COST ACTION 854

"Protozoal reproduction losses in farm ruminants"

Annual Meeting

"Reservoirs of protozoan abortifacients in livestock and wildlife"

a Management Committee meeting on 29th August 2005

a workshop for COST 854 working groups from 30th August to 1st September 2005

A CONFERENCE

"*Neospora* and Neosporosis: Achievements and Perspectives"

2nd September 2005

Staszic Palace
Warszawa, Nowy Świat Street 72
Poland

The organisers are grateful for the sponsorship assistance received from the following

Committee for Parasitology of the Polish Academy of Sciences

Witold Stefański Institute of Parasitology of the Polish Academy of Sciences

and

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MILLIPORE Sp. z o.o.

COST – European Cooperation in the field of Scientific and Technical Research

The Annual Meeting was organized by Bożena Moskwa and Władysław Cabaj from the Witold Stefański Institute of Parasitology of the Polish Academy of Sciences, in collaboration with the chairmen of COST 854, Franz Conraths (Friederich-Loeffer-Institut, Wusterhausen) David Buxton (Moredun Research Institute, Edinburgh), Luis Ortega-Mora (Complutense University of Madrid) and Bruno Gottstein (Institut für Parasitologie, Bern).

A Conference was initiated and organized by the Committee for Parasitology of the Polish Academy of Sciences, the Witold Stefański Institute of Parasitology of the Polish Academy of Sciences and COST 854. This event was jointly organized by Bożena Moskwa and Władysław Cabaj from the Witold Stefański Institute of Parasitology of the Polish Academy of Sciences, in collaboration with the chairmen of COST 854, Franz Conraths (Friederich-Loeffer-Institut, Wusterhausen).

COST 854 "Protozoal reproduction losses in farm ruminants"

Infectious organisms can cause significant losses in farm ruminant production as a result of abortion, embryonic damage or maternal infertility. The two principal agents causing protozoal abortion in ruminants are *Neospora caninum* in cattle and *Toxoplasma gondii* in sheep and goats. Both pathogens are closely related. *Tritrichomonas foetus* is a serious cause of cattle infertility. Furthermore, parasites of the genus *Sarcocystis* are widely distributed and may inflict infections affecting the reproductive tract of ruminants, which may also result in abortion.

Abortion in ruminants may pose a very considerable public health risk as many of the pathogens that cause disease in ruminants may pose a significant danger to humans. Thus rapid, accurate diagnosis is vital in order to be able to assess the degree of risk caused by potential ruminant abortifacients with zoonotic potential such as *T. gondii*, *Chlamydophila abortus* (*Chlamydia psittaci*), *Coxiella burnetii*, *Listeria monocytogenes*, *Salmonella* spp., *Campylobacter* spp. and *Brucella* spp. While *N. caninum* and *Sarcocystis* spp. are not currently considered to be zoonotic, rapid accurate diagnostic methods for protozoal causes are essential to rule in or out more dangerous pathogens, to allow meaningful risk assessments.

Neospora caninum is an important cause of infectious abortion and stillbirth in cattle world-wide. Infection is common and may frequently be passed from mother to calf (vertical transmission) with no signs of disease. Disease occurs when the parasite multiplies in the developing calf and its placenta and causes sufficient damage to trigger abortion or stillbirth. Preliminary research suggests that infection of the foetus early in gestation is more likely to be fatal to the conceptus than infection later in gestation. However it also appears that infection is more likely to be transmitted in late rather than early pregnancy. Thus the majority of infections are not fatal and in this way inapparent infections are maintained in a herd. Vertical transmission is the major route of transmission but it is likely that oocysts of *N. caninum*, produced by dogs and excreted in their faeces, may also infect cattle if they ingest contaminated food or water (horizontal transmission). Control of bovine neosporosis is difficult. Pharmaceutical preparations are known that will kill *Neospora* but their use to control infection/disease in cattle has not been sufficiently evaluated yet, and no effective vaccine is currently available. Control measures therefore rely on applying certain management strategies which are only partially satisfactory. Current knowledge suggests that *Neospora* does not cause disease in human beings.

Toxoplasma gondii is an important zoonotic infection as well as being a major cause of abortion in sheep and goats. The majority of cases of human toxoplasmosis follow the consumption of uncooked or lightly cooked meat (sheep, goat, pig, cattle, deer). There is also an added risk from drinking unpasteurised goats milk as well as from the ingestion of fruit and vegetables contaminated with soil containing *Toxoplasma oocysts*. Control is very difficult as it depends on preventing a primary infection in a pregnant sheep or goat. While certain management procedures may reduce the risk, elimination is not possible. A live commercial vaccine – for use in sheep – is sold in some EU member states. Use of a vaccine sufficiently effective to protect against abortion in sheep and goats would be considered very likely to reduce, if not prevent, the development of tissue cysts in muscle. This would make the meat (and milk) very much safer for human consumption. However this is a neglected area of research.

Tritrichomonas foetus, a venereally transmitted bovine infection, is an important cause of pregnancy loss and abortion in naturally bred cattle throughout the world. Trichomonosis has been a list

B disease by OIE classification for many years and is therefore the subject of animals disease control in several countries. Since the introduction of artificial insemination the economic importance of this disease has decreased, but there is evidence of a re-emergence in extensive husbandry in some European states. As *T. foetus* may have spread inapparently also among other livestock animals such as pigs, a basic reconsideration of the epidemiological situation in Europe and the classification of virulence and pathogenicity among *Tritrichomonas* isolates is strongly required.

To limit the impact of protozoal reproduction failure in farm ruminants, research into the biochemistry, biology and genetics of these protozoa is urgently required to answer questions relevant for diagnosis and control. This, combined with a practical understanding of the immune responses of sheep, goats and cattle to these organisms will provide some understanding of important differences in the pathogenesis of the infections. For instance, such studies may be able to answer the question why do sheep not abort more than once with *T. gondii* while cattle may pass *N. caninum* infection to their offspring in subsequent pregnancies, sometimes with no clinical effect and sometimes with fatal effect. Diagnosis of protozoal abortifacients is not always easy and the diagnostic criteria may vary from lab to lab. Standard procedures and parameters need to be set between labs and different countries so that epidemiological data can be improved and consolidated. The knowledge of risk factors for infection needs to be increased (e.g. presence of dogs or cats which may shed infectious *Neospora* or *Toxoplasma* oocysts in their faeces, lactogenic infection, seasonality, factors causing recrudescence in bovine neosporosis; asymptomatic carriers of *T. foetus* within or outside the ruminant host range etc). On the basis of a quantitative assessment of the consequences of protozoal reproduction failure it will be possible to establish models for the estimation of the economic losses and to perform cost-benefit analyses for potential control programmes. In this way management procedures to reduce the impact of disease can be developed. The ultimate goal is to enable the development of control measures including vaccine strategies for these diseases.

With a move to more extensive systems of agriculture the risk of protozoal abortion in ruminants would remain and perhaps attain greater significance. In the case of toxoplasmosis in sheep and goats infection is picked up from contaminated grass, hay and water as well concentrated loose feed. It occurs just as commonly in extensive as intensive farming systems. With bovine neosporosis evidence is accumulating to indicate that the incidence of abortion is exacerbated by stress. In some situations this may occur with more intensive farming methods (such as the feedlot systems encountered in California) while in other cases stress may occur in extensive systems of agriculture due to severe environmental conditions, such as may be caused by extremes of weather. Cases of fatal sarcocystiosis occur more frequently when extensively reared animals are moved to grassland nearer the farm or locations visited by people, due to contamination of the ground by dog and cat faeces. It should also be noted that *Sarcocystis hominis* has a life cycle in which humans and other primates are the definitive hosts and cattle the intermediate host, and so this parasite is also a zoonotic agent.

Despite considerable scientific efforts currently being undertaken in several European countries with these infections, no formal frame-work exists at the European level to permit an ongoing, structured discussion process in this rapidly evolving field. COST provides an excellent basis for such a cooperation, particularly because it allows the inclusion of groups from countries outside the European Union. This has been demonstrated for the particular aspect of vaccines against animal coccidioses in COST 820 where a Working Group on sarcocystiosis, toxoplasmosis and neosporosis existed.

COST 854 covers the following main topics:

1. Biology, biochemistry and genetic background of virulence
   - Study biological and biochemical key factors determining infection and disease

- Characterise parasite surface molecules that interact with the host cell
- Characterise the interplay of metabolic products of the parasite with the host cell
- Understand parasite differentiation from tachyzoite to bradyzoite, and vice versa (in the case of *N. caninum*, *T. gondii* and *Sarcocystis* spp.).
- Determine the genetic background of virulence

2. Pathogenesis and host immune responses
   - Define and compare the development of pathology in the different animal hosts
   - Determine the relative role of the immune responses of the dam and the foetus and their effect on infection, transmission and disease (in the case of *N. caninum*, *T. gondii* and *Sarcocystis* spp.)
   - Determine the relative role of the immune responses of the dam in pathology or to control or prevent mucosal *T. foetus* infection
   - Identify protective and diagnostic antigens
3. Diagnosis
   - Identify and improve tools to diagnose infection and/or disease
   - Standardise diagnostic techniques
4. Epidemiology, economics and control
   - Define the prevalence and/or incidence of infection or disease
   - Identify risk factors
   - Calculate the economic losses on farm ruminant production
   - Develop cost-effective preventive and therapeutic control measures

These main topics (1-4) are also the titles of the working groups of the Action which meet regularly at least once a year, either in working group-specific events or in joint meetings with other working groups of COST 854 or COST Actions working on related issues such as COST 857 "Apicomplexan Biology in the Post-Genomic Era" or COST 855 "Animal Chlamydiosis and its zoonotic implications". The involvement of young scientists in COST 854 is particularly supported by Short Term Scientific Missions which can be used to learn or apply new techniques in an experienced host laboratory.

Today, COST 854 is carried by numerous scientists from 19 signatory states in Europe and collaborators from countries all over the world, in particular Australia, New Zealand and the USA.

Franz J. Conraths
Chairman of the Management Committee of COST 854