EU-China expert seminar

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Report from the thematic session on

"Animal health - Intracellular Pathogens"

Participants

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1) Overview of relevant running Horizon 2020 projects and/or topics

Current EU-China project collaborations

1. SAPHIR (*Strengthening Animal Production and Health through the Immune Response*) Targets Porcine Reproductive and Respiratory Syndrome Virus and Mycoplasma hyopneumoniae of pigs; Eimeria and Clostridium perfringens of chickens; Bovine Respiratory Syncytial Virus and Mycoplasma bovis of cattle to develop generic vaccine approaches applicable to other pathogens
2. PARAGONE (*Vaccines for animal parasites*) targeting Ruminant helminths Fasciola hepatica, Cooperia spp., Ostertagia ostertagi, Teladorsagia circumcincta and Haemonchus contortus and, the ectoparasitic mites, Psoroptes ovis (ruminants) and Dermanyssus gallinae (poultry)

Recently completed project

LinkTADs (*Linking Epidemiology and Laboratory Research on Transboundary Animal Diseases and Zoonoses in EU and China*) bringing together world-class research institutes and experts in cross-border cooperation with the aim to coordinate research between the EU and China, thus improving scientific excellence in animal health (epidemiology and laboratory) (http://www.linktads.com)

Animal health related topics in 2017 Work Programme

1. Alternative production systems to address anti-microbial drug usage, animal welfare and the impact on health – RIA; SFS-46-2017 - *EU-China FAB Flagship initiative.*

Other collaborative research topics which could involve Chinese partners:

2. Research and approaches for emerging diseases in plants and terrestrial livestock – RIA; SFS-10-2017

3. Validation of diagnostic tools for animal and plant health - Innovation Action (IA); SFS-13-2017
4. Bee health and sustainable pollination – RIA; SFS-16-2017

2) Overview of challenges from the EU and China

Challenges in the EU

EPIZOOTIC disease challenges in Europe

Diseases: - Schmallenberg virus; Bluetongue; Lumpy Skin Disease; African Swine Fever, Avian Influenza

Solutions needed: - Better vaccines; Better monitoring strategies/frontline diagnostics/ early warning; Surveillance strategies; Increased insight into drivers of disease outbreaks

Pig Disease challenges

Emerging and re-emerging diseases (PRRSV; PED); Piglet diarrhoea (PED; TGE; Rotavirus); Diarrhoea post weaning (E.coli; Lawsonia intracellularis; Brachyspira); Porcine Respiratory Disease Complex-PRDC (Mycoplasma; Actinobacilus; Pasteurellosis (+ PRRSV/PCV/Influenza)); Zoonotic infections (Salmonellosis; Methicillin Resistant Staphylococcus Aureus - MRSA)

Research needs: - Vaccinology (multivalent; application route); Minimal Disease Production Systems (Housing; animal movements) notably to reduce the need to use anti-microbials and related public health risk; Pen-side diagnostics (On-line monitoring of symptoms/infections; Real-time)

Intra-cellular pathogens (with particular reference to bacterial infection of macrophages)

Diseases: - Brucellosis; Tuberculosis, Paratuberculosis; Q fever; Salmonellosis

Protozoal diseases: Eimeria (poultry coccidiosis resulting from infection of gut epithelial cells by the Eimeria parasite); nowadays coccidiostats are authorised; a vaccine with old production methods is available

Research needs: - Improved vaccines – need to gain a better understanding of the pathogen- host cell interaction to develop new vaccine candidates

Epidemiology

a) Towards improved surveillance and control strategies - Understanding the risks of disease emergence, introduction, endemic cycle; Understanding the constraints of current strategies (technical, social and economic); Innovative surveillance design (risk-based; syndromic etc…); Evidence based strategies
b) Promoting economic evaluation - innovative and adapted methods; development of decision tools.
c) Promoting One Health approaches - how to integrate animal and public health surveillance (including wildlife and disease vector surveillance); How to implement One Health actions in the field; Understanding its added value.
d) Promoting participatory approaches - interdisciplinary research (epidemiology, sociology, economy)
e) Improving information sharing and regional approaches - standardised epidemiological approaches (spatial, molecular…)

Challenges in China

Protozoal Disease Challenges:

Babesia, Theileria, Toxoplasmosis, Eimeria

Research needs: Epidemiology, Vaccines - Structural analysis and bioinformatics of target proteins; Chemical control – Identification of replacement drugs for the control of protozoa (Chinese herb screening and identification of their mode of action on protozoa; Application of screened Chinese herbs in the treatment of piroplasma infection).

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Contagious Bovine Pleuropneumonia control research. CBPP eradicated from China; experience with Ben1 vaccine; emerging cooperation with Africa
Research needs: - Surveillance of CBPP; improve live vaccine, new field strain protection examination; Explore the immune mechanisms of CBPP vaccination
Tuberculosis and brucellosis are endemic diseases of relative importance
Research needs on Tuberculosis: - epidemiology; protein function exploration.

Vaccinology
There is emerging concern that mass vaccination in China to contain endemic production diseases using vaccines that fail to produce sterile immunity may be driving pathogen evolution with the micro-organisms involved becoming more virulent/pathogenic.
Research needs: Epidemiological studies (using archival samples and data on vaccine utilization) complemented with targeted experimental studies

Epizootic and other diseases of main interest/concern:
Those of most concern are in pig production: PRRS; classical swine fever-CSF (controlled by vaccination); PRDC; pseudorabies (serious emergence); Porcine Epizootic Diarrhea (relatively inefficient live vaccine); Transmissible Gastroenteritis (TGE); Porcine Circo Virus (efficient killed vaccine available); FMD.
CSF and pseudorabies might become candidates for eradication policies.
Avian influenza (vaccination policy)and Japanese encephalitis are important in other species

3) Common challenges and role of the R&I

Common Challenges

Epizootic diseases – Most important diseases present in Europe and China are different and therefore priorities are largely different (Avian Influenza of interest to both but control approaches differ, with the use of vaccines in China).

Epidemiology/surveillance - Development of risk-based surveillance approaches and the decision tools to design and evaluate surveillance programs (including economic evaluation).

Endemic Diseases / pig diseases - PRRSV and Porcine Respiratory Disease Complex; Brucellosis; Tuberculosis; Coccidiosis would appear to be of mutual interest. Improved vaccines are needed for all of these diseases.
Porcine Respiratory Disease Complex (which includes Mycoplasma hyopneumonia), tuberculosis and brucellosis are all bacterial diseases. **There are few good bacterial vaccines and further research is required to address the knowledge gaps in the underpinning science**.
Vaccines are available to protect poultry against coccidiosis (Eimeria) but the current vaccine is produced in chicken and isn't sustainable in the longer-term if it is required for broilers.

Vaccines are also available for PRRSV but recombination of the vaccine attenuated virus with field strains is resulting in genetic drift of the organism so vector vaccines would therefore be ideal to prevent the vaccine contributing genetic material to an already rapidly evolving pathogen.
Research on Mycoplasma hyopneumonia, PRRSV and Coccidiosis is included in the SAPHIR project which involves EU and Chinese partners.

Vaccine technology – In addition to the need for new or improved vaccines for the specific disease challenges of mutual interest mentioned above, vaccines in general need to be improved. This will require an improved understanding of the underpinning immunology, in particular relating to immunological memory and the generation of cytotoxic T-cell responses. Research is also needed to improve vaccine vectors, multivalent vaccines and ease of application.
That vaccines which are less than ideal might be driving pathogen evolution resulting in the organisms becoming more virulent is also an area of mutual interest.

Alternatives to anti-microbials
In addition to vaccines that can reduce the need for anti-microbials (at least for certain diseases), China is active on traditional medicine such as herbs. The development of new anti-microbials is of limited interest in Europe however alternatives to anti-microbials are a potential area of interest for both China and EU.
Minimal disease production methods & systems with a One-Health perspective are needed for pig production to reduce pathogen evolution and their transfer to humans. Although the subject of a call in the 2017 Work Programme this is a very broad area and will need more than one research project.

EU-CN added value of tackling the challenges jointly
Much of the research needed on the specific disease challenges identified and in moving vaccine technology forward is basic science which will require considerable capacity for molecular biology (genomics/transcriptiomics) studies. China's strengths in this area make them ideal partners for these studies.

Comments:
In preparation for the meeting the Chinese side had suggested basic research to which the EC added a focus on intracellular pathogens, where there are particular problems, especially in relation to bacterial infections of macrophages, requiring basic research to address the knowledge gaps.