

Nature \rightleftharpoons Technology

WIAS Science Day 2016

Our generation of young scientists has been one of the great technological advancements. Implementing designs from nature, gained through observation of animals, the environment, and their interaction, has contributed to the development of novel technologies and has allowed for significant improvement of those already in existence. In turn, application of this technology has enhanced our understanding of animal nutrition, behaviour, breeding and genetics. Technology has allowed us to improve human and animal health, and to achieve a more responsible food production and sustainable environment.

During this WIAS Science Day, we invite you to highlight your research, exchange ideas, and gain inspiration from our keynote speakers about how technology in the 21st century is changing the way we study, and consequently improve, the natural world around us. We have invited two keynote speakers to share their experiences using technology to compliment nature, and using nature to optimize our technological advances. We have also invited 41 of your fellow PhD colleagues to present their work in the form of poster and oral presentations addressing topics including animal health, production, and behaviour, and environment and sustainability as it relates to nature and technology.

Oral presentations will be given by PhD candidates in parallel sessions as outlined by the program on pages 2 and 3 of these proceedings. Posters will be introduced in a “Poster Flash” session in the morning and will be on display for your viewing during lunch and coffee breaks.

It has been our pleasure to organize this showcase of PhD research. The WIAS Science Day is by us and for us, PhD candidates! We hope you will use this opportunity to connect with colleagues, expand your knowledge, and become inspired by the potential of nature and technology!

Sincerely,

WIAS Science Day 2016 Committee

Xiangyu Song (FTE), Juncai Chen (ADP), Julian Langowski (EZO), Pierre Moquet (ANU),
Wenjuan Mu (APS), Kelly Nichols (ANU), Olaf Perdijk (CBI)

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Dear participants of the WIAS Science Day, dear colleagues,

The organizing committee of the WIAS Science Day has composed a splendid programme with two distinguished key-note speakers and more than 40 contributions by WIAS PhD candidates. The committee selected the interaction between Nature and Technology as the overarching theme, an excellent choice. A great many discoveries in the natural sciences were only possible after a key-technological innovation, such as the patch clamp technique in neurosciences. On the other hand, nature provides an almost unlimited reservoir of solutions to functional problems. The effective exploitation of this reservoir as a source for novel designs is an exciting research area that still has to show its full societal potential.

Observing how animals perform and move about in their natural environment depends on high-tech observational techniques. This is particularly true for the marine environment. Advances in biotelemetry have made it possible learn a great deal about free-ranging marine vertebrates as will be highlighted by the first key-note speaker, Dr. Oliver Jewell from the Royal Netherlands Institute for Sea Research, a pioneer in this particular field. Biomimetics is a rapidly expanding research field, with a huge potential to generate useful technological solutions for mankind. Key note speaker and biomimetics expert Professor Stanislav Gorb (University of Kiel) unravels the underlying mechanisms of frictional and adhesive systems, as well as the functional significance of biological materials, and uses the elucidated biological principles to design smart adhesive systems.

Recently, Professor Johan Verreth finalized his directorship of WIAS and Denise Magendans stopped as WIAS executive secretary. They formed a highly motivated and stimulating team. Several new initiatives were generated. An example is the WIAS graduate programme that resulted in the start of several new PhD research projects, each supervised by multiple chair groups. They also provided their vital support for the successful 2015 WIAS peer review. We are more than grateful for their enthusiasm and considerable efforts to bring WIAS to the fore front of Animal Sciences and to foster a stimulating research environment, in particular for our PhD candidates.

Personally, I look forward to serve the WIAS community for the coming four years, together with the newly appointed executive secretary, Janneke van Seters, and the other members of the WIAS team, Marianne Bruining and Annet Willink.

I wish you a stimulating WIAS Science day with a lot of inspiring talks and posters, and social interactions.

Johan van Leeuwen
WIAS Scientific Director

Programme | WSD 2016

08:30	Registration & Welcome Drink <i>Orion restaurant, ground floor</i>		
09:00	<i>Orion C1032 / C2030 / C2035</i> Opening by WIAS Science Day 2016 Organizing Committee		
09:05	Welcome by WIAS Scientific Director, Prof. Johan van Leeuwen		
09:30	Keynote Speaker: Oliver Jewell (NIOZ) Advances in biotelemetry techniques to study large fish, sharks, and rays		
10:20	Poster Flash Session		
11:00	Coffee Break		
	<i>Orion C1032</i> Session A Animal Health I Chair: Nazri Nayan	<i>Orion C2030</i> Session B Animal Production Chair: Sabine van Engelen	<i>Orion C2035</i> Session C Animal Behaviour Chair: Henk van Lingen
11:30	Marloes van Splunter (CBI) Tissue-specific homing potential and kinetics of B and T cell responses to oral cholera vaccination	Simon Omasaki (ABG) Genotype by environment interaction for harvest weight, growth rate and shape between monosex and mixed sex Nile tilapia (<i>Oreochromis niloticus</i>)	Lies Zandberg (BHE) Mate choice a matter of taste? Individual variation in mate preference in great tits (<i>Parus major</i>)
11:50	Anoop Arya (ABG) Building a miRNA atlas of the pig	Tu Tran (AFI) Effect of grinding screen sizes and guar gum levels inclusion on digestibilities, growth and faecal characteristics of stripped catfish (<i>Pangasianodon hypophthalmus</i>)	Sofie van Nieuwamerongen (ADP) Development of piglets raised in either a multi-litter system or a single-litter system
12:10	Genet Mengistu (ANU) Anthelmintic activity of tanniniferous browse against <i>Haemonchus contortus</i> infective stage <i>in vitro</i>	Aart van der Linden (APS) Benchmarking beef production systems across the world for improved production and resource use efficiency	Yvonne van der Meer (ANU) Tail and ear biting behaviour in pigs affected by sanitary conditions, dietary amino acid profile, and crude protein level
12:30	Lunch & Poster Viewing <i>Orion restaurant, ground floor</i>		
	<i>Orion C1032</i> Session D Animal Health II Chair: Marloes van Splunter	<i>Orion C2030</i> Session E Environment & Sustainability Chair: Aart van der Linden	<i>Orion C2035</i> Session F Aquaculture Chair: Sofie van Nieuwamerongen

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14:00	Rogier Gaiser (HMI) Antimicrobial peptides from porcine microbiota against <i>Streptococcus suis</i>	Linda Veldhuizen (APS/MCB/BEC) Consumer interest in social sustainability issues of whitefish from capture fisheries in the northeast Atlantic	Eva Doro (CBI) Establishment and characterization of a trypanosome infection in zebrafish
14:20	Tetske Hulshof (ANU) Guanidination of amino acids: what is going on?	Avhafunani Netshipale (APS) Land Redistribution in South Africa- beneficiation and land use	Kim Tran (AFI) Effects of salinity level and diet composition on intestinal morphology of Nile tilapia (<i>Orechromis niloticus</i>)
14:40	Nirupama Benis (HMI) Network analysis of temporal functionalities of the gut induced by perturbations in new-born piglets	Hannah van Zanten (APS) The role of livestock in a sustainable diet: a land-use perspective	Carmen Embregts (CBI) Oral DNA vaccination of carp; involved mechanisms and immune responses
15:00	Coffee Break		
15:30	<i>Orion C1032 / C2030 / C2035</i> Keynote Speaker: Stanislav Gorb (University of Kiel) Insect inspired adhesives: Where are we now?		
16:20	Awards Ceremony		
17:00	Drinks & Dinner <i>Zodiac, main hall</i>		

Advances in biotelemetry techniques to study large fish, sharks and rays

Oliver Jewell

Royal Netherlands Institute for Sea Research (NIOZ)

The process of placing transmitters on wildlife in order to understand behavioural, physiological or ecological mechanisms is defined as 'animal biotelemetry'. Many marine species are difficult to study because components of their lifecycles occur solely or partially outside of the observable realm of researchers.



Advances in the technology of telemetry equipment has begun to give us glimpses into these unobservable states, however there is no such thing as the perfect tag. Careful planning is required and the type of tag selected will depend on the research questions to be asked and the strengths and weaknesses of the tags available. This key note talk will focus on techniques selected, tried and tested for research on white sharks *Carcharodon carcharias* in Southern Africa. It includes examples of acoustic, satellite and video telemetry which have improved our understanding of this mysterious predator.

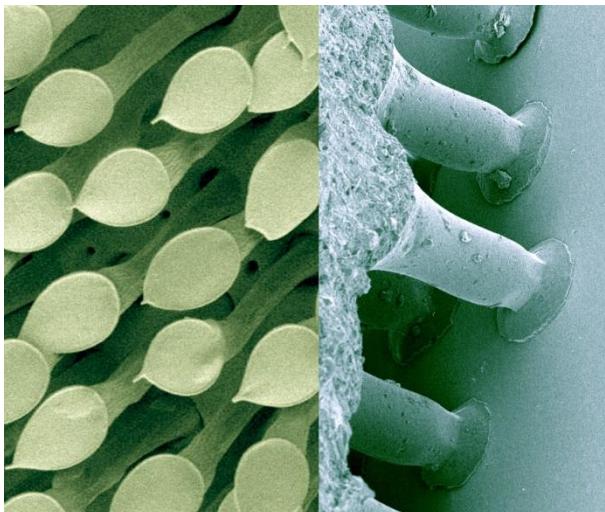
Oliver first joined Marine Dynamics in 2007 as a volunteer, while studying Oceanography at the National Oceanography Centre, Southampton. After returning to the UK and earning his Bachelor of Science with honours from the University of Southampton, Oliver returned to South Africa to continue studying great white sharks. He spent a year in Mossel Bay with Oceans Research tagging and acoustically tracking sharks, before re-joining Marine Dynamics and the Dyer Island Conservation Trust as full-time crew member, biologist and skipper in 2009. Biotelemetry has formed the backbone of his research expertise and he has tagged 50+ white sharks with a variety of satellite, acoustic, and camera/accelerometer tags, both directly through his research activities with the Dyer Island Conservation Trust, and in collaborations with Ocearch, Stanford University, Oceans Research, and Customised Animal Tracking Solutions (CATS). He has the claim-to-fame of being the only researcher to tag three of South Africa's most iconic white sharks – Slashfin, Nemo and Zane and in 2013, earned his Master's in Zoology through University of Pretoria on white shark movement patterns. He recently published the first of the findings from our acoustic tracking programme in *Marine Ecology Progress Series*. Currently, Oliver is employed by the Royal Netherlands Institute for Sea Research (NIOZ), where he is the principle investigator of ecology within the EMERGO Project, but remains an associate biologist with the Dyer Island Conservation Trust, and regularly returns to South Africa to conduct research.



Insect inspired adhesives: Where are we now?

Stanislav Gorb

Zoological Institute, University of Kiel



Insect attachment systems demonstrate their excellent adhesion and high reliability of contact. The structural background of this functional effect will be discussed. It will be demonstrated how comparative experimental biological approach can aid in development of novel tribological materials and systems. Biomimetic mushroom-shaped fibrillar adhesive microstructure inspired by these systems was characterized using a variety of measurement techniques and compared with a control flat surface made of the

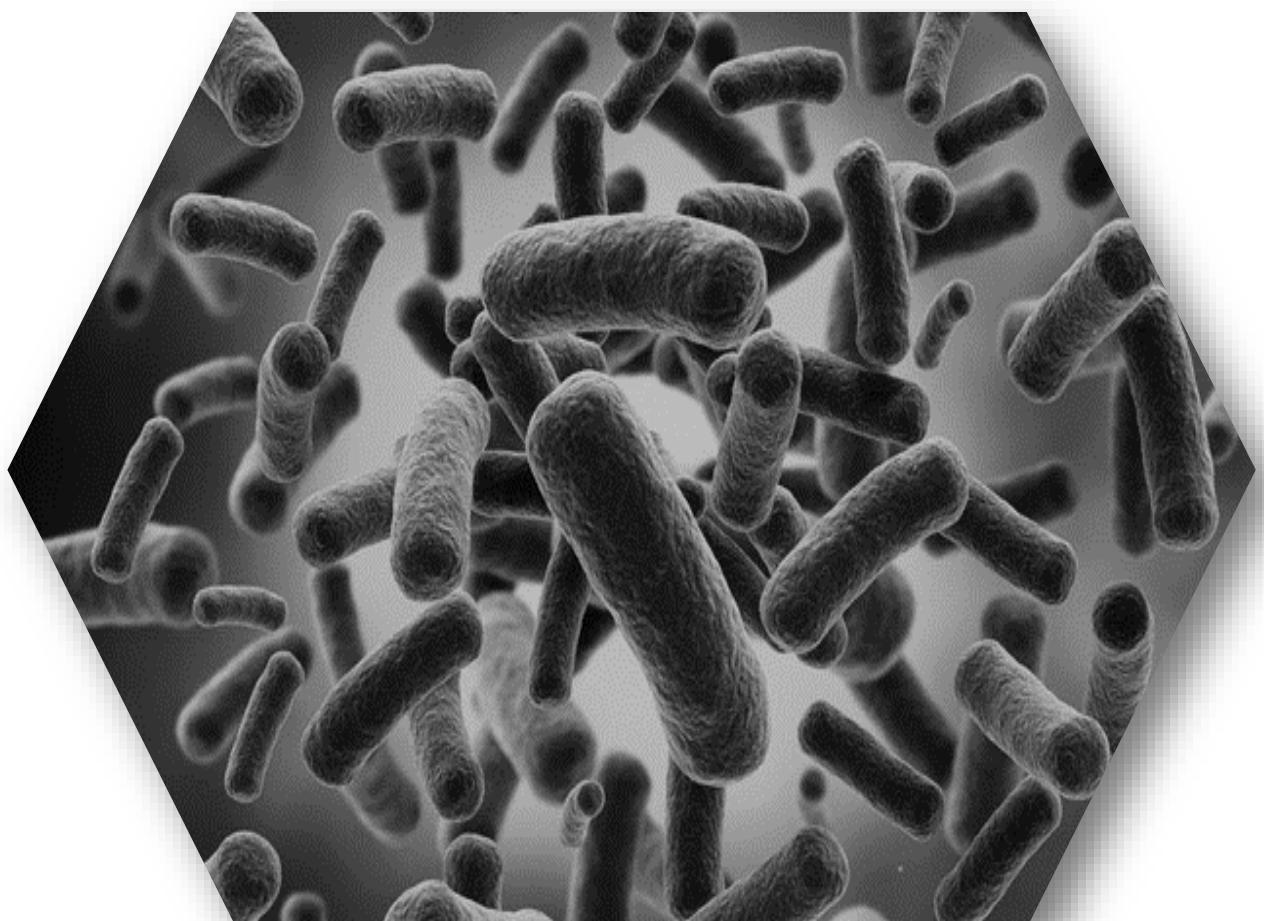
same material. Results revealed that pull-off force and peel strength of the structured specimens are more than twice those of the flat specimens. Based on the combination of several geometrical principles found in biological attachment devices, the presented microstructure exhibits a considerable step towards the development of an industrial dry adhesive.

Stanislav Gorb is a group leader at the Zoological Institute of the University of Kiel, Germany. He received his PhD degree in zoology and entomology at the Schmalhausen Institute of Zoology of the Ukrainian Academy of Sciences in Kiev, Ukraine. Gorb was a postdoctoral researcher at the University of Vienna, Austria, a research assistant at University of Jena, a group leader at the Max Planck Institutes for Developmental Biology in Tübingen and for Metals Research in Stuttgart, Germany.



Gorb's research focuses on morphology, structure, biomechanics, and evolution of surface-related functional systems in animals and plants, as well as the development of biologically inspired technological surfaces and systems. He received the Schlossmann Award (1995), Science Award of the Donors' Association for the Promotion of Science in Germany (2005), International Forum Design Gold Award (2011); Materialica "Best of" Award (2011), Transfer-Price of Schleswig-Holstein (2011) and was the BioFuture Competition winner for his works on biological attachment devices (1998). Gorb has authored three books; more than 300 papers in peer-reviewed journals; and four patents. He is corresponding member of Academy of the Science and Literature Mainz (since 2010), Germany and member of the National Academy of Sciences Leopoldina, Germany (since 2011).

Session A: Animal Health I



Abstracts: Oral Presentations| WSD 2016

Tissue-specific homing potential and kinetics of B and T cell responses to oral cholera vaccination

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Previous research has shown that oral vaccination induces immune responses in the intestinal tract and systemically, but also in the upper respiratory tract. The aim of our study was to characterise the tissue-specific homing potential and the kinetics of B and T cell responses to oral vaccination against cholera. Samples of blood, saliva, nasal wash and feces were collected from each of 14 healthy adult participants at Day 0, 7, 14, 18 and 28. Each participant received an oral dose of Dukoral® on Day 0 and Day 14 after collection of samples. Specific IgA and IgG antibodies against Dukoral or Cholera toxin B (CTB) were measured in each sample. To establish tissue-specific homing, IgA⁺ and IgG⁺ B cells and T cells were analysed with FACS for expression of integrin beta 1, integrin beta 7, CCR9, CCR10, and CLA. Our results show that after vaccination, specific IgA and IgG responses to the vaccine and CTB were detected in serum, which peaked at Day 28. In nasal wash vaccine-specific IgG was induced. CTB-specific and activated (CD69⁺) IgA⁺ and IgG⁺ B cells were present in peripheral blood and peaked at Day 18. Oral vaccination primarily induced IgA⁺ B cells with homing potential to the airways, small intestine, colon, and skin. Kinetic analysis of each tissue homing profile of the B cells peaked at Day 18. In conclusion, oral vaccination induces immune responses and homing potential of IgA⁺ B cells to airways, colon, small intestine and skin. This model, therefore, is a good model to study the effect of dietary interventions on vaccine-specific immune responses. In addition, because circulating B cells with airway homing potential are induced in this model, oral vaccination should be considered for vaccination against respiratory pathogens.

Building an miRNA atlas of the pig

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MicroRNAs (miRNAs) are small RNAs, usually ~23nt long, that play a prominent role in the post-transcriptional regulation of gene expression. Currently, 2588, 1915, 793, 994, 466, 434 and 411 miRNAs have been annotated in human, mouse, cattle, chicken, *Drosophila*, *C. elegans* and pig, respectively. Since miRNAs, in general, are highly conserved between related species it is expected that the pig will have a comparable number of miRNAs as found in human and mouse, suggesting that the annotation of pig miRNAs is largely unexplored. The present study is part of the ongoing pilot FAANG (Functional Annotation of ANimal Genomes) project where we have generated high-throughput whole-genome, RNA-seq, small-RNA-seq, and Reduced Representation Bisulfite Sequencing data from three individuals of three commercial pig breeds (Large White, Duroc and Pietrain). The aim of the study is to obtain a more detailed insight into the (epigenetic) regulation of pig gene expression.

A key specific objective within the larger aim of the current study is to predict new miRNAs and produce a miRNA expression ATLAS for the pig. Small RNA-seq data has been generated from five tissues (brain-frontal lobe, liver, muscle, spleen and testis) from the abovementioned three breeds. Further, the miRDeep2 program was used to identify and quantify miRNAs (known and putative novel) from these small RNA-seq data. A total of 1076 precursors were predicted to be present – of which 382 are known swine and novel predicted precursors. Among the predicted miRNAs in terms of distribution, 31.47%, 17.78% and 50.75% are known swine, known miRNA identified in pig for first time and novel swine miRNAs respectively. The identified miRNAs were then used in comparative analysis of conservation and relative tissue abundance of conserved and novel pig miRNAs, for gene target prediction analysis and functional analysis for miRNAs. Our results indicate that all of the tissues have different microRNAnome with the brain and testis containing the highest numbers of identified tissue specific miRNAs. The results obtained thus far and the planned future course of work will be presented in the programme.

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Anthelmintic activity of tanniniferous browse against *Haemonchus contortus* infective stage *in vitro*

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Internal parasites present a significant economic loss by resulting in suboptimal performance and/or death in extensive goat production systems. Control of these parasites has been limited to the use of synthetic anthelmintic drugs which are currently challenged by the emergence of resistant parasite strains worldwide and limited application in low input systems due to inaccessibility. The aim of the study was to examine the effect of tanniniferous (tannin rich) browse from the semi-arid Ethiopia on exsheathment of anthelmintic susceptible third stage (L_3) *Haemonchus contortus* of goats origin; and to evaluate tannins activity in inhibition of exsheathment by using a tannin binding agent, polyvinylpolypyrrolidone (PVPP). Acetone/water (70:30, v/v) extract of air dried ground *Acacia etbaica*, *Dichrostachys cinerea*, *Euclea racemosa*, *Rhus natalensis* and *Senna singueana* leaves were used. The larval exsheathment inhibition assay (LEIA) was employed where the L_3 were exposed to extracts of 1200,600,300,150 µg/ml Phosphate buffer saline (PBS), and a negative control (only PBS) for 3hours and exsheathment observed over 60minutes. PVPP treatment was done only with one concentration (1200µg/ml). Differences in mean percentage exsheathment between control, doses and PVPP were determined using the GLM procedure of SAS. All extracts showed a dose dependent responses at $p<0.05$. *E.racemosa* and *D.cinerea* were the most potent inhibitors of L_3 exsheathment even at the lowest dose of 150µg/ml. No significant differences were observed between the control and PVPP treated *E.racemosa* and *S.singueana* demonstrating tannins were principally involved in inhibition of L_3 exsheathment. On the other hand significant differences for PVPP treated *A.etbaica* ($p=0.0006$), *D.cinerea* ($p=0.00052$) and *R.natalensis* ($p=0.0009$) suggested mostly other phenolic compounds or a combined synergistic effect with tannins might have resulted in inhibition. It was concluded that the five browse species, which are voluntary consumed by goats, might be exploited to reduce parasite burden in low input goat production system.

Session B: Animal Production



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Genotype by environment interaction for harvest weight, growth rate and shape between monosex and mixed sex Nile tilapia (*Oreochromis niloticus*)

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In Kenya, Nile tilapia (*Oreochromis niloticus*) is mostly grown in ponds. For a national breeding program that aims to provide genetically improved broodstock to hatcheries that supply monosex fry to smallholder pond farmers, it is important to assess the genetic correlation (r_g) for traits between the mixed sex breeding candidates from the breeding nucleus and monosex production fish. The purpose of the study was to estimate the genetic parameters for harvest weight (HW), daily growth coefficient (DGC) and body shape and investigate genotype by environment interaction (GxE) for these traits between mixed sex and monosex populations. Forty-eight sires and 76 dams from the F₂ generation of a local *O. niloticus* strain, kept at Sagana Aquaculture Research Station, Kenya were used to produce 76 full-sib families. Mixed sex fry (3 days old) from each full sib family were divided into two groups of 50 individuals each. One group was fed a diet treated with methyl-testosterone to induce sex reversal (monosex) while the other group was reared on a control diet (mixed sex). After hapa rearing, tagging and weighing, fish were randomly divided and stocked in six earthen ponds, three for mixed sex and three for monosex fish. After 5 months, 2105 fish were harvested, photographed and weighed. Heritability estimates for HW, DGC and shape were 0.21 ± 0.03 , 0.26 ± 0.04 and 0.12 ± 0.03 for mixed sex respectively. Genetic correlations for HW between monosex and mixed sex was 0.74 ± 0.14 , suggesting low GxE. The corresponding r_g for DGC and shape were lower; 0.59 ± 0.10 and -0.19 ± 0.11 respectively, denoting presence of GxE. It is concluded that GxE between the mixed sex nucleus and monosex production fish is important, and that a breeding program for Nile tilapia needs to include production performance from monosex siblings.

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Effect of grinding screen sizes and guar gum levels inclusion on digestibilities, growth and faecal characteristics of stripped catfish (*Pangasianodon hypophthalmus*)

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In fish knowledge on impacts of physical conditions inside the gastrointestinal tract (GIT) on digestion of nutrients is scarce. It is hypothesized that diet properties, like feed particle size and dietary viscosity, alter physical conditions of chyme (e.g., dry matter, pH, viscosity, osmolarity). Such changes might alter total nutrient digestion and location of digestion inside GIT. Therefore, it was assessed how feed particle sizes (e.g. fineness of grinding) and dietary viscosity influence physical characteristics of chyme in different GIT parts in relation to nutrient digestion of striped catfish. The experiment had a 2x3 factorial design: two feed particle sizes, by grinding the ingredient mixture at two screen sizes (0.8 versus 1.2mm); and three dietary viscosity levels by inclusion of guar gum (0, 0.3, and 0.6%). After 52d feeding, chyme of fish was collected in 4 GIT sections: stomach, proximal, mid and distal intestine. Particle size and dietary viscosity impacted chyme viscosity. The impact altered throughout the GIT. Both effects on chyme viscosity were largest in the stomach and diminished towards the distal intestine. The pH and osmolarity were unaffected by both factors. Chyme dry matter content was only affected by dietary viscosity; declining with increasing viscosity. This effect occurred in the stomach, disappeared in proximal and mid intestine and reappeared in distal intestine. Digestibility of dry matter and protein showed the same pattern and declined with dietary viscosity. This effect of viscosity on digestion already occurred in the stomach and persisted throughout the GIT. Feed particle size only affected digestibility in the last part of the GIT. In conclusion, both feed particle size and dietary viscosity altered chyme viscosity and dry matter content. These effects are depending on the location inside the GIT. The hampered digestion inside the stomach by increasing viscosity was not compensated in different segments of the GIT.

Benchmarking beef production systems across the world for improved production and resource use efficiency

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The projected increase in global demand for animal-source food raises the question to what extent livestock production can be increased from the current levels. The aim of this research is to benchmark actual beef production against potential (*i.e.* the theoretical maximum) and feed-limited beef production.

Potential beef production is defined by cattle breed and climate. Feed-limited production is affected, in addition, by feed quality and quantity. Differences between actual and potential or feed-limited production are named yield gaps, indicating the scope to increase production. Potential and feed-limited production were simulated with the model LiGAPS-Beef (Livestock simulator for Generic Analysis of Agricultural Production Systems) for different systems across the world. Assessing land use for feed production enabled to quantify production at crop-livestock systems level.

Predictions by LiGAPS for average daily gains of cattle were in reasonable agreement with measured ones ($R^2\text{-adj.} = 0.47$; root mean square error = 150 g day $^{-1}$, 18.2% of mean measured values), and large deviations were explained by health issues not simulated. Potential and feed quality limited production for Charolais cattle in France was 72 and 46 g beef kg $^{-1}$ DM feed, for Hereford cattle in Uruguay 64 and 40 g beef kg $^{-1}$ DM feed, for Brahman \times Shorthorn cattle in Australia 66 and 43 g beef kg $^{-1}$ DM feed. Yield gaps in an extensive and intensive system with Charolais cattle in France were 79% and 72% at crop-livestock systems level. Beef and human digestible protein production per hectare were calculated for various crop-livestock systems. The benchmarking method applied is effective to assess the scope for increasing beef production and feed conversion efficiency, and for decreasing land use for feed crops. Yield gap analysis enables to identify constraining bio-physical factors for beef production and provides options to improve farm management.

Session C: Animal Behaviour



Mate choice a matter of taste? Individual variation in mate preference in great tits (*Parus major*)

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¹ Behavioural Ecology Group, Wageningen University, ² Netherlands Institute of Ecology (NIOO-KNAW)

When all individuals have similar mate preferences, variation within a population should decrease, also known as the 'lek paradox'. Resolution of this paradox has been attempted by considering fluctuating selection, condition dependence of the signal and choice for non-additive genetic benefits. The possible role of individual differences in mate choice however is severely underexplored. Variation in mate preference may weaken the strong directional selection on ornaments and may thereby allow diversity to persist. Moreover perceived mate quality and compatibility may influence reproductive investment. Here we tested for individual differences in great tit mate preferences, and whether these preferences varied depending on the chooser's own traits, since this would affect the relative benefit of complementary traits in their partner. In great tits, both sexes are ornamented and invest heavily in reproduction. They both display multiple ornaments primarily relating to dominance (breast stripe) and parental care (yellow plumage). We expected that not only the females, but both sexes would display mate preferences. Using a 6 choice test 59 females and 60 males were tested for their mate preference. Preference functions were calculated for a number of traits such as breast stripe size, intensity of yellow breast feathers and personality and analysed as functions valued traits. Here we describe the individual mate preferences in relation to the choosers own phenotype.

Development of piglets raised in either a multi-litter system or a single-litter system

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Multi-suckling systems, in which lactating sows and their litters are group housed, may provide a better transition from group housing during gestation than individual housing. We developed such a system for five sows with a communal feeding area where piglets can learn to eat with the floor-fed sows. Post-weaning, these piglets were housed in an enriched pen in a group of 40. We hypothesized that contact among multiple litters and more environmental complexity in the multi-litter system facilitates piglets' adaptation to weaning. In 5 batches with 80 piglets each, post-weaning performance was investigated from 4-9 weeks of age. The multi-litter (ML) system was compared with a conventional single-litter (SL) system in which piglets were housed with a crated sow before weaning, followed by post-weaning housing in groups of 10 littermates in a standard pen. Post-weaning floor area and feeder area were equal per piglet. Mixed models were used for analyses, with 40 piglets within system and batch as experimental unit. ML piglets ate 81% more feed between day 1 and 2 ($p<0.01$) and had an 82% higher weight gain until day 5 than SL piglets ($p<0.05$) despite having a similar weaning weight (ML: 8.4 ± 0.2 kg, SL: 8.3 ± 0.2 kg). ML piglets seemed to suffer less from diarrhea from day 0-14 post-weaning, indicated by a lower fecal consistency score (0.27 ± 0.03 vs. 0.39 ± 0.03 , $p<0.05$). Over the entire post-weaning phase, ML piglets had a 24% higher weight gain ($p<0.05$) and showed more play behavior (4.0 ± 0.3 vs. 2.8 ± 0.3 freq/h, $p<0.05$) and less damaging oral manipulation (1.8 ± 0.3 vs. 3.5 ± 0.4 freq/h, $p<0.01$) such as tail biting. Although early postnatal piglet mortality was higher in the ML system, which may have had an influence, we propose that the ML system (with more enrichment and a larger group to facilitate eating behavior) contributed to improved post-weaning performance.

Abstracts: Oral Presentations| WSD 2016

Tail and ear biting behaviour in pigs affected by sanitary conditions, dietary amino acid profile, and crude protein level

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There is strong incentive to reduce crude protein (CP) level in pigs diets to support the efficiency of protein conversion from inedible to edible products for human consumption. Dietary protein deficiencies as a possible consequence, might however increase the risk of tail- and ear biting problems. This risk might be even higher in pigs kept by low sanitary conditions (LSC), as these pigs might have higher nutrient requirements.

To study this risk a trial was performed, in a 2x2x2 factorial arrangement, using 576 10-week old boars (9/pen) housed in different sanitary conditions; low (LSC) vs. high sanitary conditions (HSC), and offered one of four different diets *ad libitum*, differing in CP level (normal (NP); based on NRC (2012), or low (LP); 80% of NRC advise), and AA-profile (basic or supplemented). Pigs in HSC received vaccinations against six common pig diseases before the experiment and received an antibiotic treatment on arrival. They were housed in a cleaned and disinfected part of the accommodation with a strict hygiene protocol. LSC pigs were housed in pens that had not been cleaned after the previous batch of pigs was removed, and starting from 5 weeks, every 2 weeks fresh manure from another pig farm was spread in LSC pens. Frequencies of biting behaviour were observed using continuous recording at 20 and 23 weeks of age for 10 x 10 min. per pen per week.

LSC pigs showed more ear biting than HSC pigs ($P=0.03$). Reduction of CP level also resulted in more biting behaviour ($P=0.02$) and fighting ($P=0.04$). The difference in dietary AA-profiles did not affect behavioural observations ($P>0.05$). In conclusion, when reducing CP in pig diets, attention should be paid to the increased risk on behavioural problems especially when pigs are kept under low sanitary conditions.

Session D: Animal Health II



Antimicrobial peptides from porcine microbiota against *Streptococcus suis*

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There is a growing interest in identifying commensal organisms that produce antimicrobial peptides (AMPs) against veterinary pathogens, as these could be used as an alternative to antibiotics for controlling important animal diseases. We have used a high-throughput screening method to isolate AMP-producing bacteria with a view to develop an AMP-based approach to prevent infection of piglets with *Streptococcus suis*. *S. suis* is a zoonotic porcine pathogen, causing large economic losses to the swine industry worldwide. There is no effective vaccine against most serotypes of *S. suis*, and resistance against commonly used antibiotics is increasingly reported. Therefore, it is relevant to develop alternatives to conventional antibiotics to control *S. suis*. Samples from the oropharynx and small intestinal content have been obtained from different piglets around weaning. From these samples a bank of 10,150 individually picked bacterial colonies was created and screened for growth-inhibiting activity against several clinically relevant *S. suis* serotypes in overlay assays. Promising candidates were identified by 16S rRNA gene sequencing. One isolate, identified as a *Staphylococcus pasteuri*, showed consistent activity and mining of the whole genome sequence revealed two genes in the *agr* operon encoding for 25-amino acid, α -helical amphipathic peptides. Both chemically synthetized and purified peptides show very rapid and narrow-spectrum antimicrobial activity with an MIC of 2 μ M for both peptides. Two other selected isolates were identified as *Rothia nasimurium*, and genome mining showed the presence of a putative non-ribosomal peptide synthetase (NRPS). Purification and characterization of the molecule responsible for the antimicrobial effect, combined with *in silico* analysis of the NRPS cluster, confirmed that these *R. nasimurium* isolates produce valinomycin, a depsipeptide ionophore antibiotic. We show that the microbiota can be a valuable source of AMP-producing bacteria with specific activity against pathogenic bacteria and, as such, could prove useful as alternative strategy to control pathogens.

Guanidination of amino acids: what is going on?

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Lysine is often the first limiting amino acid (AA) for growth in animal diets. Lysine is also the most sensitive AA to reactions with sugars during heat treatment because of its amino group on the side-chain (ϵ -amino group). When analysing the amino acid content using strong acidic conditions, necessary to breakdown peptide bonds, part of the sugar-lysine bonds breakdown as well and contributes to the lysine content. This sugar-bound lysine, however, cannot be used by animals for protein synthesis. It is, therefore, important to analyse only the lysine molecules with free ϵ -amino groups, referred to as reactive lysine. This can be achieved by the guanidination reaction using *O*-methylisourea (OMIU) as the reagent. The OMIU was assumed to bind specifically to the ϵ -amino group of lysine and this reaction results in homoarginine. Homoarginine is an AA which does not occur in nature, is acid stable and can be analysed using acid hydrolysis. The amount of homoarginine is, thus, equal to the amount of reactive (i.e. unmodified) lysine in the feed material.

Preliminary results, however, indicated that OMIU may also bind to the α -amino group of lysine (i.e. involved in peptide bonding). Free lysine (L-lysine HCl) is used to supplement commercial diets and has free α - and ϵ -amino groups. Studies were undertaken to determine the binding of OMIU to α -amino groups of several AA, the specificity of OMIU to the ϵ -amino group of lysine, and to optimize the guanidination reaction for free lysine. The recovery of AA after guanidination was low even when reaction conditions, i.e. pH of the OMIU solution, OMIU:lysine ratio, and reaction time, were optimised. Thus, binding of OMIU to α -amino groups may hamper its use for materials that contain large amounts of free lysine such as lysine supplemented diets for animals. Results and further implications will be presented.

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Network analysis of temporal functionalities of the gut induced by perturbations in new-born piglets

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Evidence is accumulating that perturbation of early life microbial colonization of the gut induces long-lasting adverse health effects in individuals. Understanding the mechanisms behind these effects will facilitate modulation of intestinal health. The objective of this study was to identify biological processes involved in these long lasting effects and the (molecular) factors that regulate them. We used an antibiotic and an antibiotic in combination with stress on piglets as an early life perturbation. Then we used host gene expression data from the gut (jejunum) tissue and community-scale analysis of gut microbiota from the same location of the gut on three different time points to gauge the reaction to the perturbation. We analysed the data in two dimensions, treatment and time, with quadratic regression analysis. Then we applied network based, data integration approaches to find correlations between host gene expression and the resident microbial species.

Results

We observed significant long-lasting differences in jejunal gene expression patterns resulting from the early life perturbations. In addition, we were able to identify potential key gene regulators (hubs) for these long-lasting effects. Data integration also showed that there are a handful of bacterial groups that were associated with temporal changes in gene expression.

Conclusion

The applied approach allowed us to unearth biological processes involved in long lasting effects in the gut due to the early life perturbation of microbial colonization. The observed data are consistent with the hypothesis that these long lasting effects are most probably due to differences in the programming of the gut immune system as induced by the temporary early life changes in the composition and/or diversity of microbiota in the gut.

Session E: Environment & Sustainability



Consumer interest in social sustainability issues of whitefish from capture fisheries in the northeast Atlantic

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Consumers are becoming increasingly interested in product attributes relating to sustainability. Consumers of whitefish mainly demonstrate an interest in environmental sustainability, since they are paying 10%-14% more for whitefish that is labelled as originating from sustainably managed fish stocks. However, studies have shown that consumers generally prefer improved social sustainability over improved environmental sustainability. Therefore, the objective of this study was to investigate consumer interest in social sustainability attributes of whitefish from the northeast Atlantic. The method used is choice modelling, a method to determine preferences for several product attributes based on consumer choices. The selected attributes are worker safety, product quality, fish welfare, local employment and approach to overfishing. Inclusion of the latter environmental sustainability attribute enabled a comparison of preferences for social sustainability in relation to preferences for environmental sustainability. A survey was developed that consisted of five choice sets in which each attribute was compared to one other attribute, and five choice sets in which three attributes were compared to two other attributes. This survey was completed by 457 respondents. The conditional logit model that was fitted to the data showed that people have the strongest preference for an improved approach to overfishing, followed by improved fish welfare, improved product quality, improved worker safety and improved local employment. This result indicates that people prefer environmental sustainability over social sustainability in the context of whitefish from the northeast Atlantic. Furthermore, this result indicates that in this context, people prefer social sustainability attributes relating to animals over social sustainability attributes relating to the product or to other people. However, a mixed logit model that was fitted to the data indicates that there is choice heterogeneity among respondents that cannot be explained from attribute preferences. Therefore, further analyses will focus on exploring explanatory variables such as concern, trust and values.

Land Redistribution in South Africa- beneficiation and land use

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Land redistribution programme has been going on in South Africa for the past two decades; with anticipation that it will address national challenges of inequalities, food insecurity and unemployment. Studies on land redistribution programmes had been based on few farms and could not provide general assessment of the programme. This study focused on large number of redistributed farms in the Waterberg District Municipality, with an aim of analysing the effect of changes made to the land redistribution programme (leading to four distinguishable models over time) on the degree of beneficiation and the extent of land use. Data were collected through individual surveys, key informants interviews and stakeholder workshop. The numbers of beneficiaries and the level of beneficiary participation, both on averages per farm, were different ($p<0.05$) among land redistribution models. The extent of land used for crops differed ($p<0.05$) among models when expressed in hectares per farm, but no differences were observed when expressed as percentage of total farm land. The number of beneficiaries decreased while the level of beneficiary participation decreased over time. The extent of land used for livestock differed ($p<0.05$) among models when expressed both in hectares and as percentages of total farm land. Although the models differed in extent of land used, there were no identifiable trends over time. The changes in land redistribution programme over time were found to be a trade-off between the number of beneficiaries and level of participation. The lack of trends on extent of land use could be attributed to the fact that previous land ownership, intended land use, developments in agricultural sector of an area and the social class of beneficiaries represented the context in which land redistribution was being implemented. All these factors did not result in systematic trends on the extent of land use.

The role of livestock in a sustainable diet: a land-use perspective

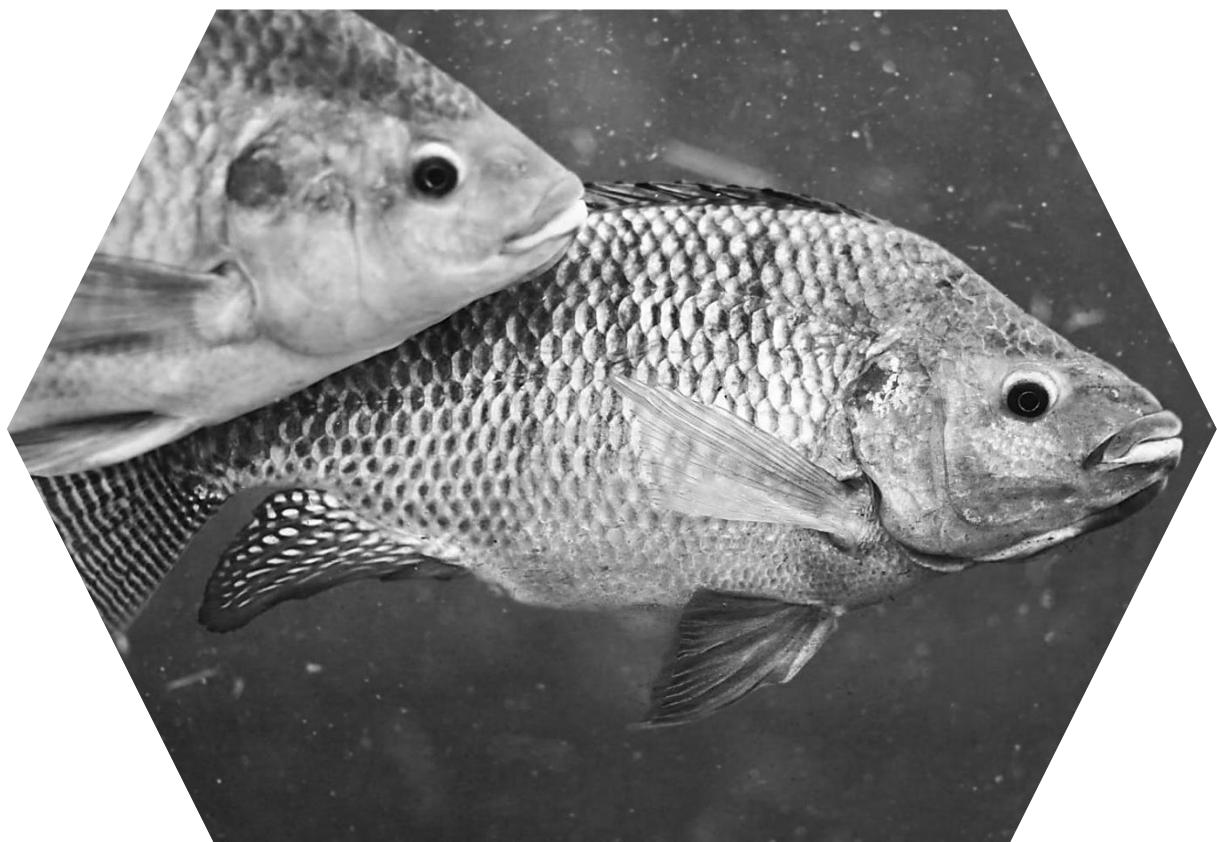
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In 2000, the Food and Agricultural Organisation (FAO) projected that global demand for animal-source food (ASF) would double by 2050. Those projections, however, are based on global trends for a growing population and increasing incomes and urbanization, but not based on ensuring global nutrition security in a sustainable way. Currently, the world's livestock sector add to the total anthropogenic emissions of greenhouse gases and competes for scarce resources, such as land, water, and fossil energy. Because especially land is a strict limitation of nutrition security, we took a land-use perspective. No matter how efficiently food is produced, direct consumption of cereals by humans is more efficient ecologically than consumption of livestock fed these cereals, and, therefore, it is often indicated that vegan diets are most land efficient. Should we shift, therefore, to vegan diets? Not necessarily! Because livestock has a potential to convert co-products from human food, food waste, and biomass from marginal land, referred to as 'leftover streams', into high quality ASF. Livestock that eat these leftover streams do not compete with humans for cropland, and, therefore, contribute to sustainable nutrition security. By feeding only leftover streams to livestock, the number of humans fed per hectare is maximized. How much ASF can we consume, however, when we only feed leftover steams to livestock? We calculated, that based on leftovers only, about 21 g of protein from ASF can be produced person per day. The daily recommended intake of protein is about 60 g per person per day, from which about a third must be from AFS. These 21 g from AFS is produced without competing with food crops from arable land. We can almost satisfy, therefore the daily recommended intake of protein of an average global person while avoiding competition for land between feed and food production.

Session F: Aquaculture



Establishment and characterization of a trypanosome infection in zebrafish

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The protozoan parasite *Trypanosoma carassii* is an extracellular blood flagellate that can infect several fish species and cause a chronic infection. It is phylogenetically closely related to the mammalian parasite *Trypanosoma brucei* that is causing the fatal sleeping sickness disease. In the current study we present the establishment and characterization of a trypanosome infection model for the first time in zebrafish. Zebrafish is a widely used model organism owing to its transparency, small size, easy handling and most importantly the availability of transgenic lines for real-time *in vivo* imaging. We first characterized the progression of the infection at various stages of (immune) development by infecting 5 days post-fertilization (dpf) larvae, 1-month-old juvenile and 3-months-old adult zebrafish with low, medium and high doses of *T. carassii*. As expected, we found that a fully developed adaptive immune system in adult zebrafish can clear the infection, whereas young larvae were more susceptible. Interestingly, in some cases larval zebrafish with only innate immune system also survived the infection. To further investigate how young larvae can cope with the infection, we took advantage of the transparency of the zebrafish larvae and of the numerous transgenic lines that allow the identification of specific cell types expressing immune molecules. We were able to monitor real-time cell migration, cell proliferation and host cell-parasite interaction *in vivo*. By using transgenic lines in which the blood vessels are fluorescently labelled, we were able to capture how the parasites damage and disrupt the blood vessels; by using tnf α :GFP and il1b:GFP transgenic zebrafish lines we were able to monitor cytokine expression *in vivo* throughout the infection. To our knowledge this is the first study describing a trypanosome infection model in zebrafish and provides a novel approach to investigate the *in vivo* dynamics of host-pathogen interaction in a developing immune system.

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Effects of salinity level and diet composition on intestinal morphology of Nile tilapia (*Orechromis niloticus*)

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Climate change leads to rising sea levels and consequently to increased salinization of coastal areas by flooding sea water invasion into freshwater aquifers. An increase in salinity of the aquatic habitat can be a critical environmental stress factor for fresh aquatic organism, including fish. Recent reports on Nile tilapia demonstrate that changes in salinity can alter histopathological characteristics of head kidney, gill epithelium and liver. Information on the impact of salinity on gut barrier function is lacking. This study investigated the impact of salinity and diet composition on intestinal morphology of Nile tilapia. Triplicate groups of 35 fish weighing 35 gram were fed a "Control" and "Test" diet containing plant protein (54% soybean meal) source and kept at "fresh" water (0‰) and saline water (15‰) for 8 weeks. Six fish per treatment were sampled for intestinal morphology analysis at the end of week 1, 4 and 8. The "Test" diet induced a mild enteritis response. The impact of salinity on intestinal morphology parameters was stronger. However, the salinity effect was independent of dietary composition indicated by the absence of an interaction between dietary and salinity ($P>0.05$). All intestinal morphology parameters altered over time ($P<0.01$). Nile tilapia subjected to saline water had an enhanced appearance of intestinal disorders and this enteritis like response aggravated overtime ($P<0.01$). This study demonstrated that increased water salinity hampers gut barrier function (intestinal inflammation), but this response is not aggravated by diet composition.

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Oral DNA vaccination of carp; involved mechanisms and immune responses

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A typical fish farm is comprised of tens of cages or ponds, each of which can contain >20,000 fish. Individual injection is the most used method to vaccinate fish in aquaculture but, given the high numbers, is often impractical and has some major disadvantages regarding fish welfare. Injection vaccination causes high stress levels since fish have to be caught and anesthetized prior to vaccination. Furthermore, it often induces local reactions at the site of injection leading to inflammation and tissue damage. Alternatively, oral vaccines can be mixed with a standard fish feed and can therefore easily be delivered to large numbers of fish and stress-free. As a downside, orally administered vaccines often require protection against the harsh environment of the stomach and intestine to prevent vaccine breakdown. Micro-encapsulation using natural polymers extracted from e.g. algae can enhance vaccine protection and subsequent delivery to the second intestinal segment, where the vaccine is taken up and further processed in order to mount a protective immune response. Thorough knowledge of the mechanisms of oral vaccine uptake and induced immune responses is necessary to be able to design effective oral vaccines for fish.

In this presentation a step-to-step approach to the development of oral vaccines for fish will be discussed. It will entail the topics of *what* we use as a vaccine (types of vaccines and choice of antigen), *how* to deliver it (vaccine encapsulation procedures) and *where* and *when* uptake of the vaccine and induction of the immune response takes place. Focus will be on a newly established experimental oral vaccine for carp against Spring Viremia of Carp Virus (SVCV). This vaccine, when administered orally, induces a redistribution of various immune cells to several immune-relevant organs, triggering a local mucosal but also more broad, systemic immune response.

Poster Presentations



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1. Predicting direct and indirect genetic effects on survival time in laying hens using repeated observations

T. Brinker, E. Ellen, R. Veerkamp, P. Bijma

2. Genetics and Technology: Genetic effects on bovine milk infrared spectra

Q. Wang, A. Hulzebosch, H. Bovenhuis

3. *In vivo* dynamics of a developing immune response in zebrafish; Real-time imaging of antigen uptake and immune cell trafficking

S. Jacobs, G. Wiegertjes, J. van Leeuwen, M. Forlenza

4. Defining desired genetic gains for breeding goal traits for a Holstein-Friesian cattle breeding program in Kenya

C. M. Kariuki, J. A. M. van Arendonk, A. K. Kahi, H. Komen

5. Dutch dairy farms after milk quota abolition: economic and environmental consequences of a new manure policy

C. W. Klootwijk, C. E. Van Middelaar, P. B. M. Berentsen, I. J. M. deBoer

6. Effect of time on methane concentrations measured on dairy cows in automatic milking systems

S. van Engelen, H. Bovenhuis, P. P. J. van der Tol, M. H. P. W. Visker

7. Influence of distance to urban markets on intensification of smallholder dairy production

S. A. Migose, B. O. Bebe, I. J. M. De Boer, S. J. Oosting

8. Evaluation of two strains of *Ceriporiopsis subvermispora* on improving the nutritive values of wheat straw for ruminant feed

N. Nayan, A. Sonnenberg, J. Cone

9. Traditional knowledge about local breeds of cattle across generations of Fulbe pastoralists around the W Biosphere Reserve in Benin

C. Tamou, R. Ripoll-Bosch, I. J. M. de Boer, S. J. Oosting

10. Development of a simulation model for calculating heat balances of African catfish farms with a recirculating aquaculture system

D. Karimi, P. Rappoldt, A. Aarnink, E. Eding, J. Verreth

11. Do feather pecking hens go with their guts?

J. A. J. van der Eijk, A. Lammers, B. Kemp, M. Naguib, T. B. Rodenburg

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- 12. Kermit's sticky little fingers: A biomimetic point of view on tree frog adhesion**
J. K. A. Langowski, D. Dodou, J. van Leeuwen
- 13. Assessing the role of animal source food in a sustainable diet**
O. van Hal, H. H. E. van Zanten, I. J. M. de Boer
- 14. The impact of subclinical ketosis on the global warming potential of milk**
P. F. Mostert, E. A. M. Bokkers, C. E. van Middelaar, and I. J. M. de Boer
- 15. Economic values of growth, feed intake, mortality and uniformity for gilthead seabream (*Sparus aurata*)**
K. Janssen, M. Besson, P. Berentsen, H. Komen
- 16. Can natural antibodies be used to predict longevity in dairy cows?**
B. de Klerk, B. Ducro, H. Heuven, H. Parmentier, J. A. M van Arendonk, J. van der Poel
- 17. In vitro gas and methane production on adaptation of rumen microflora to silages of maize harvested at different stages of maturity**
F. M. Macome, J. W. Cone, W. F. Pellikaan, J. T. Schonewille, B. Hatew W. H. Hendriks
- 18. Digital Dermatitis in dairy cattle, how infectious is it?**
F. Biemans, P. Bijma, M. de Jong
- 19. Economic and environmental breeding objectives in fish farming under quota restrictions**
M. Besson, J. Aubin, H. Komen, E. Quillet, M. Vandeputte, J. A. M. van Arendonk, I. J. M. de Boer
- 20. A new approach to study dilemma's between animal welfare and public health**
M. van Asselt, E. N. Stassen
- 21. Genetic origin, admixture and population history of aurochs and primitive European cattle populations**
M. R. Upadhyay, W. Chen, J. A. Lenstra, R. R. Goderie, D. E. MacHugh, S. D. Park, D. A. Magee, European Cattle Genetic Diversity Consortium, D. Matassino, Y. Ciani, H. J. Megens, J. A. M. van Arendonk, M. A. M. Groenen, R. P. M. A. Crooijmans

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