

# TSETSE AND TRYPANOSOMIASIS INFORMATION QUARTERLY

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## SECTION A – NEWS

### INTEGRATED CONTROL OF PATHOGENIC TRYPANOSOMES AND THEIR VECTORS

Integrated Control of Pathogenic Trypanosomes and their Vectors is a new 'Concerted Action' initiative supported by DGXII of the European Commission under the INCO-DC (International Co-operation with Developing Countries) Programme of the Fourth Framework. The Concerted Action will be co-ordinated by the University of Glasgow, has 27 developing country, European and International partners, and will run for four years commencing 1 July 1998.

The overall objective of the Concerted Action is to exploit results relevant to the control of pathogenic trypanosomes and their vectors obtained in ongoing and future research projects funded by the European Commission and other donors. This will be effected through a series of seven international workshops, and through scientific exchanges, a World Wide Web site (Internet), and a newsletter. It is thereby intended to make a positive contribution towards increased livestock productivity and lead to economic benefit in the developing countries affected by trypanosomiasis.

The Concerted Action will be fully complementary to the FAO/IAEA/OAU-IBAR/WHO Programme Against African Trypanosomiasis (PAAT), although it will not be restricted to Africa. One of the four major components of PAAT, which has the overall objective to solve the trypanosomiasis problem within the broader context of food security, human health, rural development and sustainable agriculture, is the Research and Development (R & D) Module. This has the specific objective to provide guidance, support and direction to trypanosomiasis research within the context of agricultural development. The proposed Concerted Action will provide a mechanism whereby many of the PAAT R & D Module's recommendations can be implemented at the level of individual research groups. The outputs of the integrated research conducted under the Concerted Action will in turn be made available to the working group of the PAAT Policy, Planning and Implementation Module.

The Concerted Action covers the following broad areas:

- Integration of vector and trypanosomiasis control with sustainable rural development
- Integration of vector and trypanosomiasis control with the control of other livestock diseases in evolving farming systems
- Understanding the nature of tolerance and resistance to trypanosomiasis and its synergistic combination with innovative drugs and vector baits

Under each of these areas, the Concerted Action has specific objectives, as follows:

#### **Area 1: Integration of vector and trypanosomiasis control with sustainable rural development**

- Improved methodologies for determining the direct and indirect socio-economic impact of trypanosomiasis.
- Methodological approaches to alternative and socio-economically and environmentally sustainable land uses in tsetse infested areas.

- Environmental monitoring approaches and methods including indicators of tsetse and trypanosomiasis control.

**Area 2: Integration of vector and trypanosomiasis control with the control of other livestock diseases in evolving farming systems**

- Improved epidemiological methods, including diagnostics, disease surveillance and reporting and the corresponding information sharing mechanisms.
- Decision support systems including risk assessment and disease impact evaluation to assist in the implementation of animal health strategies and the development of the associated services sector.
- Socio-economic and policy analysis of integrated and participatory disease management schemes including all stakeholders.
- Maximising the efficacy of existing and novel chemical agents for control of the disease and its vectors.

**Area 3: Understanding the nature of tolerance and resistance to trypanosomiasis and its synergistic combination with innovative drugs and vector baits**

- Optimised strategies for synergistic and economically efficient use of drugs and bait technologies.
- Identification of mechanisms underlying tolerance, acquired and genetic resistance to trypanosomiasis and immunological, molecular and genetic approaches to enhance it.

The implementation of these objectives will be overseen by an Area Co-ordinator, and conducted through a series of 13 Actions, each of which falls under one or more of the general areas outlined above. These Actions will cover specific areas of research under the guidance of Action Leaders, and are listed below. The international scientific workshops will bring together partners in the Concerted Action researching these topics. Additional interaction and exchange of materials, results and ideas will be brought about through scientific exchanges, the WWW site and the newsletter.

**Actions under 'Integrated Control of Pathogenic Trypanosomes and their Vectors'**

1. Socio-economic impact assessment.
2. Socio-economic analysis of disease management schemes.
3. Environmental impact assessment.
4. Diagnosis and Epidemiology of tsetse-transmitted trypanosomiasis.
5. Diagnosis and Epidemiology of non-tsetse-transmitted trypanosomiasis.
6. Data Management.
7. Decision support systems.
8. Risk assessment and disease impact evaluation.
9. Drug delivery and resistance.
10. Integrated Vector Control.
11. Synergistic use of drugs and bait technologies.
12. Identification of mechanisms of acquired and genetic resistance.
13. Enhancing acquired and genetic resistance.

Further information on the Concerted Action can be obtained from the University of Glasgow Co-ordinators, Mark Eisler (based in Nairobi) and Peter Holmes (in Glasgow). Dr Mark Eisler can be contacted c/o ILRI, P.O. Box 30709, Nairobi, Kenya (tel. +254 2 630743; fax: +254 2 631499; e-mail: m.eisler@vet.gla.ac.uk).

## **PROGRAMME AGAINST AFRICAN TRYPANOSOMIASIS**

### **Amendment to List of Advisory Group Coordinators**

Dr Brent Swallow has withdrawn from the Panel of PAAT Advisory Group Coordinators, where he served as an expert on socio-economics aspects. His replacement is Dr J.B.M. Kamuanga, a national of the Democratic Republic of the Congo, whose education and work experience meet those required for the position. His contact details are as follows:

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## **MEETING**

### **International Colloquium: 'Sleeping Sickness Rediscovered'**

The 40th International Colloquium of the Institute of Tropical Medicine, Antwerp, Belgium, entitled 'Sleeping Sickness Rediscovered', will be held in Antwerp from 14 (evening) to 17 December 1998. The objective of the colloquium is to review recent achievements and developments in the understanding and control of sleeping sickness which may have an impact on the current disease situation. The official language of the colloquium will be English.

The main topics to be covered are: (i) Control activities: state of the art and perspectives for the near future with respect to international, bilateral, national and non-governmental agencies and programmes; (ii) Control tools: recent developments in diagnosis, treatment and vector control; and (iii) Research: state of the art and perspectives concerning pathogenesis, drug development, experimental treatment, vaccine development and vector control.

Website information and registration are available on <http://www.itg.be/colloq98> or from the Colloquium Secretariat, Institute of Tropical Medicine: tel. (32) 3 247 62 06; fax (32) 3 247 62 13; e-mail [dvmelle@itg.be](mailto:dvmelle@itg.be).

## **TRAINING COURSE**

### **The Ecology of Parasitic Systems**

A new training course on 'The Ecology of Parasitic Systems' is being organised, every other year, in the Institut Pasteur, Paris, beginning next year. This full-time course in French is dedicated to the study of the circulation of parasites (fungi excepted) in natural and modified ecosystems, with a clear-cut epidemiological approach. Students must have a DEA (in France) or an equivalent diploma (M.Sc.) in Parasitology or

Epidemiology and possess a good knowledge of the French language. After two months of theoretical studies in Paris, a field- or laboratory-based training period will be organised, lasting about 6 weeks, either in France or overseas. The first session will begin on 18 January 1999.

For further information and administrative details, please contact the Secretariat des Enseignements et des Stages, Institut Pasteur, Paris, France (fax: 33 (0)1 40 61 30 46). For further information on the scientific programme, please contact the co-ordinator, Professor François Rodhain, who is also in charge of the Pasteur Institute's Medical Entomology course (e-mail: [frodhain@pasteur.fr](mailto:frodhain@pasteur.fr)).

### **OIE VETERINARY BIOTECHNOLOGY DATABASE**

Since 1989, the Office International des Epizooties (OIE), has been gathering information, using a questionnaire, on laboratory diagnostic methods and products based on biotechnology (including transgenic animals) that are used, or show promise for future use, in the control of animal diseases. A total of 192 laboratories have responded to the questionnaire, and data collected on over 25,000 biotechnology methods and products have been organised into a database that can now be accessed on OIE's website under 'OIE Veterinary Biotechnology Database' (<http://www.oie.int>, open 'File Downloads', then 'Biotech') or on diskette.

The database allows the user to search by key word, either by name of the pathogen, by technique used (nucleic acid probe, PCR, etc.) or by biological reagent (antibody, peptide, antigen, etc.). Analysis by country or region can also be done. Not only animal health but other biomedical scientists may find the database useful, and all researchers are encouraged to contribute new information by means of the questionnaire available on the website.

**SECTION B – ABSTRACTS****1. GENERAL (INCLUDING LAND USE)**

10465 **Ancelle, T., 1996.** Le réveil de la trypanosomose: un nouveau défi pour une maladie oubliée. [Recrudescence of trypanosomiasis: a new challenge from a forgotten disease.] *Médecine tropicale*, **56** (4): 347-348.

Laboratoire de Parasitologie, Hôpital Cochin, 27 rue du Faubourg Saint-Jacques, 75014 Paris, France.

The author of this editorial draws attention to the current unsatisfactory situation regarding human African trypanosomiasis. In the 1960s it was thought that this disease had been brought under control and consequently those in charge of providing funds for control measures forgot about it. Now it has reappeared explosively in many of the old foci in Zaire, Uganda, southern Sudan, Angola, and elsewhere. Population displacement due to war and the breakdown of health services are the main causes. Experts expect more than 25,000 new cases to be notified each year. In some villages the prevalence has reached 50-70%. Cheaper drugs are urgently needed to treat the disease, those there are being toxic or too expensive or not readily available. Control programmes, comprising active case-finding by mobile teams, systematic treatment of cases and vector control by trapping, have shown their efficacy: the methods are simple but need organisation and money to rehabilitate them, perhaps by setting up an agency dedicated to human trypanosomiasis. The second priority is research on control strategies, the reinstatement of 'orphan' drugs and the development of new ones. The public image of a laboratory developing a drug which would drastically reduce the disease would surely not be negative.

[Some comments on this editorial by P. Cattand and J. Jannin (WHO) are included in *Médecine tropicale*, **57** (1): 102-103. They clarify the position concerning the current availability of drugs and mention the national and international organisations involved in the control of trypanosomiasis, including the coordinating role of PAAT.]

10466 **Cox, F.E.G. (ed.), 1996.** *The Wellcome Trust illustrated history of tropical diseases*. London, UK; Wellcome Trust. 452 pp.

This richly illustrated book presents an informative and accessible history of tropical diseases with the emphasis on the nature of discovery and the individuals involved. The chapters covering the 41 tropical diseases or disorders selected for inclusion have been written by clinicians and scientists with an understanding of the diseases described. The most important and lasting findings are emphasised. The seven sections cover bacterial, viral, protozoal and helminth diseases, mycoses, genetic and nutritional disorders. The chapter on African trypanosomiasis (B.I. Williams, pp. 178-191) covers: the 14th century (death on the Niger); the 18th century (hidden treasure from Guinea); the 19th century (too much blood in the brain; the French connection; microscopic findings; nagana); the 20th century (Gambian fever; Entebbe encounter; incrimination of the tsetse fly; when is a tsetse fly bite infectious?; a new trypanosome? human nagana?; clues from biochemistry).

10467 **Dumas, M. and Bouteille, B., 1997.** Actualité des trypanosomoses. [Update on trypanosomiasis.] *Médecine tropicale*, **57** (3 Suppl.): 65-69.

Dumas: Institut d'Epidémiologie Neurologique et de Neurologie Tropicale, Faculté de Médecine, 2 rue du Docteur Marcland, 87025 Limoges Cedex, France.

Sleeping sickness is currently undergoing a recrudescence, mainly as a result of major socioeconomic problems in Africa. Despite the reigning pessimism due to the current situation (increasing incidence, lack of quick and easy diagnostic techniques, and unavailability of active non-toxic therapeutic agents), research holds the promise of more effective control of this disease in the future. Mapping of infected households is now necessary to allow better early identification and follow-up of patients. Great advances have been made in the study of the pathogenesis of nervous involvement and it has been demonstrated that the characteristic symptoms of sleeping sickness are due to penetration of trypanosomes into the CNS through the blood-brain barrier. However, an unsolved problem is determining whether the blood-brain barrier has been breached and CNS involvement has occurred as this knowledge is a prerequisite for deciding whether or not to undertake treatment using highly toxic melarsoprol. Research to identify new criteria for staging blood/lymph and nervous involvement is under way and encouraging results have been obtained using auto-antibodies against nervous system components. Although there is now greater hope that a vaccine will be developed in the future, treatment has not advanced greatly in the last 50 years. Pentamidine can be effective in some patients with 'early-stage' nervous involvement. Melarsoprol is fatal in about 5% of patients treated. New drugs (e.g. nitroimidazoles) may become available one day but most research is being done in a few, mostly university, laboratories which cannot themselves assure development.

10468 **International Livestock Research Institute, 1997.** *ILRI 1996: out of Africa, into a global mandate.* Nairobi, Kenya; ILRI. 54 pp. (ISBN 92 9146 020 6.)

ILRI, P.O. Box 30709, Nairobi, Kenya.

During 1996, ILRI took its first steps from Africa into both Asia and Latin America, and the seven sections of this report continue the 'out of..., into...' theme by describing ILRI's work along the lines of 'out of the laboratory, into farmers' fields'. One article describes how a potential vaccine for East Coast fever has been developed and is now being field tested. Two articles, on market-oriented smallholder dairying and on the Small Ruminant Research Network, focus on ILRI's partnerships with national agricultural research systems which help to facilitate extension. Two articles, on grass varieties and forage legumes, describe progress 'out of the gene bank, into farmers' fields', and another stresses the importance of assessing true credit constraint ('out of economic theory, into practical application'). ILRI's research in molecular genetics is currently focused on the genes for trypanotolerance found in N'Dama cattle. Markers for these genes in laboratory animals have already been identified and are now being sought in cattle. Pilot breeding schemes to test the practical application of marker-assisted selection are being planned in collaboration with the ITC in The Gambia. While this work focuses on trypanotolerance,

the techniques are of global relevance and will be applicable to other 'quantitative traits' such as milk and meat yield and resistance to other diseases and parasites.

- 10469 **Mills, A. and Pender, J., 1996.** Environmental impact assessment of tsetse control: historical quantification of land cover and land use. *In: Power, C.H., Rosenberg, L.J. and Downey, I. (eds), Remote sensing and GIS for natural resource management* (conference proceedings) (Chatham, UK; Natural Resources Institute), pp. 72-86.

NRI, Central Avenue, Chatham Maritime, Chatham, Kent ME4 4TB, UK.

Tsetse control has been the primary method of reducing trypanosomiasis in Zimbabwe for more than 50 years. In order to measure its effect on land use, land use changes in north-western Zimbabwe near Lake Kariba were recorded over the 20 year period from 1972 to 1993 and were quantified using Landsat TM and Multi-Spectral Scanner (MSS) data. The pattern of land use change is complex, involving intensification in already settled areas, expansion into virgin land and occasional contraction. Expansion into preferred vegetation complexes can be seen. A wide range of factors affect patterns of land use change, and a small sub-set of variables studied here demonstrates the potential for using remotely sensed data with other datasets in a GIS to interpret land use change.

- 10470 **Reid, R.S., Wilson, C.J. and Kruska, R.L., 1996.** The influence of human use on rangeland biodiversity in Ghibe Valley, Ethiopia, as affected by natural resource use changes and livestock disease control. *In: West, N.E. (ed.), Rangelands in a sustainable biosphere* (Proceedings of the Fifth International Rangeland Congress, Salt Lake City, Utah, USA, 23-28 July 1995), *volume 1: contributed presentations* (Denver, USA; Society for Range Management), pp. 468-469.

ILRI, P.O. Box 30709, Nairobi, Kenya.

In south-western Ethiopia, recent chaotic events, changes in land tenure and the introduction of tsetse fly (*Glossina tachinoides*) control have precipitated changes in the use of land and other natural resources. These changes have in turn initiated shifts in rangeland biodiversity. Small-holder cultivated fields were unexpectedly found to contain more tree and bird species than less used rangelands. Conversion of rangelands to agriculture sustained biodiversity unless the rangelands were converted into large, mechanised farms involving tree removal or if conversion occurred in species-rich riparian corridors.

- 10471 **Robertson, H.G. (ed.), 1997.** *Insects in African economy and environment* (Joint Congress of the Entomological Society of Southern Africa (11th Congress) and the African Association of Insect Scientists (12th Congress), Stellenbosch, South Africa, 30 June – 4 July 1997). Pretoria, South Africa; Entomological Society of Southern Africa. 255 pp. (ISBN 0 620 21415 5.)



This volume includes the following abstracts on tsetse and trypanosomiasis: Farmers as partners in pest and vector management: recent experiences of ICIPE (F.G. Kiros, p. 30); Tsetse and trypanosomiasis: an African problem (E.M. Nevill, pp. 165-166); Tsetse in South Africa: where are they now? (E.M. Nevill, p. 167); Eradication of the tsetse fly *Glossina austeni* by the sterile insect technique (SIT) in Zanzibar: could South Africa be next? (V.A. Dyck, K.G. Juma, A.R. Msangi, K.M. Saleh, N. Kiwia, M.J.B. Vreysen, A.G. Parker, J. Hendrichs and U. Feldmann, p. 168); The assessment of rural population's knowledge on human trypanosomiasis in Côte d'Ivoire (M. Dagnogo, Y. Yapi and M. Koné, pp. 169-170); Responses of *Glossina fuscipes fuscipes* Newstead (Diptera: Glossinidae) to host odour baits in the field (J.-B.B. Muhigwa and R.K. Saini, p. 170); Properties of a tsetse fly midgut trypanolysin (M.H. Abakar and E.O. Osir, p. 171).

10472 **Service, M.W., 1996.** *Medical entomology for students.* London, UK; Chapman and Hall. 278 pp. (ISBN 0 412 71230 X.)

Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, UK.

This textbook, which is primarily aimed at students of tropical medicine, parasitology, entomology and pest control, but is also intended as a source of information for physicians, nurses, health officials and community health workers, provides basic information on the recognition, biology, medical importance and control of arthropods affecting human health. It covers mosquitoes, blackflies, phlebotomine sandflies, biting midges, horseflies, tsetse flies, house, stable and latrine flies, fleas, lice, bedbugs, triatomine bugs, cockroaches, ticks, scabies, scrub typhus and other mites.

10473 **Silva, R.A.M.S. and Dávila, A.M.R. (eds), 1997.** *Proceedings of the First Internet Conference on Salivarian Trypanosomes* (Tryplink-L discussion list, 9-14 December 1996). Rome, Italy; FAO (*FAO Animal Production and Health Paper*, no. 135). 55 pp. (ISBN 92 5 104006 0.)

The First Internet Conference on Salivarian Trypanosomes was initiated by the Brazilian Enterprise for Research in Agriculture (EMBRAPA). In view of the economic importance of trypanosomiasis in animal production worldwide, and particularly in developing countries in the tropics, the meeting attracted great attention and a number of contributions of high standard were received. The papers presented to the conference are reproduced in these proceedings. They cover a wide range of topics concerning the diagnosis, epidemiology and control of trypanosome diseases and their impact on agricultural production. An account of the recent introduction of *Trypanosoma vivax* into Brazil and Bolivia, and its subsequent spread through areas of high livestock densities, highlights the growing need for a greater understanding of the epidemiology of diseases in general. Several papers illustrate how recent progress in the development of molecular biology may offer the potential to improve the diagnosis of trypanosome infections and may also open new avenues of research for novel approaches to control and immunisation. For presentations on African trypanosomiasis, see *TTIQ*, **21** (3): nos. 10488, 10512, 10515, 10522, 10526-10528, 10530, 10567.

- 10474 **Uilenberg, G. and Hamers, R. (eds), 1993.** *Resistance or tolerance of animals to disease, and veterinary epidemiology and diagnostic methods* (Proceedings of EEC Contractant Workshops, 2-6 November 1992, Rethymnon, Crete, Greece). Maisons-Alfort, France; CIRAD. 183 pp. (ISBN 2 87614 132 9.)

This volume consists of 30 contributions on the first topic and 20 on the second. Special emphasis is placed on genetic resistance to disease in farm animals, and to the epidemiology of protozoal diseases, incorporating the results of 15 research projects funded by the EU. Conclusions of the workshops are also included. The following papers relate to trypanosomiasis: Trypanotolerance of cattle and small ruminants in Africa: research on mechanisms and selection criteria (A. Verhulst, V.S. Pandey, F. Demey and N. van Meirvenne, pp. 39-42); Parasitological and serological prevalence of trypanosomiasis in various breeds of cattle in Benin (V.S. Pandey, A. Doko, E. Magnus and A. Verhulst, pp. 68-71); Development of diagnostics for *T. evansi* in camels and water buffaloes; perspectives in vaccine development (R. Hamers, E.B. Songa, O. Diall and S. Panyim, pp. 113-117); A PCR method for highly sensitive detection of *Trypanosoma evansi* in blood samples (S. Panyim, N. Viseshakul, P. Luxananil, N. Wuyts and N. Chokesajjawatee, pp. 138-143). The following abstracts are also included: Humoral antibodies in camels (R. Hamers, S. Muyldermans, T. Atarhouch, N. Bendahman, E. Bajyana-Songa and C. Hamers-Casterman, p. 67); Detection and strain identification of *Trypanosoma evansi* by PCR-amplification of a kinetoplast minicircle DNA sequence for use in diagnosis and epidemiology of camel trypanosomiasis (O. Diall, E. Bajyana Songa, D. de Vos, N. Bendahman, S. Muyldermans, N. van Meirvenne and R. Hamers, p. 144); Animal trypano-somiasis: field and laboratory studies of drug resistant African trypanosomes (M.C. Eisler, E.A. Gault and P.H. Holmes, p. 156); Wild animals as reservoirs of animal and human trypanosomiasis (A. Verhulst, N. van Meirvenne, P. Büscher and V.S. Pandey, p. 161).

## 2. TSETSE BIOLOGY

### (a) REARING OF TSETSE FLIES

### (b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

[See also **21**: no. 10472.]

- 10475 **Beaty, B.J. and Marquardt, W.C. (eds), 1996.** *The biology of disease vectors.* Niwot, CO, USA; University Press of Colorado. 648 pp.

This book contains 35 chapters grouped in five sections: Introduction to arthropods and vectors; Molecular biology of vectors; Biology, physiology and development of vectors; Population genetics and molecular systematics; Surveillance and control of vectors. It is especially suitable for undergraduate and masters level courses, for students of public health and/or epidemiology.

- 10476 **Loder, P.M.J., Hargrove, J.W. and Randolph, S.E., 1998.** A model for blood meal digestion and fat metabolism in male tsetse flies (Glossinidae). *Physiological Entomology*, **23** (1): 43-52.

Loder: CAB International, Wallingford OX10 8DE, UK.

Fat and haematin levels of mature male *Glossina morsitans morsitans* were estimated at different times after feeding at temperatures between 15 and 30°C. Flies were kept (largely inactive) in 7.5 × 2.5 cm tubes, or in actograph cages, where flight activity increased with time after feeding. Haematin excretion was modelled as a series of three first order reactions, all with the same rate parameter. The model accounted for > 98% of the variance in mean haematin in each of seven experiments; the rate parameter increased linearly with temperature and activity level. A similar approach was adopted for modelling fat metabolism. The rate coefficients of lipogenesis increased with temperature, and that for lipolysis with temperature, activity level and their interaction. All experiments were analysed simultaneously to provide equations predicting haematin or fat levels for all times, for active or inactive flies, and for temperatures between 15 and 30°C. Haematin exhibited large variations between individuals, but for active flies the expected haematin content at a given time varied little between flies kept at 25 and at 30°C. In inactive flies kept at 25°C, lipogenesis peaked at ≈ 24 h and lipolysis at ≈ 48 h. For active flies the times were 12 and 24 h, respectively; both rates were about twice as high as in inactive flies. Active flies produced (up to 1 mg) more fat out of a given size of blood meal than inactive flies. Curves of fat content against logarithm of haematin content differed little with temperature, and can therefore be useful for comparative studies of field populations of tsetse.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also **21**: nos. 10482, 10502.]

- 10477 **Djiteye, A., Mooloo, S.K., Foua Bi, K., Touré, M., Boiré, S., Bengaly, S., Coulibaly, E., Diarra, M., Traoré, D., Ouattara, I. and Coulibaly, Z., 1997.** Réactualisation des données sur la répartition des glossines au Mali. [Update on the distribution of tsetse flies in Mali.] *Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux*, **50** (2): 126-132.

Djiteye: Laboratoire Central Vétérinaire, B.P. 2295, Bamako, Mali.

The area of tsetse fly infestation in Mali is approximately 200,000 km<sup>2</sup>, south of parallel 14°30'N and west of meridian 4°30'W. Four species have been reported: two riverine (*Glossina palpalis gambiensis* and *G. tachinoides*) and two savanna species (*G. morsitans submorsitans* and *G. longipalpis*). *G. m. submorsitans* has a more or less continuous distribution along the borders with Côte d'Ivoire, Guinea and Senegal up to the northern limit of the National Park 'Boucle du Baoulé'. A low population density, apparently discontinuous in forest zones, has been encountered east of Bamako. *G. p.*

*gambiensis* was localised along the Bani River, the Niger River and its tributaries, as well as along the tributaries of the Senegal River (Baoulé, Bafing and Bagoé). *G. tachinoides* was present in most of the riverine forest galleries in the south-eastern part of the country. The presence in Mali of *G. longipalpis* was not confirmed during this survey. A relatively significant decrease in the distribution zones of tsetse flies has been observed in Mali following several years of drought and/or intensive deforestation.

10478 **Langley, P.A., 1996.** Practical applications for techniques to determine the nutritional state and age of field-caught tsetse flies. (Review.) *In*: Symondson, W.O.C. and Liddell, J.E. (eds), *The ecology of agricultural pests: biochemical approaches* (London, UK; Chapman and Hall), pp. 479-497.

School of Pure and Applied Biology, University of Wales, P.O. Box 915, Cardiff CF1 3TL, UK.

The nutritional state and age composition of captured tsetse flies depends on the capture techniques employed. Hence, in order to evaluate biases and to measure seasonal effects upon survival and feeding success in tsetse populations, semi-automated systems have been developed in the laboratory for use on field-collected material. Nutritional state is reflected in the extent of lipid reserves and the amount of residual blood-meal remaining in the intestine. Lipid content is measured in dried flies by weight differences after chloroform extraction. The residual blood-meal in the same fly is then measured spectrophotometrically following conversion of the dried abdominal contents to pyridine haemochromagen by first dissolving in sodium hydroxide and ethanol, followed by reacting with pyridine in the presence of sodium dithionite. The absorbance of the pink colour formed is measured at either 558 or 417 nm and is compared with a standard curve prepared with known amounts of haematin. The chronological ages of individual adult flies can be measured with reference to the degrees of fray on the trailing edge of the wings; six categories are recognised and can provide an estimate of the relative ages of flies of both sexes in a fly population. A highly accurate estimate of the relative ages of females can be obtained by ovarian dissection, since mature eggs from each of the four ovarioles ovulate singly and sequentially at 9- or 10-day intervals (at 25°C). After the fourth ovulation the presence of relics of the previous oocyte must be identified in order to recognise ovulations 5 to 8. After this, at about 70 days of age, the technique cannot be used alone. However, when used in conjunction with wing fray analysis, it is possible to categorise flies of any age with accuracy. The problems associated with these techniques are that they require the skills of highly trained technicians for their operation and must be performed on freshly caught material. An alternative method, which is subject to greater inherent variation than that of ovarian categorisation, is to measure the pteridine content of the head capsule. In many Diptera, pteridines accumulate in a predictable manner with time. Storage of desiccated heads in the dark for up to 1 month is followed by extraction into chloroform, separation of the pteridines into an aqueous buffer phase and fluorometric measurement. Standard curves are constructed using laboratory-reared insects of known age. In field experiments (in Côte d'Ivoire using *Glossina tachinoides* and Kenya using *G. pallidipes*), the pteridine fluorescence technique has shown excellent correlation with wing fray category and with ovarian configuration in the estimation of the chronological age of flies.

- 10479 **Odulaja, A., Mihok, S. and Abu-Zinid, I.M., 1998.** The magnitude of site and time interaction effect in tsetse fly (Diptera: Glossinidae) trap catches. *Bulletin of Entomological Research*, **88** (1): 59-64.

Odulaja: ICIPE, P.O. Box 30772, Nairobi, Kenya.

Site and time effects are important factors determining trap catches of tsetse flies. These factors may interact significantly and therefore confound interpretation of time series data used for population monitoring. We therefore investigated the magnitude and importance of site  $\times$  time interactions in trap catches of *Glossina pallidipes* and *G. longipennis* using a 2200 trap-days (400 trap-months) data set from Kenya. The interaction was found to be significant ( $P < 0.05$ ) in 46-100% of the combinations of different numbers of months and sites between 2 and 12. The mean percentage variance due to the interaction ranged between 4% and 28% for *G. pallidipes* and 12% and 36% for *G. longipennis*. The interaction was usually less important than the effect of site alone but more important than the effect of time alone. These results suggest that tsetse researchers should examine critically the adequacy of existing approaches to population monitoring with traps and to testing new traps and odour baits.

### 3. TSETSE CONTROL (INCLUDING ENVIRONMENTAL SIDE-EFFECTS)

[See also 21: nos. 10469, 10475.]

- 10480 **Okoth, J.O., Omare-Okurut, A. and Eboyu, F., 1998.** The use of theatre to mobilize and sensitize rural communities to participate in tsetse control in Bugiri district, Busoga, Uganda: a case study. *Annals of Tropical Medicine and Parasitology*, **92** (1): 127-128.

Okoth: Livestock Health Research Institute (LIRI), P.O. Box 96, Tororo, Uganda.

Previous attempts in Bugiri district to involve local communities in tsetse control by means of teaching selected villagers (focus representatives) about tsetse traps and asking them to mobilise their communities in trap construction and use have been only partially successful. A much larger proportion of each local community needs to be informed about tsetse control and encouraged to participate in it. Theatre had already been successfully used by community-based organisations to educate villagers about the problems of poor sanitation, contaminated water and HIV. An attempt was therefore made to integrate tsetse control into the primary health care system. A story was written by the villagers, using a traditional folkloristic approach, telling the dangers of tsetse, the need to work together, the need for accurate information and the need to control tsetse, and several songs were also produced. The story and songs were turned into a play called *Ekiriita Omwana* ('Your child will die because of your negligence') under the guidance of scientists who checked for accuracy. The final script and song are now being used by community-based organisations and schools, and performances in the district have

resulted in local civic leaders contributing money for tsetse control targets and in increased participation by villagers.

#### 4. EPIDEMIOLOGY: VECTOR-HOST AND VECTOR-PARASITE INTERACTIONS

[See also **21**: nos. 10495, 10526, 10528.]

- 10481 **Bock, G.R. and Cardew, G. (eds), 1996.** *Olfaction in mosquito-host interactions* (Proceedings of CIBA Foundation Symposium 200, London, UK, 31 October – 2 November 1995). Chichester, UK; John Wiley & Sons. 331 pp. (ISBN 0 471 96362 3.)

This volume includes the following papers which have some relevance to tsetse and trypanosomiasis: Vector insects and their control (M.J. Lehane, pp. 8-21); Odour plumes and odour-mediated flight in insects (R.T. Carde, pp. 54-70); Olfactory basis of host location by mosquitoes and other haematophagous Diptera (A. Cork, pp. 71-88).

- 10482 **Djiteye, A., Mooloo, S.K., Foua Bi, K., Coulibaly, E., Diarra, M., Ouattara, I., Traoré, D., Coulibaly, Z. and Diarra, A., 1997.** Variations saisonnières de la densité apparente et du taux d'infection par *Trypanosoma* spp. de *Glossina palpalis gambiensis* (Vanderplank, 1949) en zone soudanienne au Mali. [Seasonal variations of the apparent density and trypanosome infection rates of *G. p. gambiensis* in the Sudanese zone of Mali.] *Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux*, **50** (2): 133-137.

Djiteye: Laboratoire Central Vétérinaire, B.P. 2295, Bamako, Mali.

*G. p. gambiensis* infests riparian and gallery forests of the Niger River and its tributaries in the agropastoral zone of Baguinéda-Tienfala. The incidence of trypanosomiasis in livestock (related to the apparent density of this tsetse subspecies and its trypanosome infection rates) varies depending on the season and the site. In the Tienfala site (left bank of the river) the highest apparent density (21.70 tsetse/trap/day) was observed at the end of the rainy season and the lowest (5.23) during the hot dry season. The sex ratio was generally in favour of females (60.74%). In the Baguinéda site (right bank), the highest apparent density (8.70) was observed during the cold dry season, and the lowest (2.91) at the end of the rainy season. The sex ratio was generally in favour of males (57.81). The trypanosome infection rate was higher at the end than at the beginning of the rainy season and the observed rates varied between 6.66 and 10.68% against 0.48 and 1.48%, respectively. Depending on the location in *G. p. gambiensis*, the infections were due to subgenera *Duttonella* (*Trypanosoma vivax*: 80%), *Nannomonas* (*T. congolense*: 4%), *Megatrypanum* (*T. grayi*: 2%) and to immature stages located only in the midgut (14%).

- 10483 **Mattioli, R.C., 1997.** Factors affecting trypanosome infection rate in tsetse fly (Diptera: Glossinidae) populations. *Parassitologia*, **39** (1): 53-57.  
ITC, P.M.B. 14, Banjul, Gambia.

Wide variations in trypanosome infection rate are observed in different tsetse fly populations. Environmental factors and features proper to the vector, mammalian host and infecting trypanosome species acting in the acquisition and development of infective trypanosome infection in tsetse are reviewed.

10484 **Morlais, I., Grébaud, P., Bodo, J.-M., Djoha, S., Herder, S. and Cuny, S., 1997.**

Identification par la réaction de polymérisation en chaîne des trypanosomes circulant chez les glossines dans trois foyers de trypanosomose humaine au Cameroun. [Identification by the PCR technique of trypanosomes circulating in tsetse flies in three human trypanosomiasis foci in Cameroon.] (Meeting abstract.) *Médecine tropicale*, **57** (3 Suppl.): 82.

Morlais: Laboratoire de Recherches sur les Trypanosomoses, OCEAC, Yaoundé, Cameroon.

Microscopical examination of 888 non-teneral tsetse flies (principally *Glossina palpalis palpalis*) revealed an infection rate of 12.1%. PCR analysis was carried out on 467 flies, of which 93 were microscopically positive, using primers specific to *Trypanosoma brucei s.l.*, *T. vivax*, *T. congolense* forest type and *T. simiae*. Eighty-nine infections were identified: 55.1% were *T. congolense*; 37.1% were mixed infections, mostly *T. brucei* and *T. congolense*. These primers could not identify 38 of the 93 microscopically positive flies: these were tested with *T. congolense* savanna type primers but this subgroup was never identified. These cases could represent distinct strains existing in isolated foci which do not hybridise with the primers used or, more likely, are *T. grayi* since reptiles were abundant in the study sites. PCR identified infections in 34 flies which were microscopically negative. The infection rate of tsetse populations was significantly higher by PCR amplification (16.5%) than by microscopy (12.4%).

10485 **Penchenier, L., Wang Sonne and Louis, F.J., 1997.** Foyers historiques de trypanosomiase humaine africaine en Afrique centrale et flambées épidémiques: des cycles de quarante ans. [Historic foci of human trypanosomiasis in Central Africa and epidemic outbreaks: 40 year cycles.] (Meeting abstract.) *Médecine tropicale*, **57** (3 Suppl.): 81.

Penchenier: Laboratoire de Recherches sur les Trypanosomoses, OCEAC, Yaoundé, Cameroon.

Epidemiological data on human trypanosomiasis in Central Africa are available from the beginning of the century, i.e. since colonisation, and are particularly numerous since the 1920s. Analysis of these data has brought to light a striking fact with regard to the distribution of foci in time and space: the foci are stable and relatively isolated. Foci flare up and extend outwards from an epicentre and then retreat again at the end of the epidemic. This might be due to each focus having its own strain of trypanosome but this does not explain why the spaces separating the foci, whose biotopes are often comparable with those of the foci, are not endemic areas of trypanosomiasis. Molecular biological and genetic studies of these populations may give answers to these questions.

- 10486 **Reifenberg, J.-M., 1996.** *Etude des relations parasites-hôtes dans l'épidémiologie moléculaire des trypanosomoses bovines au Burkina Faso.* [Study of parasite-host relationships in the molecular epidemiology of bovine trypanosomoses in Burkina Faso.] Thèse de doctorat en Biologie des systèmes intégrés, agronomie, environnement; Université de Montpellier II Sciences et Techniques du Languedoc, Montpellier, France. 172 pp.

Reifenberg: CIRAD-EMVT, B.P. 5035, 34032 Montpellier Cedex 1, France.

The author's two main objectives were to simplify existing protocols of molecular characterisation of trypanosomes in tsetse flies and in their vertebrate hosts for use in the field, and to evaluate precisely the domain of use of these biotechnologies. The results obtained show that PCR constitutes a very effective means of detecting mixed and low-level infections in both vectors and hosts provided certain precautions are taken. The main limitation of the method is the non-recognition by known molecular markers of certain trypanosomes detectable by classic parasitological methods. PCR was used to study parasite-vector affinities. The affinity between *morsitans* group tsetse flies and savanna type *Trypanosoma congolense* was confirmed: savanna tsetse species were found to be more often infected, and with more parasites, than riverine species. On the other hand, although *Glossina palpalis gambiensis* showed the highest intestinal infection rate, the hypothetical affinity between riverine tsetse and forest type *T. congolense* appeared less strong. Other factors (type of vertebrate host, availability of food, diversity of parasites ingested during different blood meals, temperature, etc.) which might affect vector specificity are discussed. PCR was also used to study parasite emission by *G. tachinoides* experimentally infected with savanna type *T. congolense* in order to define more clearly the role of this species in the epizootiology of animal trypanosomosis. A great variability in parasite emission both within and between individuals was observed. In natural conditions in the field, other numerous factors occur, related to the vector, the host and the environment. PCR was also used in a large epidemiological survey carried out in Sissili Province (Yalé pastoral zone), Burkina Faso. Among the principal results obtained, about 40% of trypanosomes observed microscopically were not characterised by currently available probes. Two presumed cycles of trypanosome transmission in *G. tachinoides* and in animals in the Yalé pastoral zone were outlined: a wild cycle with *T. congolense* forest and savanna types, *T. simiae*, *T. vivax* and unidentified trypanosomes with warthog and/or bushbuck as reservoirs, and a domestic cycle in cattle and savanna type *T. congolense* and *T. vivax*. All the results obtained have been used to draw up a diagram clarifying the affinities between *T. congolense* savanna and forest types and the species of tsetse according to their habitat.

- 10487 **Reifenberg, J.M., Solano, P., Bauer, B., Kabore, I., Cuny, G., Duvallet, G. and Cuisance, D., 1997.** Apport de la technique PCR pour une meilleure compréhension de l'épizootologie des trypanosomoses bovines: exemple de la zone d'aménagement pastoral de Yalé au Burkina Faso. [Advantage of the PCR technique in assessing the epidemiology of bovine trypanosomosis: example of the agropastoral development area of Yalé, Burkina Faso.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **50** (1): 14-22.



Reifenberg: CIRAD-EMVT, B.P. 5035, 34032 Montpellier Cedex 1, France.

The PCR technique was used to identify trypanosomes in both tsetse and infected cattle in the agropastoral development area of Yalé in southern Burkina Faso. Out of 84 parasitologically positive midguts of *Glossina tachinoides*, 50 (*Trypanosoma congolense* savanna and riverine forest types, *T. simiae* and *T. vivax*) were identified by PCR. Using PCR on bovine blood samples, it was found that *T. congolense* savanna type and *T. vivax* were predominant, while the riverine forest type of *T. congolense* could not be detected. Some aparasitaemic but clinically suspect animals reacted positively when specific primers for the savanna type of *T. congolense* were used. The results confirmed the high potential of the PCR technique in detecting cryptic and/or mixed infections in the different hosts. Added to previous studies describing comparable approaches, the present results show that the tools of molecular biology can provide valuable information on the complex relationships between the savanna or riverine forest types of *T. congolense* and their vectors, and also their vertebrate hosts. This probably enables the molecular markers to be considered as pathogenicity markers. Their diagnostic capability and their contribution to a better understanding of parasite/host relationships for better control in the field are discussed.

- 10488 **Reifenberg, J.M., Solano, P., Cuisance, D. and Duvallet, G., 1997.** Contribution of the PCR technique for a better understanding of the epidemiology of animal trypanosomosis in West Africa. *FAO Animal Production and Health Paper*, no. 135: 52-54.

CIRAD-EMVT, B.P. 5035, 34032 Montpellier Cedex 1, France.

Recent studies in Côte d'Ivoire and Burkina Faso using molecular biology techniques have successfully identified mixed infections with savanna and forest types of *Trypanosoma congolense* in *Glossina longipalpis* and *G. tachinoides*. Surveys in other regions of West Africa have highlighted parasite-vector specificity between savanna tsetse flies (*morsitans* group) and savanna type *T. congolense* and also between gallery forest tsetse flies (*palpalis* group) and forest type *T. congolense*. Laboratory studies have confirmed these parasite-vector compatibilities noted in the field, showing low vectorial competence of *G. tachinoides* for *T. congolense* savanna type; complicated affinity relationships between, on the one hand, savanna type *T. congolense* and the *morsitans* group tsetse flies, and, on the other hand, riverine-forest type *T. congolense* and the *palpalis* group tsetse flies; and PCR interpretation difficulty in evaluating the mechanical transmission of the disease.

- 10489 **Truc, P., Formenty, P., Diallo, P.B., Komoin-Oka, C. and Lauginie, F., 1997.** Confirmation of two distinct classes of zymodemes of *Trypanosoma brucei* infecting man and wild mammals in Côte d'Ivoire: suspected difference in pathogenicity. *Annals of Tropical Medicine and Parasitology*, **91** (8): 951-956.  
Truc: Laboratoire de Biologie des Parasites et Vecteurs, IPR/OCCGE, B.P. 1500, 01 Bouaké, Côte d'Ivoire.

In this study the KIVI method was combined with precise genetic identification of isolates (by isoenzyme analysis) to investigate the types of trypanosome present in humans and other animals in Côte d'Ivoire. A total of 43 trypanosome stocks were examined: six reference stocks had been identified as *T. b. gambiense* or belonging to the bouaflé strain group of *T. b. brucei*; the remaining 37 stocks were isolated from humans or other mammals during case-detection surveys (29 by KIVI, 8 by rodent inoculation). Isoenzyme analysis was carried out on 13 enzyme systems, representing 15 loci, and a dendrogram was constructed. Thirty different zymodemes were seen among the 43 isolates, arranged in three major groups. One group consisted of 11 zymodemes, 10 from man and one from a hartebeest, and was clearly equivalent to the previously described *T. b. gambiense* Group 1. Another major group comprised three zymodemes, from waterbuck and buffalo, with enzyme patterns not previously described: this was named the *T. brucei* camoé strain group. The third major group, comprising 16 zymodemes, four from man and 12 from domestic and wild animals, was the most heterogeneous and corresponded to the previously described *T. brucei* bouaflé strain group. Human subjects infected with *T. b. gambiense* Group 1 reported feeling unwell for a mean of 8 months, whereas subjects with *T. brucei* bouaflé infections reported feeling unwell for a mean period of 2 months and were already in the second stage of the disease. The different disease patterns would, if confirmed, affect diagnosis, treatment and control, and possibly explain some of the variations in response to chemotherapy.

10490 **Woolhouse, M.E.J. and Hargrove, J.W., 1998.** On the interpretation of age-prevalence curves for trypanosome infections of tsetse flies. *Parasitology*, **116** (2): 149-156.

Woolhouse: CTVM, University of Edinburgh, Roslin, Midlothian EH25 9RG, UK.

Epidemiological models are used to analyse eight published data sets reporting age-prevalence curves for trypanosome infections of the tsetse fly *Glossina pallidipes*. A model assuming a fixed maturation period and a rate of infection which is independent of fly age is adequate for *Trypanosoma vivax*-type infections, explaining 98% of observed variance in prevalence by site and age, allowing that the rate of infection may be site dependent. This model is not adequate for *T. congolense*-type infections and the fit can be improved by allowing (i) the rates of infection to decline with age (although non-teneral flies remain susceptible), (ii) a fraction of resistant flies, which may vary between sites, (iii) increased mortality of infected flies, and (iv) variation in the maturation period. Models with these features can explain up to 97% of observed variance. Parameter estimates from published experimental data suggest that all may contribute in practice but that (i) and/or (ii) are likely to be the most important.

## 5. HUMAN TRYPANOSOMIASIS

### (a) SURVEILLANCE

[See also 21: no. 10467.]

- 10491 **Ancelle, T., Paugam, A., Bourlioux, F., Merad, A. and Vigier, J.-P., 1997.** Evaluation expérimentale de la technique du quantitative buffy coat (QBC<sup>®</sup> Malaria) dans le diagnostic de *Trypanosoma brucei gambiense*. [Experimental evaluation of the quantitative buffy coat technique (QBC<sup>®</sup> Malaria) in the diagnosis of *T. b. gambiense*.] (Meeting abstract.) *Médecine tropicale*, **57** (3 Suppl.): 82.

Ancelle: Laboratoire de Parasitologie, Hôpital Cochin, 27 rue du Faubourg Saint-Jacques, 75014 Paris, France.

The quantitative buffy coat technique (QBC) was compared with the capillary tube centrifugation technique (CTC) for diagnosing *T. b. gambiense* infections in samples of mouse blood at a range of dilutions. The sensitivity of the QBC test was > 95% for a concentration of 450 trypanosomes/ml, decreasing to 13.5% for a concentration of 15/ml (1 trypanosome/tube). The sensitivity of the CTC test was 100% for a concentration of 7500 trypanosomes/ml, 20% at 1500/ml. Stability of the sample in the QBC tube was estimated at 2 h, the sensitivity decreasing from the 4th hour and the trypanosomes losing their mobility. The sensitivity of the QBC technique is thus superior to that of the CTC technique, especially for low parasitaemias.

- 10492 **Bisser, S., Bouteille, B., Sarda, J., Stanghellini, A., Ricard, D., Jauberteau, M.O., Marchan, F., Dumas, M. and Breton, J.C., 1997.** Apport des examens biochimiques dans le diagnostic de la phase nerveuse de la trypanosomose humaine africaine. [Contribution of biochemistry in the diagnosis of the nervous stage of human African trypanosomiasis.] *Bulletin de la Société de Pathologie exotique*, **90** (5): 321-326.

Bisser: Institut d'Epidémiologie Neurologique et de Neurologie Tropicale, Faculté de Médecine, 2 rue du Dr Raymond Marcland, F-87025 Limoges Cedex, France.

A study was carried out on 140 individuals from Congo, 70 with parasitologically confirmed human African trypanosomiasis (HAT) and 70 uninfected controls, to try to find a clinical or biological marker for the beginning of neurological involvement. The stage of disease in the HAT patients was determined according to the classical criterion of CSF cell count: less than 5 cells/ $\mu$ l for the first stage (P1), more than 5 cells/ $\mu$ l for the second stage (P2). The following blood biochemical parameters were studied: glucose, urea, creatinine, sodium, potassium, calcium, chloride, phosphorus, uric acid, total bilirubin, unconjugated bilirubin, total cholesterol, triglycerides, total proteins, aspartate aminotransferase (ASAT), alanine aminotransferase (ALAT), creatinine phosphokinase, alkaline phosphatase,  $\gamma$ -glutamyltransferase, IgM and IgG, complement fraction C3c, transferrin, seromucoid  $\alpha$ 1, haptoglobin and albumin. IgM, IgG, protein levels and blood-brain barrier (BBB) impairment were also studied in CSF. Comparison of these variables in HAT patients and their controls, and in P1 and P2 individuals, showed a clear

association of CSF IgM levels and BBB impairment with P2 patients, although there was a slow gradation in the biological disturbances and a precise threshold point could not be determined. However, it is suggested that CSF cell count level be raised to 20 cells/ $\mu$ l to define the beginning of neurological involvement.

- 10493 **Bureau, P., Demaille, H., Morlais, I., Penchenier, L. and Jannin, J., 1997.** La trypanosomiase humaine africaine dans les états de l'O.C.E.A.C.: nécessité de la mise en place d'un système de surveillance épidémiologique. [Human African trypanosomiasis in the OCEAC countries: need to set up an epidemiological surveillance system.] (Meeting abstract.) *Médecine tropicale*, **57** (3 Suppl.): 81.

Bureau: Laboratoire de Recherches sur les Trypanosomoses, OCEAC, Yaoundé, Cameroon.

Faced with the present epidemic of human trypanosomiasis which is affecting more and more countries in Central Africa, urgent action must be taken to revive and coordinate control activities. Following a statement of the lack of information available in the OCEAC area, an action plan has been put forward for gathering field data (geographic, economic, demographic, epidemiological, etc.) which will be incorporated in a geographic information system. This should provide a means of managing all these data and linking them to the same basic geographic unit, the village.

- 10494 **Lejon, V., Büscher, P., Magnus, E., Moons, A., Wouters, I. and Meirvenne, N. van, 1998.** A semi-quantitative ELISA for detection of *Trypanosoma brucei gambiense* specific antibodies in serum and cerebrospinal fluid of sleeping sickness patients. *Acta Tropica*, **69** (2): 151-164.

Lejon: Department of Parasitology, Institute of Tropical Medicine, Nationalestraat 155, B-4000 Antwerp, Belgium.

A semi-quantitative ELISA, using variable surface glycoprotein of *T. b. gambiense* as antigen, was developed for the detection of antibodies of different immunoglobulin isotypes in serum and CSF of sleeping sickness patients. Using the assay, the antibody profiles of paired serum and CSF samples of 28 patients were studied. Total concentrations of various Ig isotypes were also determined. In serum and CSF a large increase in IgG, basically IgG<sub>1</sub>, as well as in IgM levels was observed. The concentration of IgA remained relatively normal. The antitrypanosomal antibodies detected in serum and CSF were mainly of the IgG (IgG<sub>1</sub> and IgG<sub>3</sub>) and IgM isotypes. Measurement of immunoglobulin and trypanosome specific antibody concentrations in serum and CSF allows calculation of intrathecal antibody synthesis and is a possible tool for determining the clinical stage of sleeping sickness.

#### (b) PATHOLOGY AND IMMUNOLOGY

- 10495 **Odiit, M., Kansime, F. and Enyaru, J.C.K., 1997.** Duration of symptoms and case fatality of sleeping sickness caused by *Trypanosoma brucei rhodesiense* in Tororo, Uganda. *East African Medical Journal*, **74** (12): 792-795.

Odiit: Livestock Health Research Institute (LIRI), Sleeping Sickness Programme, P.O. Box 96, Tororo, Uganda.

Although there have been recent molecular biological studies looking for evidence of possible genetic changes in the *T. b. rhodesiense* population in the Busoga and Tororo areas of Uganda, such studies are not yet complemented by parallel clinical studies to determine the possible implications to the sleeping sickness patient. A study of the duration of symptoms and the case fatality of *T. b. rhodesiense* sleeping sickness showed that the disease progressed to the stage of CNS involvement between 3 weeks and 2 months of infection. Most (> 80%) deaths occurred within 6 months of acquiring the infection. The case fatality rate of treated sleeping sickness patients was 6%, of which the rate in the late-stage of sleeping sickness was more than two and a half times that in the early stage. The incidence of melarsoprol encephalopathy was 2.5% and case fatality due to this condition was 1.0% and similar to previous findings. Thus it appears that the virulence of *T. b. rhodesiense* circulating in south-east Uganda has not changed during the past decades.

### (c) TREATMENT

[See also **21**: no. 10467.]

- 10496 **World Health Organization, 1997.** Essential drugs. WHO Model Formulary. Antiprotozoal drugs. *WHO Drug Information*, **11** (3): 144-152.

Information is given on uses, dosage, contraindications, precautions, adverse effects and drug interactions for drugs used in amoebiasis, giardiasis, leishmaniasis, human African trypanosomiasis (melarsoprol, pentamidine, suramin sodium, eflornithine) and Chagas' disease.

## 6. ANIMAL TRYPANOSOMIASIS

### (a) SURVEY AND DISTRIBUTION

- 10497 **Babagana, A., 1996.** Fatal diseases of goats diagnosed at necropsy in Zaria, Nigeria. *Bulletin of Animal Health and Production in Africa*, **44** (2): 115-116.

Department of Disease Control, School of Veterinary Medicine, University of Zambia, P.O. Box 32379, Lusaka, Zambia.

Necropsy records kept at the Faculty of Veterinary Medicine and Veterinary Teaching Hospital, Ahmadu Bello University, Zaria, Nigeria, over an 11 year period (January 1977 to December 1987) were used to investigate the pattern of diseases of goats

most commonly encountered, based on post mortem examinations. Of 583 goats, only 8.75% had died of trypanosomiasis. The most common causes of death were respiratory disorders (22.64%) and gastrointestinal parasitism (20.64%).

- 10498 **Dia, M.L., Meirvenne, N. van, Magnus, E., Luckins, A.G., Diop, C., Thiam, A., Jacquiet, P. and Hamers, R., 1997.** Evaluation de quatre tests de diagnostic: frottis sanguins, CATT, IFI et ELISA-Ag dans l'étude de l'épidémiologie de la trypanosomose cameline à *Trypanosoma evansi* en Mauritanie. [Evaluation of four diagnostic tests, blood smears, CATT, IFAT and Ag-ELISA, in a study of the epidemiology of *T. evansi* camel trypano-somosis in Mauritania.] *Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux*, **50** (1): 29-36.

Dia: CNERV, B.P. 167, Nouakchott, Mauritania.

A study was conducted on the epidemiology of camel trypanosomosis caused by *T. evansi* in Mauritania using 2078 one-humped camels of different ages from four regions with different climates and ecology (Trarza, Gorgol, Adrar and Hodh El Chargui). The prevalence of the infection was determined by blood smear examinations and three serological tests: the card agglutination test for trypanosomosis (CATT), an indirect fluorescent antibody test (IFAT) and an enzyme-linked immunosorbent assay (ELISA) for the detection of trypanosomal antigens. The overall parasitological prevalence of the infection was 1.4%; seropositivity rates were 16.5% with CATT, 24.3% with IFAT and 14.1% using antigen-detection ELISA. Prevalence rates varied according to region, herd, age of the camels and herd management strategy. The study showed that camel trypanosomosis was widespread in Mauritania, especially in the wooded areas close to watercourses used by the animals.

- 10499 **El Sawalhy, A. and El-Sherbini, S., 1997.** Diagnosis of chronic camel trypanosomosis by detection of the antibody of trypanosome tyrosine aminotransferase. *Deutsche Tierärztliche Wochenschrift*, **104** (12): 531-533.

El Sawalhy: Department of Animal Medicine, Faculty of Veterinary Medicine, Moshtohour, Takh, Benha, Egypt.

Sera from animals with acute and chronic *Trypanosoma evansi* infections were examined directly for trypanosome tyrosine aminotransferase (TATase) activity and indirectly for the ability of these sera to inhibit TATase activity. Sera from mice and camels with high parasitaemias contained significant levels of trypanosome TATase activity. In contrast the chronic sera from both mice and camels did not contain significant TATase activity but the chronic sera were able to neutralise the enzyme activity in trypanosome homogenates. The sera from other pathological conditions did not neutralise the enzyme activity. It is suggested that the inhibitory factor in the chronic sera is an antibody to the trypanosome TATase. The potential use of the direct enzyme assay and the indirect neutralisation assay as diagnostic tools is discussed. Finally, the use of these assays to distinguish between early (acute) and late (chronic) infections is also suggested.

- 10500 Greiner, M., Kumar, S. and Kyeswa, C., 1997. Evaluation and comparison of antibody ELISAs for serodiagnosis of bovine trypanosomosis. *Veterinary Parasitology*, **73** (3-4): 197-205.

Greiner: Department of Tropical Veterinary Medicine and Epidemiology, Institute for Parasitology and Tropical Veterinary Medicine, Freie Universität Berlin, Königsweg 67, D-14163 Berlin, Germany.

A total of 457 serum samples from cattle kept under moderate tsetse challenge in Mukono County, Uganda, 79 of them with confirmed trypanosomosis, and 86 sera from cattle in Germany were tested for *Trypanosoma* antibodies using enzyme-linked immunosorbent assay (ELISA) with antigen obtained from bloodstream form (BSF) *T. brucei* and *in vitro* cultivated procyclic (PRO) trypanosomes. The BSF and PRO ELISA showed a moderate quantitative correlation. A difference plot revealed a slightly non-linear relation between the two methods. Cut-off values were established using (A) non-exposed controls, (B) exposed negative controls and (C) by mixture distribution analysis of the quantitative ELISA results for the sample from the endemic target population. The diagnostic agreement between both assays was significant ( $\kappa$ ,  $P < 0.05$ ). The diagnostic accuracy of the two tests relative to standard parasitological detection methods was not markedly different as shown by the areas under the receiver operating characteristic (ROC) plots. In our study, neither non-exposed controls (cut-off A) nor exposed negative controls (cut-off B) were suitable for establishing cut-off values. Based on the cut-off value C, derived from mixture distribution analysis, the proportion of animals with elevated antibody levels in the study population was estimated by both assays at 45% (41-50% binomial 95% confidence interval). This can be regarded as an unbiased estimate of the proportion of 'sero-responders' and not necessarily as a proxy for infection prevalence in the target population. We recommend the PRO ELISA to be used for seroepidemiological surveys, since *in vitro* cultivation of procyclic trypanosomes allows a continuous and standardised preparation of test antigen.

- 10501 Makumyaviri, A.M. and Ngarambe, M., 1997. Diagnostic parasitologique et sérologique des trypanosomoses chez les bovins élevés au Nord-Kivu, Congo. [Parasitological and serological diagnosis of trypanosomiasis in cattle in the Northern Kivu province, Congo.] *Revue de Médecine vétérinaire*, **148** (10): 809-812.

Makumyaviri: Faculté de Médecine Vétérinaire, UNILU, B.P. 1825, Lubumbashi, Zaire.

A hundred and eighty Ankole cattle were tested for trypanosomiasis in four districts in the Northern Kivu province of Congo. The thin blood film technique revealed 23.9% of infections while 61.7% of animals were positive for the antigen-trapping (Ag-ELISA) method. *Trypanosoma brucei* was the most frequent aetiological agent (44.3%) followed by *T. congolense* (33.8%) and *T. vivax* (21.9%). Significant differences in infection rates were observed between districts ( $P < 0.05$ ), suggesting a relationship to the geographical distribution of tsetse flies and to the food value of the pastures available to the cattle. The high frequency of *T. brucei* circulating antigens (97.0%), and of mixed infections with *T.*

*brucei* and *T. congolense* (89.6%), shows the need to reconsider the chemotherapeutic use of diminazene aceturate (3.5 mg/kg) and isometamidium chloride (0.5 mg/kg) as the main control measure against infections in Northern Kivu province.

10502 **Onyiah, J.A., 1997.** African animal trypanosomosis: an overview of the current status in Nigeria. *Tropical Veterinarian*, **15** (3-4): 111-116.

NITR, P.M.B. 2077, Kaduna, Nigeria.

Animal trypanosomosis and tsetse flies are widely distributed in Nigeria from latitude 4°N to 13°N, an area covering all the five agro-ecological zones of the country, including the highlands of Jos, Mambilla and Obudu, areas previously considered as being tsetse and trypanosomosis free. Surveys for animal trypanosomosis between 1989 and 1991 showed an overall prevalence of 4.3% in cattle, 1.6% in sheep and 1.0% in goats. In more recent studies undertaken by NITR across all the agro-ecological zones from 1993 to 1996, the overall prevalence by the ELISA technique was 10.0% in cattle, 8.6% in sheep and 8.1% in goats, with prevalences in certain high-density livestock-producing localities of up to 41.2% in the ruminant populations sampled. *Trypanosoma vivax* was the predominant species in all livestock breeds and in all areas surveyed. This was followed by *T. congo-lense* and *T. brucei*. Eleven tsetse species are found in Nigeria, four of which are important transmitters of trypanosomosis: *Glossina morsitans submorsitans*, *G. palpalis*, *G. tachinoides* and *G. longipalpis*. Field observation suggests a decline of *G. m. submorsitans* and *G. longipalpis* from most of their defined belts/habitats in the Northwest and Central agro-ecological zones, an expansion of the *palpalis* group species to the highlands of the Jos Plateau, and reinfestation of the Northeast tsetse corridor (Adamawa, Bornu and Taraba states), areas previously reclaimed from tsetse. Increased activity of tsetse has been observed in some human settlements, with an increase in trypanosomosis in peridomestic animals. Trypanosomosis in resident ruminant herds in areas of Delta and Bornu states may be transmitted by tabanids and *Stomoxys* as high densities of these biting flies were seen in the apparent absence of, or low, tsetse activity. The trypanotolerance of some breeds, the clinical effects of trypanosomosis, economic losses, fear of the disease discouraging commercial livestock production, diagnostic techniques, vector control strategies and the use of trypanocidal drugs are discussed. Focus areas for future research are suggested.

10503 **Seignot, J., 1997.** Enquête sero-épidémiologique à propos des trypanosomoses équine et asines dans la région de Dakar, Sénégal. [Seroepidemiological investigation on trypanosomiasis in horses and donkeys in the Dakar region, Senegal.] (Meeting abstract.) *Médecine tropicale*, **57** (3 Suppl.): 81.

Direction Interarmées du Service de Santé des Forces Françaises au Cap-Vert, Dakar, Senegal.

Clinical, parasitological and serological examination of horses, ponies and donkeys in the Dakar region revealed a serological prevalence of trypanosomiasis of 6.5%. The principal causative species was *Trypanosoma vivax*, followed by *T. congolense*. *T. brucei*, *T. evansi* and *T. equiperdum* were not detected. Animals recently imported into Senegal were most affected, developing acute infections with parasitaemia. Local horses were



least affected and most of their infections were subclinical. Imported animals which had been in Senegal for a considerable time showed intermediate prevalence and mainly chronic infections. The use of traps showed that tsetse flies, which had been considered eradicated since 1983, had reappeared. Tsetse control using traps and screens, together with isometamidium prophylaxis, is recommended.

#### (b) PATHOLOGY AND IMMUNOLOGY

[See also 21: no. 10511.]

10504 **Dam, J.T.P. van, Heide, D. van der, Ingh, T.S.G.A.M. van den, Wensing, T. and Zwart, D., 1998.** The effect of the quality of roughage on the course of *Trypanosoma vivax* infection in West African Dwarf goats. II. Metabolic profile, packed cell volume, and pathology of disease. *Livestock Production Science*, **53** (1): 81-90.

Dam: Nutreco Swine Research Centre, P.O. Box 240, 5830 AE Boxmeer, Netherlands.

Effects of trypanosome infection and feed quality on the metabolism of trypanotolerant West African Dwarf goats were measured. Goats were allotted to either a diet of lucerne pellets (crude protein level = 172 g/kg dry matter;  $n = 14$ ) or a diet of chopped grass straw (crude protein level = 68 g/kg dry matter;  $n = 15$ ). Five animals per feed group served as controls, and the other animals were infected with *T. vivax*. Before and after infection, blood samples were taken weekly and analysed for PCV and parasitaemia, and for serum metabolites and hormone concentrations. Six weeks after infection, the goats were killed and post mortem analysis was carried out to study the pathology of disease. Infected animals showed reduced feed intake, increased plasma non-esterified fatty acids concentration, and decreased serum insulin concentration. Liver triacylglycerol concentration was increased in all grass straw-fed animals, and in some infected goats fed lucerne. Infection drastically reduced serum concentration of thyroxine and triiodothyronine. Infection caused an increased weight of the liver and prescapular lymph nodes in animals from both feed treatments, but lymph nodes were more enlarged in infected animals fed lucerne. Pathological findings were typical for *T. vivax* infection in goats, irrespective of feed type. PCV was reduced by infection in both feed groups to values below 20 percentage points. Serum  $\gamma$ -globulin concentration was increased more in infected animals fed lucerne than in those fed grass straw. It was concluded that, by maintaining a higher protein intake, the nutritional status of infected West African Dwarf goats was improved. This was reflected in the serum concentrations of some metabolites and hormones. However, in general, no indications of an interaction between infection and feed type with respect to nutritional status were found. Differences in feed quality did not change the nature and severity of pathological variables, measured at autopsy after 6 weeks of infection.

10505 **Dam, J.T.P. van, Hofs, P., Tolkamp, B.J. and Zwart, D., 1998.** The effect of the quality of roughage on the course of *Trypanosoma vivax* infection in West

African dwarf goats. I. Organic matter intake, body weight change and efficiency of nitrogen metabolism. *Livestock Production Science*, **53** (1): 69-80.

Dam: Nutreco Swine Research Centre, P.O. Box 240, 5830 AE Boxmeer, Netherlands.

Twenty-nine West African Dwarf goats were randomly allotted to either a diet of pelleted lucerne with a high N content (crude protein level = 172 g/kg dry matter;  $n = 14$ ) or chopped grass straw with a low N content (crude protein level = 68 g/kg dry matter;  $n = 15$ ). Nine animals fed lucerne and 10 animals fed grass straw were infected with *T. vivax* to study its effects on feed intake and efficiency of N utilisation during the first 6 weeks of infection. Infection reduced organic matter intake (OMI) from 55 (s.e. 2) to 38 (s.e. 2) g/kg<sup>0.75</sup>/day ( $P < 0.001$ ). OMI was not affected by feed type ( $P > 0.10$ ). The relative decrease of digestible organic matter intake (DOMI) due to infection was the same in animals fed lucerne or grass straw (36 and 35%). Retention of N was lower in infected animals and in animals fed grass straw. By relating N retention to DOMI, the efficiency of N utilisation, corrected for feed intake level, was estimated. No effect of infection or feed type on the efficiency of N utilisation was detected. One overall regression equation was estimated: N retention =  $-0.45$  (s.e. 0.04) +  $0.017$  (s.e. 0.002)  $\times$  DOMI ( $n = 29$ ;  $r^2 = 0.86$ ). Serum urea concentration was higher in the goats fed lucerne than in the goats fed grass straw; only in the lucerne group, infected animals showed a lower serum urea concentration post infection (p.i.) than control animals. Serum creatinine concentration was higher in grass straw-fed animals than in lucerne-fed animals. From the former group, infected animals had a lower creatinine concentration p.i. than controls. It is concluded that infection affected feed intake, but not the efficiency of N utilisation.

10506 **Doko, A., Verhulst, A., Pandey, V.S. and Stuyft, P. van der, 1997.** Trypanosomose expérimentale à *Trypanosoma brucei brucei* chez les taurins Holstein et les zébus Bororo blancs. [Experimental *T. b. brucei* infection in Holstein taurine and white Bororo zebu cattle.] *Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux*, **50** (1): 23-28.

Pandey: Institut de Médecine tropicale Prince Léopold, Nationalestraat 155, B-2000 Antwerp, Belgium.

Holstein taurine cattle ( $n = 6$ ) and white Bororo zebu cattle ( $n = 10$ ) were experimentally infected with AnTat 1.1, an antigenic variant of *T. b. brucei*. Clinical signs, PCV, parasitaemia, humoral immune response and haemolytic complement were monitored to study the clinical evolution and the degree of susceptibility to *T. b. brucei*. Animals of both breeds were highly susceptible to the infection. Holsteins developed an acute disease, lethal within a few weeks, whereas white Bororo zebus developed a chronic disease with progressive inanition and death after a few months. The drop in PCV 20 days p.i. was  $1.2 \pm 0.7$  in zebu and  $11.2 \pm 3.6$  in Holstein, indicating that zebus were more resistant to anaemia. Animals from both breeds remained parasitaemic until the terminal phase of the disease. Large quantities of AnTat 1.1 specific trypanolytic antibodies were produced during the infection, but titres were not correlated with the level of resistance. In both breeds the infection induced persistent hypocomplementaemia. The lowest

complement level was  $692 \pm 232$  units HC50/ml on day 14 p.i. in Holstein (i.e. 42% of the initial level at day 0) and  $846 \pm 140$  units HC50/ml on day 84 p.i. in zebu (79% of the initial level). The present study shows that the responses of white Bororo zebu and Holstein cattle are quite different from those previously observed in Lagune and Borgou cattle submitted to a similar experimental protocol. Individual variations are important in all breeds studied.

10507 **McKeever, D.J. (ed.), 1995.** *Novel immunization strategies against protozoan parasites* (Proceedings of a Workshop held at ILRAD, Nairobi, Kenya, 1-4 November 1993). Nairobi, Kenya; ILRAD. (ISBN 92 9055 299 9.)

Included in these proceedings are the following papers: The trypanosomiasis research programme at ILRAD [now ILRI] (A.J. Teale, pp. 3-5); Production of tumour necrosis factor alpha during bovine trypanosomiasis: possible correlation with severity of anaemia associated with the disease (M. Sileghem and L. Gaidulis, pp. 59-66); Bovine T-cell responses to defined *Trypanosoma congolense* antigens during infection (V. Lutje, E. Authié, A. Boulange and D.J.L. Williams, pp. 79-82).

10508 **Olubayo, R.O., Moloo, S.K. and Naessens, J., 1996.** Comparative parasite development in African buffalo and N'Dama cattle infected with either *Trypanosoma congolense* or *T. vivax*. *Bulletin of Animal Health and Production in Africa*, **44** (1): 23-32.

Olubayo: ICIPE, P.O. Box 30722, Nairobi, Kenya.

African buffalo (*Syncerus caffer*) and trypanotolerant N'Dama cattle were compared for their resistance to *T. congolense* and *T. vivax* infections. Several compartments of the immune system were followed during the infections and compared between the two species. Several parameters suggested that the buffaloes were much more resistant to trypanosomiasis than the N'Dama cattle: they had a much longer prepatent period, their parasitaemia levels were lower (about 100 fold in *T. congolense*) and anaemia, measured as a drop in PCV, was either very short (*T. congolense*) or not present (*T. vivax*) in buffaloes. The N'Dama produced neutralising antibodies before the buffalo, ruling out such antibodies as the cause of the buffalo's greater resistance to trypanosomiasis. Changes in lymphocyte populations were similar in both buffalo and N'Dama: a decrease in CD2<sup>+</sup> T cells, but an increase in  $\gamma/\delta$  T cells and B cells. However, neutrophils increased in buffalo but dropped in N'Dama, suggesting that they may play a role in the resistance of the buffalo. An unidentified leukocyte population, that could not be recognised by its surface phenotype, appeared in the peripheral blood of the buffalo, but not in N'Dama, around the time that the PCV started to drop. It is possible that these cells are immature erythroid cells produced by a more effective erythropoiesis in buffalo.

10509 **Taylor, K.A., 1998.** Immune responses of cattle to African trypanosomes: protective or pathogenic? (Review.) *International Journal for Parasitology*, **28** (2): 219-240.

ILRI, P.O. Box 30709, Nairobi, Kenya.

Trypanosomosis in domestic livestock negatively impacts on food production and economic growth in many parts of the world, particularly in sub-Saharan Africa. Current methods of control are inadequate to prevent the enormous annual socio-economic losses resulting from this disease. Hope for a vaccine based on the variant surface glycoprotein coat was abandoned several years ago when the complexity of the parasite's antigenic repertoire was appreciated. As a result, research is now focused on identifying invariant trypanosome components as potential targets for interrupting infection or infection-mediated disease. The identification of immune mechanisms involved in parasite and disease control, or conversely those responses that are associated with a poor clinical outcome, should facilitate the search for vaccine candidates and subsequent vaccine design strategies. To this end, comparative studies on the immune responses of trypanotolerant and trypanosusceptible breeds of cattle can be exploited. These studies have revealed that trypanotolerant and trypanosusceptible breeds of cattle have distinct antibody responses. Trypanosusceptible cattle produce high titres of polyspecific IgM but fail to produce IgG to specific trypanosome antigens. In contrast, although T cell and macrophage/monocyte responses of infected cattle are depressed, significant differences have not been described between tolerant and susceptible breeds of cattle. In this review, isotype-dependent effector mechanisms, such as complement activation, binding to Fc receptors, activation of phagocytic cells, neutralisation of parasite components, clearance of immune complexes and autoimmune responses, are discussed in the context of their potential impact on either susceptibility or tolerance of cattle to trypanosomosis. In addition, the links between specific cytokine patterns, macrophage/monocyte activation and depressed T cell responses that occur during trypanosome infection are presented. The identification of mechanisms that mediate depressed immune responses might suggest novel disease intervention strategies.

### (c) TRYPANOTOLERANCE

[See also **21**: no. 10468.]

10510 **Dolan, R.B., 1997.** The Orma Boran – a trypanotolerant East African breed. *World Animal Review*, no. 89: 54-56.

KETRI, P.O. Box 362, Kikuyu, Kenya.

The Kenya Trypanosomiasis Research Institute has studied cattle of the Orma Boran breed for more than 15 years in the tsetse fly-infested Tana River region of Kenya. These cattle, compared to other *Bos indicus* East African breeds, have demonstrated a certain degree of trypanotolerance. They have lower morbidity and mortality rates and require fewer drug treatments. A selection programme was established in order to improve meat production characteristics of these cattle while preserving their trypanotolerance. The bulls from this selection programme are now being sold to breeders in other Kenyan regions infested by tsetse.

10511 **Suliman, H.B., Feldman, B.F., Majiwa, P.A.O. and Logan-Henfrey, L.L., 1997.** The molecular aspects of anemia in cattle infected with *Trypanosoma congolense*. (Meeting abstract.) *Veterinary Clinical Pathology*, **26** (1): 20.

Department of Biomedical Sciences and Pathobiology, VA-MD Regional College of Veterinary Medicine, Blacksburg, VA, USA.

The hallmark of trypanosomiasis is a prominent and progressive nonresponsive anaemia, the pathophysiological mechanism(s) of which remain undefined. A blunted erythropoietin (Epo) response has been proposed as one possible mechanism. Competitive reverse transcription and PCR were used to compare the concentrations of Epo and erythropoietin receptor (EpoR) mRNAs in kidney and bone marrow during acute *T. congolense* infection in trypanosusceptible Boran and trypanotolerant N'Dama cattle. Boran cattle were anaemic with PCV ranging between 14 and 19% while N'Dama cattle had PCV between 20 and 27%. The increase in Epo mRNA in the kidneys was not significantly different between the breeds but the EpoR mRNA was significantly ( $P < 0.05$ ) higher in the N'Dama bone marrow, suggesting that Boran cattle are incapable of eliciting an appropriate Epo response for their degree of anaemia. Also, the concentration of mRNAs for IFN $\gamma$  in Boran kidney and for IL-1 $\alpha$  and  $\beta$  and IFN $\gamma$  in Boran bone marrow were significantly higher than in N'Dama. Nucleotide sequence analysis of the 3' untranslated region of the Epo cDNA sequences revealed a polymorphism, and a single position mutation of Tyr (in Boran) to His (in N'Dama) was identified on the predicted peptide sequence of the EpoR. These are the first observations linking a genetic marker (Epo and EpoR polymorphism) to a phenotypic criterion (PCV) for trypanotolerance in cattle.

#### (d) TREATMENT

10512 **Geerts, S., Kageruka, P., Deken, R. de, Brandt, J.R.A., Kazadi, J.M., Diarra, B., Eisler, M.C., Lemmouchi, Y., Schacht, E. and Holmes, P.H., 1997.** Extension of the prophylactic effects of isometamidium and ethidium using sustained release devices. *FAO Animal Production and Health Paper*, no. 135: 36-38.

Geerts: Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium.

Two experiments were carried out, each using six adult cows. In the first, three cows were injected i.m. with isometamidium at 0.5 mg/kg body weight. The other three cows received the same dose of the drug by means of a sustained release device (SRD) implanted subcutaneously. In the second experiment, three cows were injected i.m. with 1 mg/kg ethidium, while the other three cows received a SRD containing the same dose of ethidium. The prophylactic effect of each drug formulation was evaluated by challenging the cows with an average of eight *Glossina morsitans* infected with *Trypanosoma congolense* IL 1180 at monthly intervals from 1 month post treatment onwards. The average protection period using the isometamidium SRD was 20 months versus 5.7 months for the i.m. treated group, i.e. 3.2 times longer. An inflammatory reaction appeared at the SRD implantation site shortly after treatment and quite a large nodule developed during the first weeks which disappeared gradually afterwards. Serum concentration of isometamidium remained quite constant in the SRD group, with peak levels of 0.8 ng/ml at 1 month and 0.4 ng/ml at 5 months post treatment, whereas there

was a rapid drop in concentration in the i.m. treated group from 5 ng/ml on day 1 to 0.1 ng/ml at 85 days post treatment. The average prophylactic period for ethidium was 8.3 months in the SRD treated group versus 3 months in the i.m. treated group, i.e. 2.8 times longer. The inflammatory reaction at the implantation site was less pronounced than that with isometamidium. The possible development of drug resistance after SRD use is discussed.

- 10513 **Pathak, K.M.L., Bhatnagar, C.S. and Kapoor, M., 1998.** Trypanocidal value of quinapyramine methyl sulphate in experimental *Trypanosoma evansi* infection in donkeys. *Indian Veterinary Journal*, **75** (1): 7-9.

Pathak: Department of Veterinary Parasitology, College of Veterinary and Animal Science, Bikaner 334001, India.

The therapeutic efficacy of a single s.c. injection of quinapyramine methylsulphate at 4.5 mg/kg body weight against experimental *T. evansi* infection in donkeys was evaluated. The drug was found to be 50% trypanocidal within 6 h and 100% within 12 h with no relapse of infection up to 28 days, as confirmed by the biological test. Subsequent to treatment, the animals showed improvement in health and haematological parameters.

## 7. EXPERIMENTAL TRYPANOSOMIASIS

### (a) DIAGNOSTICS

[See **21**: no. 10530.]

### (b) PATHOLOGY AND IMMUNOLOGY

[See also **21**: nos. 10549, 10568.]

- 10514 **Beschin, A., Brys, L., Magez, S., Radwanska, M. and Baetselier, P. de, 1998.** *Trypanosoma brucei* infection elicits nitric oxide-dependent and nitric oxide-independent suppressive mechanisms. [Mice.] *Journal of Leukocyte Biology*, **63** (4): 429-439.

Beschin: Instituut voor Moleculaire Biologie (Eenheid CIMM), Paardenstraat 65, B-1640 Sint Genesius Rode, Belgium.

- 10515 **Black, S.J., Wang, Q., Hamilton, E., Wang, J., Praagh, A. van and Muranjan, M., 1997.** Plasma purines and *Trypanosoma brucei*. [Cape buffalo, cows, mice.] *FAO Animal Production and Health Paper*, no. 135: 22-24.

Black: Department of Veterinary and Animal Sciences, University of Massachusetts, Paige Laboratory, Amherst, MA 01003, USA.

- 10516 **Lundkvist, G.B., Christenson, J., El Tayeb, R.A.K., Peng, Z.-C., Grillner, P., Mhlanga, J., Bentivoglio, M. and Kristensson, K., 1998.** Altered neuronal activity rhythm and glutamate receptor expression in the suprachiasmatic nuclei of *Trypanosoma brucei*-infected rats. *Journal of Neuropathology and Experimental Neurology*, **57** (1): 21-29.

Kristensson: Department of Neuroscience, Karolinska Institute, Doktorsringen 17, S-17177 Stockholm, Sweden.

- 10517 **Muranjan, M., Nussenzweig, V. and Tomlinson, S., 1998.** Characterization of the human serum trypanosome toxin, haptoglobin-related protein. *Journal of Biological Chemistry*, **273** (7): 3884-3887.

Tomlinson: Department of Pathology, New York University Medical Center, MSB 127, 550 First Avenue, New York, NY 10016, USA.

Haptoglobin-related protein (HPR) is an integral part of two distinct high molecular weight complexes (trypanosome lytic factor 1 (TLF1) and TLF2) that are lytic for *Trypanosoma brucei brucei*. Previous data indicate that HPR represents the toxic component of both trypanosome lytic factors. It has been proposed that after uptake by the parasite, haemoglobin (Hb) bound to HPR causes lysis in a peroxidase-dependent process. We report that the molecular architecture of HPR in normal human serum is different from that of haptoglobin (Hp) and that HPR does not bind Hb in normal human serum. Immunodepletion of all detectable Hb from TLF1 does not deplete TLF1 of HPR or trypanolytic activity, suggesting that the mechanism of parasite lysis is Hb-independent.

- 10518 **Ngure, R.M., Eckersall, P.D., Jennings, F.W., Burke, J.M., Stear, M.J., Kennedy, P.G.E. and Murray, M., 1997.** Major acute phase response of haptoglobin and serum amyloid-P following experimental infection of mice with *Trypanosoma brucei brucei*. *Parasitology International*, **46** (4): 247-254.

Department of Veterinary Clinical Studies, University of Glasgow Veterinary School, Bearsden Road, Bearsden, Glasgow G61 1QH, UK.

- 10519 **Raisinghani, G., Gupta, M.L., Kumar, D.K. and Manohar, G.S., 1997.** Predilection sites of *Trypanosoma evansi* during paroxysmal and non-paroxysmal phases of infection in albino rats. *Indian Journal of Animal Sciences*, **67** (4): 294-297.

Raisinghani: TH-1, Veterinary College, Staff Colony, Bikaner, Rajasthan 334001, India.

- 10520 **Schopf, L.R., Filutowicz, H., Bi, X.-J. and Mansfield, J.M., 1998.** Interleukin-4-dependent immunoglobulin G1 isotype switch in the presence of a polarized antigen-specific Th1-cell response to the trypanosome variant surface glycoprotein. [*T. b. rhodesiense*; mice.] *Infection and Immunity*, **66** (2): 451-461.

Mansfield: Department of Bacteriology, University of Wisconsin, AHBS Building, 1655 Linden Drive, Madison, WI 53706, USA.

- 10521 **Yang, H.-C. and Yao, K.-F., 1995.** [Studies on anti-idiotypic antibody vaccine of *Trypanosoma evansi*. III. Identification of an anti-idiotypic antibody to elicit a response against the variable surface glycoproteins of *Trypanosoma evansi*.] (In Chinese with English summary.) *Chinese Journal of Veterinary Medicine*, **21** (3): 3-5.

College of Veterinary Medicine, Beijing Agricultural University, Beijing 100094, China.

### (c) CHEMOTHERAPEUTICS

[See also **21**: nos. 10542, 10550.]

- 10522 **Atouguia, J. and Jennings, F., 1997.** Topical chemotherapy of experimental CNS-trypanosomiasis: drug combinations. *FAO Animal Production and Health Paper*, no. 135: 39-42.

Atouguia: Instituto de Higiene e Medicina Tropical, Rua da Junqueira 96, 1400 Lisbon, Portugal.

Developments in the therapy of late stage human trypanosomiasis are reviewed. Various new compounds have been studied, some with trypanocidal effect *in vitro* and in animal models, but none has been approved for use in humans. Some good results have been obtained with combinations of available drugs in animal models (eflornithine with bleomycin, suramin, melarsoprol and other arsenicals, antimonials and berenil) but the most successful combinations are of arsenicals with the nitroimidazoles, which are not approved for use in humans because of their potential mutagenic or teratogenic properties. Of the drug combinations tried in humans, only eflornithine with melarsoprol is clearly effective. Topical melarsoprol treatment, either alone or combined with nitrofurans, has provided permanent cures in the CNS-trypanosomiasis mouse model. Using a gel formulation, a nifurtimox/melarsoprol combination produced permanent cures which were superior to melarsoprol monotherapy. Gels of the nitroimidazoles MK-436, fexinidazole and megazol when used with melarsoprol gel can cure CNS-trypanosomiasis in mice with a single day's treatment, but megazol is the only nitroimidazole currently under development.

- 10523 **Koide, T., Nose, M., Inoue, M., Ogihara, Y., Yabu, Y. and Ohta, N., 1998.** Trypanocidal effects of gallic acid and related compounds. [*T. b. brucei*.] *Planta Medica*, **64** (1): 27-30.

Nose: Department of Pharmacognosy and Plant Chemistry, Faculty of Pharmaceutical Sciences, Nagoya City University, 3-1 Tunabe-dori, Mizuhuku, Nagoya 467, Japan.



- 10524 **Seley, K.L., Schneller, S.W., Rattendi, D., Lane, S. and Bacchi, C.J., 1997.** Synthesis and antitrypanosomal activities of a series of 7-deaza-5'-noraristeromycin derivatives with variations in the cyclopentyl ring substituents. [*T. b. brucei*, *T. b. rhodesiense*.] *Antimicrobial Agents and Chemotherapy*, **41** (8): 1658-1661.

Schneller: Department of Chemistry, Auburn University, Auburn, AL 36849-5312, USA.

## 8. TRYPANOSOME RESEARCH

### (a) CULTIVATION OF TRYPANOSOMES

### (b) TAXONOMY, CHARACTERISATION OF ISOLATES

- 10525 **Haag, J., O'hUigin, C. and Overath, P., 1998.** The molecular phylogeny of trypanosomes: evidence for an early divergence of the Salivaria. *Molecular and Biochemical Parasitology*, **91** (1): 37-49.

Haag: Abteilung Membranbiochemie, Max Planck Institut für Biologie, Corrensstrasse 38, D-72076 Tübingen, Germany.

A molecular phylogenetic reconstruction of trypanosome evolution based on nucleotide sequences of small subunit rRNA genes is presented. The evolutionary tree suggests an ancient split into one branch containing all Salivarian trypanosomes and a branch containing all non-Salivarian lineages. The tree is discussed in relation to the modes of adaptation that allow trypanosomes to infect immunocompetent vertebrates. Most importantly, the early divergence of the Salivarian lineages suggests that the presence of a dense proteinaceous surface coat that is subject to antigenic variation is a unique invention of this group of parasites.

- 10526 **Hide, G., 1997.** Comment on Dr Michel Tibayrenc's lecture. *FAO Animal Production and Health Paper*, no. 135: 47-51.

Wellcome Unit of Molecular Parasitology, University of Glasgow, Anderson College, 56 Dumbarton Road, Glasgow G11 6NU, UK.

The author, in commenting on the lecture by Tibayrenc (see **21**: no. 10528), describes the method (RFLP) used by his laboratory in tracking strains in order to obtain meaningful epidemiological data. The banding patterns obtained are used to calculate similarity coefficients which, using cluster analysis techniques, can then be used to generate a dendrogram of relationships. Studies on trypanosome isolates from West Africa showed that *Trypanosoma brucei gambiense* fell into two distinct groups. Isolates from Kenya, Uganda and Zambia were also of two types, suggesting that *T. b. rhodesiense* is not a monophyletic group, i.e. human infectivity has arisen more than once. The implications for epidemiology and the significance of the animal reservoir are discussed.

Further analysis of East African stocks from Tororo, Uganda, showed: (i) a highly homogeneous group, all human serum resistant or isolated from humans (*T. b. rhodesiense*), 23% of isolates from cattle being of this type; and (ii) a highly heterogeneous group, all human serum sensitive and never found in humans (*T. b. brucei*). Furthermore, some *T. brucei* populations appear to be clonal while others are not. It was calculated that the cattle-fly-man transmission cycle was five times more probable than the man-fly-man cycle, suggesting that treatment of the 23% of cattle harbouring human-infective trypanosomes could damp down or prevent an epidemic.

10527 **Jones, T.W., 1997.** Serodeme analysis – past, present, has it any future? *FAO Animal Production and Health Paper*, no. 135: 29-31.

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10528 **Tibayrenc, M., 1997.** Molecular epidemiology of salivarian trypanosomes. *FAO Animal Production and Health Paper*, no. 135: 43-46.

Centre d'Etudes sur le Polymorphisme des Microorganismes (CEPM), UMR CNRS/ORSTOM 9926, ORSTOM, B.P. 5045, 34032 Montpellier Cedex 01, France.

This paper discusses some of the pitfalls of strain typing and molecular taxonomy. An empirical approach to typing strains, by analysing visually the profiles generated by the molecular tools used and considering that the stocks that appear identical pertain to the same strain, and are therefore involved in the same epidemic chain, can be misleading because the identity of strains is highly dependent upon the resolution power of the molecular tools employed. For example, stocks that appear identical with four primers may prove heterogeneous with 20, so a fair level of resolution is needed (up to 22 isoenzyme loci plus 25 RAPD primers). However, strain typing relies on the assumption that genotypes are sufficiently stable in space and time to be reliably characterised. This will depend on whether the species is clonal or whether it undergoes regular genetic recombination, a question that can be addressed by a population genetic approach based on the analysis of linkage disequilibrium. The cases of *Trypanosoma congolense* (clonal) and *T. brucei* (still under debate), and the difficulties of clarifying whether a particular taxonomic entity is a real clade, are discussed. (For comments on this paper, see **21**: no. 10526.)

10529 **Tibayrenc, M., 1998.** Genetic epidemiology of parasitic protozoa and other infectious agents: the need for an integrated approach. [*T. brucei* spp., *T. congolense*.] *International Journal for Parasitology*, **28** (1): 85-104.

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This paper emphasises the relevance of the concepts and methods of evolutionary genetics for studying the epidemiology of parasitic protozoa and other pathogenic agents.

Population genetics and phylogenetic analysis both contribute to identifying the relevant evolutionary and epidemiologically discrete units of research (discrete typing units = DTUs) that can be equated to distinct phylogenetic lines. It is necessary (i) to establish that a given species represents a reliable DTU; (ii) to see whether a given species is further structured into lower DTUs that correspond to either clonal lineages or to cryptic species, and could exhibit distinct biomedical properties (virulence, resistance to drugs, etc.). DTUs at the species and subspecies level can be conveniently identified by specific genetic markers or sets of genetic markers ('tags') for epidemiological follow-up. For any kind of pathogen (protozoa, fungi, bacteria, viruses), DTUs represent the relevant units of research, not only for epidemiology, but also for other applied researches (clinical study, pathogenicity, vaccine and drug design, immunology, etc.). The development of an 'integrated genetic epidemiology of infectious diseases', that would explore the respective role of, and the interactions between, the genetic diversity (and its biological consequences) of the pathogen, the host and the vector (in the case of vector-borne diseases) is called for.

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[See also 21: no. 10515.]

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