five Year Antimicrobial Resistance (AMR) Strategy’, developed by BBSRC, Veterinary Medicines Directorate (VMD) of the Department for Environment, Food and Rural Affairs (Defra), the Northern Ireland Executive, the Scottish government, the Welsh Government and the UK Public Health agencies
Exploiting animal microbiomes: Novel antimicrobials

Several antimicrobial peptides

Genomic + Culture + AI in silico → ~30 lead compounds

Prokaryotome + Eukaryotome

UK Patent number: GB1621737.4

Exploiting animal microbiomes: Novel antimicrobials

- Short AA AMPs – low cost
- Low MICs against a range of pathogenic bacteria
- Rapid bactericidal killing
- Anti-biofilm activity
- Minimal cytotoxicity against mammalian cell lines
- Multimodal target/mechanism of action
- No detectable resistance
- Excellent templates for the design of novel veterinary therapies
- Further opportunities for modifications and positive improvements
Exploiting animal microbiomes

Murine model of MRSA wound infection

Veterinary applications
Exploiting animal microbiomes

Livestock and poultry production

- Mastitis
- Blackhead disease
- Treatment and animals

Feed additive  Immunomodulants  Anti-inflammatives

Veterinary medicine

- Bacteriaemia
- Mycoses
- Probiotics

Mycoses

Cecacin_56 Biofilm prevention

Esophageal candid By Rosalie Ierardi

Mastitis

Crop Mycosis in Turkey

Turkey

Crop Mycosis in Turkey

1/2x MIC  1x MIC  2x MIC  3x MIC

Biofilm Reduction (%)
Animal microbiomes are complex but offer an abundance of explorative research outcomes crucial for veterinary applications.