

WOAH Collaborative Centre Reports Activities 2022

Activities in 2022

This report has been submitted : 7 février 2023 04:20

Centre Information

Title of WOA Collaborating Centre	Surveillance and Control of Animal Protozoan Diseases
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Name (including Title and Position) of Head of the Collaborating Centre (WOAH Contact Point):	Dr. Naoaki Yokoyama, Professor
Name of the writer:	Dr. Naoaki Yokoyama

TOR1 AND 2: SERVICES PROVIDED

1. Activities as a centre of research, expertise, standardisation and dissemination of techniques within the remit of the mandate given by WOA

Disease control	
Title of activity	Scope
	Combination of clofazimine and atovaquone, Malaria Box compounds, naphthoquine phosphate, Capsicum annum

<p>Identification and evaluation of anti-protozoan compounds as potential chemotherapeutic agents</p>	<p>methanolic extract, ascorbic acid-diminzene aceturate combination, extracts from pomegranate (<i>Punica granatum</i>) peel, and <i>Artemisia herba-alba</i> methanolic extract were evaluated as antiprotozoal agents. Benzophenone Glucosides and B-Type Proanthocyanidin Dimers from <i>Zambian Cassia</i> abbreviate and nitrofurantoin were evaluated as antitrypanosomal agents. Kijimicin was evaluated as an anti-<i>Toxoplasma gondii</i> agent. Extracts from Egyptian medicinal plants, α-tocopheryloxy acetic acid were evaluated as antimalarial agents. Extracts from Egyptian medicinal plants were evaluated against <i>Toxoplasma gondii</i> and <i>Neospora caninum</i>. Compounds from Chinese medicinal plants were evaluated as therapeutic agents for cryptosporidiosis.</p>
<p>Disease control</p>	
<p>Title of activity</p>	<p>Scope</p>
<p>Identification of drug targets</p>	<p>Phosphatidylinositol 4-kinase was characterized as a drug target in <i>Babesia microti</i>.</p>
<p>Disease control</p>	
<p>Title of activity</p>	<p>Scope</p>
<p>Elucidation of molecular mechanisms of protozoa transmission</p>	<p>Role of dense granule antigen 7 in vertical transmission of <i>Neospora caninum</i> was evaluated in mouse model. Molecules involved in yolk protein precursor (vitellogenin, Vg) synthesis and Vg uptake were investigated to identify key tick factor involved in <i>Babesia</i> transmission.</p>
<p>Disease control</p>	
<p>Title of activity</p>	<p>Scope</p>
<p>Elucidation of molecular mechanisms involved in protozoan invasion into host cells and development</p>	<p>The effect of the deletion of acylated pleckstrin homology domain-containing protein on the RBC invasion and asexual reproduction of <i>Plasmodium yoelii</i> was investigated. The role of <i>Brca2</i> in the development and differentiation of <i>Plasmodium berghei</i> in mice were investigated. <i>Toxoplasma gondii</i> motifs in stage-specific promoters were investigated.</p>
<p>Disease control</p>	
<p>Title of activity</p>	<p>Scope</p>
<p>Investigation of immune responses against protozoan infection</p>	<p>Cross-species immunity during acute <i>Babesia</i> co-infection was investigated in mouse model.</p>
<p>Epidemiology, surveillance, risk assessment</p>	
<p>Title of activity</p>	<p>Scope</p>

Surveillance of protozoan parasites	Seasonal variation of <i>Trypanosoma theileri</i> infection in cattle in Japan and the effect of infection on the health and production were investigated. Horses in Paraguay were surveyed for animal trypanosomes. Bactrian camels in Mongolia were surveyed for infections with bovine <i>Babesia</i> species. Cattle in Burkina Faso were surveyed for <i>Babesia</i> and <i>Theileria</i> species. Cattle in Tanzania were surveyed for hemoprotozoan parasites. Donkeys in Sri Lanka were surveyed for <i>Theileria equi</i> and <i>Babesia caballi</i> infections. Goats in the Philippines were surveyed for <i>Babesia</i> and <i>Theileria</i> species.
Epidemiology, surveillance, risk assessment	
Title of activity	Scope
Vector surveillance	Anopheles mosquitoes were surveyed as potential vectors transmitting <i>Plasmodium bubalis</i> in Thailand. Ticks collected from cattle in Turkey were surveyed for hemoprotozoan parasites. Ticks collected from stray dogs in South Africa were investigated to identify the tick species and detect hemoprotozoan infections.
Epidemiology, surveillance, risk assessment	
Title of activity	Scope
Risk factor identification	Risk factors for equine trypanosomosis in horses in Paraguay were investigated.
Training, capacity building	
Title of activity	Scope
Training on diagnosis, surveillance, and control of animal protozoan diseases	Scientists from Sweden, Mongolia, South Africa, the Philippines, India, Sri Lanka, Vietnam, Kyrgyzstan, China, Bangladesh, Thailand, Egypt, Ghana, Tanzania, Congo, Japan, and Paraguay were trained on diagnosis, surveillance, and control of animal protozoan diseases via technical visits, seminars, and internships.
Zoonoses	
Title of activity	Scope
Epidemiological surveys	Human sera from the Philippines were screened for antibodies to <i>Toxoplasma gondii</i>
Wildlife	
Title of activity	Scope

Epidemiological surveys	Asian elephants in Thailand were surveyed for <i>Toxoplasma gondii</i> using serodiagnostic tests.
Diagnosis, biotechnology and laboratory	
Title of activity	Scope
Development and evaluation of diagnostic assays	Recombinant forms of GRA6, GRA7, and GRA14 antigens were comparatively evaluated for the serodiagnosis of <i>Toxoplasma gondii</i> . A novel antigen for the serodiagnosis of <i>Babesia gibsoni</i> was identified and evaluated in an enzyme-linked immunosorbent assay.
Vaccines	
Title of activity	Scope
Development of models for immunoscreening to identify vaccine candidate antigens	A model based on macrophage stimulation was developed for immunoscreening to identify <i>Toxoplasma gondii</i> and <i>Neospora caninum</i> vaccine candidates.
Vaccines	
Title of activity	Scope
Evaluation of a DNA vaccine delivery system	GRA15 DNA Vaccine with a Liposomal Nanocarrier Composed of an SS-Cleavable and pH-Activated Lipid-like Material was evaluated for its protective efficacy against <i>Toxoplasma gondii</i> in mouse model.
Vaccines	
Title of activity	Scope
Characterization of protozoan antigens as vaccine candidates	PO protein was characterized as a vaccine candidate against <i>Babesia divergens</i> . The role of peroxiredoxin 1 in reducing the fatal consequences of toxoplasmosis was investigated in mouse model. Peptides containing conserved B-cell epitopes of GP-45 were evaluated as vaccine candidates against <i>Babesia bigemina</i> . The recombinant forms of ectodomains I and II of <i>Babesia bovis</i> apical membrane antigen 1 were evaluated as vaccine candidates. The recent advances in vaccine development and the immune response against toxoplasmosis in sheep and goats were reviewed.
Taxonomy	
Title of activity	Scope
Taxonomy of new protozoan species	A recently discovered <i>Babesia</i> species, formerly known as <i>Babesia</i> sp. Mymensingh, was named <i>Babesia naoakii</i> n. sp. based on morphological and genetic distinctions.

Taxonomy	
Title of activity	Scope
Evolution	The evolutionary relationship between Babesia vulpes and Babesia microti-like species infecting raccoon dogs in South Korea was investigated.

TOR3: HARMONISATION OF STANDARDS

2. Proposal or development of any procedure that will facilitate harmonisation of international regulations applicable to the main focus area for which you were designated

Proposal title	Scope/Content	Applicable area
Validation of diagnostic assays	Enzyme-linked immunosorbent assays developed using GRA6, GRA7, and GRA14 antigens were comparatively evaluated for the serodiagnosis of Toxoplasma gondii in human. An ELISA was developed based a novel antigen known as BgP30 for the serodiagnosis of Babesia gibsoni. Nested PCR assays based on cytochrome b gene for detecting Babesia bovis and Babesia bigemina were developed and validated.	health management Veterinary products

4. Did your Collaborating Centre maintain a network with other WOAHA Collaborating Centres (CC), Reference Laboratories (RL), or organisations designated for the same specialty, to coordinate scientific and technical studies?

Yes

Name of OIE CC/RL/other organisation(s)	Location	Region of networking Centre	Purpose
1) RL for Dourine, ANSES, France, 2) RL for Surra, Institute of Tropical Medicine Antwerp, Belgium, 3) RL for Surra, National Research Center for Protozoan Diseases, Obihiro University of Agriculture and Veterinary Medicine, Japan, and 4) RL for trypanosomoses (tsetse-transmitted), CIRAD-IRD, France	France Belgium Japan	Asia and Pasific Europe	To create awareness on NTTAT as high impact neglected veterinary diseases, develop tools to enhance the surveillance capacity, foster collaborative research, and fill gaps in knowledge on disease epidemiology, pathogenesis, drug efficacy, vaccines, modes of transmission, reservoir hosts, and vector control.
			To develop and validate an

RL for bovine babesiosis, Autonomous University of Querétaro	Mexico	Americas	ELISA capable of detecting antibodies to both Babesia bovis and Babesia bigemina in cattle.
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TOR4 AND 5: NETWORKING AND COLLABORATION

5. Did your Collaborating Centre maintain a network with other WOAAH Collaborating Centres, Reference laboratories, or organisations in other disciplines, to coordinate scientific and technical studies?

Yes

Name of OIE CC/RL/other organisation(s)	Location	Region of networking Centre	Purpose
Institute of Veterinary Medicine, Mongolian University of Life Sciences	Mongolia	Asia and Pasific	To survey Bactrian camels for bovine babesiosis.
School of Veterinary Medicine, University of Zambia	Zambia	Africa	To evaluate the trypanocidal activities of compounds from Cassia abbreviata bark extract.
Centro de Diagnostico Veterinario, San Lorenzo	Paraguay	Americas	To survey trypanosomiasis and identify its risk factors in horses in Paraguay.
Faculty of Veterinary Science, Mahidol University	Thailand	Asia and Pasific	To survey toxoplasmosis in Asian elephants.
Laboratoire National d'Elevage and Dierenartsen Zonder Grenzen-Vétérinaires Sans Frontières Belgique	Burkina Faso	Africa	To survey ticks and tick-borne diseases in cattle in Burkina Faso.
Veterinary Research Institute	Sri Lanka	Asia and Pasific	To survey equine piroplasmosis among donkeys in Sri Lanka and sequencing the genome of Babesia sp. Mymensingh and its naming as Babesia naoakii n. sp.

Main Campus and College of Veterinary Medicine, Barili Campus, Cebu Technological University	The Philippines	Asia and Pasific	To survey toxoplasmosis in human and hemoprptozoan parasites in goats in the Philippines.
Instituto de Patobiología Veterinaria	Argentina	Americas	To develop and validate nested PCR assays for Babesia bovis and Babesia bigemina.
Faculty of Veterinary Science, Chulalongkorn University	Thailand	Asia and Pasific	To identify potential vectors transmitting Plasmodium bubalis.
Faculty of Veterinary Medicine, South Valley University	Egypt	Africa	To evaluate medicinal plant extracts against Plasmodium parasites, Toxoplasma gondii, and Neospora caninum.
Faculty of Veterinary Medicine, Selcuk University	Turkey	Europe	To survey protozoan parasites in tick from cattle in Turkey.
College of Natural Sciences, Autonomous University of Queretaro	Mexico	Americas	To evaluate conserved epitopes in Babesia bigemina GP-45 as candidates for vaccines.
Faculty of Veterinary Medicine, Chiang Mai University	Thailand	Asia and Pasific	To evaluate Babesia bovis AMA-1 antigen as a vaccine candidate.
Unit for Environmental Sciences and Management, North-West University	South Africa	Africa	To survey ticks and tick-borne diseases in stray dogs in South Africa.
Key Laboratory of Preventive Veterinary Medicine in Hubei Province	China	Asia and Pasific	To identify Babesia gibsoni diagnostic antigens by screening its transcriptome.
Korea National Institute of Health, Korea Disease Control and Prevention Agency	South Korea	Asia and Pasific	To investigate the evolutionary relationship between Babesia Vulpes and

			Babesia microti-like parasites.
Zanzibar Livestock Research Institute	Tanzania	Africa	To identify hemoprotozoan parasites infecting cattle in Tanzania.

TOR6: EXPERT CONSULTANTS

6. Did your Collaborating Centre place expert consultants at the disposal of WOAAH?

Yes

NAME OF EXPERT	KIND OF CONSULTANCY	SUBJECT
Dr. Noboru Inoue	Provided expert advice on a systematic control of vectors and management of infected animals.	Control of surra epidemics in horses in Indonesia

TOR7: SCIENTIFIC AND TECHNICAL TRAINING

7. Did your Collaborating Centre provide advice/services to requests from Members in your main focus area?

Yes

Provision of confirmatory diagnostic services

Horses from the Netherlands, UK, New Zealand, and USA were tested for equine piroplasmosis. Cattle in Japan were tested for trypanosomiasis. Tick species infesting animals in Japan were identified.

Supply of diagnostic and research materials

Theileria equi and Babesia caballi IFAT slides were supplied to institutions in France, UK, Canada, Argentina, Mexico, and Japan. Theileria equi and Babesia caballi DNA samples were provided to a laboratory in the Netherlands and Romania. Babesia bovis and Babesia bigemina IFAT slides were provided to a laboratory in Mexico. Babesia bovis and Babesia bigemina DNA samples were provided to laboratories in South Africa and Mexico. Antigen for serodiagnosis of trypanosomiasis was provided to an institution in South Africa. Trypanosoma DNA samples were provided to institutions in South Africa and United Arab Emirates. Toxoplasma gondii strains were provided to institutions in Mongolia and Japan. Toxoplasma gondii GRA7 recombinant protein was provided to an institution in Mongolia.

Expert advice on the diagnosis of protozoan diseases and vectors:

Expert advice for the diagnosis of animal protozoan diseases was provided to institutions in the Netherlands, Argentina, Mexico, Australia, France, Kyrgyzstan, Mongolia, Paraguay, Japan, USA, Sri Lanka, China, and Zimbabwe. Advice on in vitro cultivation of protozoan parasites was provided to institutions in the Netherlands, Sri Lanka, Argentina, France, and Japan. Advice on regulations related to surra (Trypanosoma evansi) during transnational movement of dogs was provided to veterinarians and public in Japan and USA. Advice on control of surra epidemics in horses was provided to an institution in Indonesia. Advice on risk management policy was provided to an institution in Japan. Expert advice on tick identification, distribution, and control was provided to institutions in Japan. Advice on treatment and prevention of toxoplasmosis was provided to a member of public in Japan.

8. Did your Collaborating Centre provide scientific and technical training, within the remit of the mandate given by WOAAH, to personnel from WOAAH Members?

Yes

a) Technical visit : 9

b) Seminars : 201

c) Hands-on training courses: 0

d) Internships (>1 month) : 3

TYPE OF TECHNICAL TRAINING PROVIDED (A, B, C OR D)	CONTENT	COUNTRY OF ORIGIN OF THE EXPERT(S) PROVIDED WITH TRAINING	NO. PARTICIPANTS FROM THE CORRESPONDING COUNTRY
A	Provided training on cultivation of bovine and equine piroplasms and screening drug candidates in vitro.	Sweden	1
A	Provided training on in vitro cultivation of field isolates of equine piroplasms and on diagnosis of animal trypanosomosis	Mongolia	3
A	Provided training on diagnosis of animal trypanosomosis	South Africa	4
A	Provided training on diagnosis of animal trypanosomosis	The Philippines	1
B	Educated on the problems associated with currently used assays for the diagnosis of equine piroplasmosis	India	2
B	Educated on the current status and control of bovine and equine piroplasmosis and the limitations of currently used diagnostic assays	Japan	176
B	Educated on diagnosis, surveillance, and control of bovine babesiosis	Mongolia	2
B	Educated on diagnosis, surveillance, and control of bovine babesiosis	Sri Lanka	1
B	Educated on diagnosis, surveillance, and control of bovine babesiosis	Vietnam	1

B	Educated on diagnosis, surveillance, and control of bovine babesiosis	Kyrgyzstan	1
B	Educated on diagnosis, surveillance, and control of bovine babesiosis	China	1
B	Educated on diagnosis, surveillance, and control of bovine babesiosis	Bangladesh	1
B	Educated on diagnosis, surveillance, and control of bovine babesiosis	Thailand	2
B	Educated on diagnosis, surveillance, and control of bovine babesiosis	Egypt	2
B	Educated on diagnosis, surveillance, and control of bovine babesiosis	Ghana	2
B	Educated on diagnosis, surveillance, and control of bovine babesiosis	Tanzania	2
B	Educated on diagnosis, surveillance, and control of bovine babesiosis	Congo	2
B	Educated on diagnosis, surveillance, and control of bovine babesiosis and animal trypanosomosis	Mongolia	4
B	Educated on the diagnosis, and control of animal protozoan diseases	Paraguay	1
B	Educated on the diagnosis, and control of animal protozoan diseases	South Africa	4
B	Educated on the diagnosis, and control of animal protozoan	The Philippines	1

	diseases		
D	Offered Internship to become acquainted with diagnosis and surveillance of animal trypanosomosis	South Africa	2
D	Offered Internship to become acquainted with diagnosis and surveillance of animal trypanosomosis	The Philippines	2

TOR8: SCIENTIFIC MEETINGS

9. Did your Collaborating Centre organise or participate in the organisation of scientific meetings related to your main focus area on behalf of WOA?H?

No

TOR9: DATA AND INFORMATION DISSEMINATION

10. Publication and dissemination of any information within the remit of the mandate given by WOA?H that may be useful to Members of WOA?H

a) Articles published in peer-reviewed journals:

56

1. Keisuke Suganuma, Mitsunori Kayano, Katsuya Kida, Yrjö T Gröhn, Ryotaro Miura, Yuma Ohari, Daiki Mizushima, Noboru Inoue, Genetic and seasonal variations of *Trypanosoma theileri* and the association of *Trypanosoma theileri* infection with dairy cattle productivity in Northern Japan. *Parasitology International*. 2022 Feb; 86: 102476.
2. Nattawat Chaiyawong, Takahiro Ishizaki, Hassan Hakimi, Masahito Asada, Kazuhide Yahata, Osamu Kaneko, Distinct effects on the secretion of MTRAP and AMA1 in *Plasmodium yoelii* following deletion of acylated pleckstrin homology domain-containing protein. *Parasitology International*. 2022 Feb; 86: 102479.
3. Bumduuren Tuvshintulga, Thillaiampalam Sivakumar, Arifin Budiman Nugraha, Believe Ahedor, Enkhbaatar Batmagnai, Davaajav Otgonsuren, MingMing Liu, Xuenan Xuan, Ikuo Igarashi, Naoaki Yokoyama, Combination of clofazimine and atovaquone as a potent therapeutic regimen for the radical cure of *Babesia microti* infection in immunocompromised hosts. *The Journal of Infectious Diseases*. 2022 Jan; 225(2): 238-242.
4. Arpron Leesombun, Coh-Ichi Nihei, Daisuke Kondoh, Yoshifumi Nishikawa, Polyether ionophore kijimicin inhibits growth of *Toxoplasma gondii* and controls acute toxoplasmosis in mice. *Parasitology Research*. 2022 Jan; 121(1): 413-422.
5. Davaajav Otgonsuren, Thillaiampalam Sivakumar, Tovuu Amgalanbaatar, Batsaikhan Enkhtaivan, Sandagdorj Narantsatsral, Batdorj Davaasuren, Myagmar Zoljargal, Dalantai Munkhgerel, Batbold Davkharbayar, Enkhbaatar Batmagnai, Bumduuren Tuvshintulga, Believe Ahedor, Punsantsogvoo Myagmarsuren, Banzragch Battur, Badgar Battsetseg, Naoaki Yokoyama, Molecular survey of bovine *Babesia* species in Bactrian camels (*Camelus bactrianus*) in Mongolia. *Ticks and Tick-borne Diseases*. 2022 Jan; 13(1): 101871.
6. Ragab M Fereig, Yoshifumi Nishikawa, Macrophage stimulation as a useful approach for immunoscreening of potential vaccine candidates against *Toxoplasma gondii* and *Neospora caninum* infections. *Methods in Molecular Biology*. 2022 Jan; 2411: 129-144.
7. Mohamed Abdo Rizk, Shima Abd El-Salam El-Sayed, Rasha Eltaysh, Ikuo Igarashi, In vivo antibabesial activity and bioinformatic analysis of compounds derived from the Medicines for Malaria Venture box against *Babesia microti*. *Molecular and Biochemical Parasitology*. 2022 Jan; 247: 111444.
8. Linous Munsimbwe, Keisuke Suganuma, Yoshinobu Ishikawa, Kennedy Choongo, Takashi Kikuchi, Izumi Shirakura, Toshihiro Murata, Benzophenone glucosides and B-type proanthocyanidin dimers from *Zambian Cassia abbreviata* and their trypanocidal activities. *Journal of Natural Products*. 2022 Jan; 85(1): 91-104.
9. Abdelbaset E Abdelbaset, Mostafa F N Abushahba, Makoto Igarashi, *Toxoplasma gondii* in humans and animals in Japan: An epidemiological overview. *Parasitology International*. 2022 April; 87: 102533.

10. Shengwei Ji, Mingming Liu, Eloiza May Galon, Mohamed Abdo Rizk, Bumduuren Tuvshintulga, Jixu Li, Iqra Zafar, Yae Hasegawa, Aiko Iguchi, Naoaki Yokoyama, Xuenan Xuan, Inhibitory effect of naphthoquine phosphate on *Babesia gibsoni* in vitro and *Babesia rodhaini* in vivo. *Parasites & Vectors*. 2022 Jan; 15(1): 10.
11. Keisuke Suganuma, Tomás J Acosta, Maria Fátima Rodríguez Valinotti, Antonio Rodríguez Sanchez, Ehab Mossaad, Afraa Elata, Noboru Inoue, First molecular survey of animal trypanosomes in Paraguayan horses. *Veterinary Parasitology: Regional Studies and Reports*. 2022 Jan; 27: 100664.
12. Mahmoud AbouLaila, Makoto Igarashi, Ahmed ElKhatam, Soad Menshawy, Gastrointestinal nematodes from buffalo in Minoufiya Governorate, Egypt with special reference to *Bunostomum phlebotomum*. *Veterinary Parasitology: Regional Studies and Reports*. 2022 Jan; 27: 100673.
13. Taishi Kidaka, Tatsuki Sugi, Kyoko Hayashida, Yutaka Suzuki, Xuenan Xuan, Jitender P Dubey, Junya Yamagishi, TSS-seq of *Toxoplasma gondii* sporozoites revealed a novel motif in stage-specific promoters. *Infection, Genetics and Evolution*. 2022 Mar; 98: 105213.
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15. Paul Franck Adjou Moumouni, Germaine Lim-Bamba Minoungou, Christian Enonkpon Dovonou, Eloiza May Galon, Artemis Efstratiou, Maria Agnes Tumwebaze, Benedicto Byamukama, Patrick Vudriko, Rika Umemiya-Shirafuji, Hiroshi Suzuki, Xuenan Xuan, A survey of tick infestation and tick-borne piroplasm infection of cattle in Oudalan and Séno provinces, Northern Burkina Faso. *Pathogens*. 2022; 11(1): 31
16. Tanjila Hasan, Ryo Kawanishi, Hidetaka Akita, Yoshifumi Nishikawa, *Toxoplasma gondii* GRA15 DNA vaccine with a liposomal nanocarrier composed of an SS-cleavable and pH-activated lipid-like material induces protective immunity against Toxoplasmosis in mice. *Vaccines (Basel)*. 2021 Dec; 10(1): 21.
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20. Rochelle Haidee Ybañez, Yoshifumi Nishikawa, Comparative performance of recombinant GRA6, GRA7, and GRA14 for the serodetection of *T. gondii* infection and analysis of IgG subclasses in human sera from the philippines. *Pathogens*. 2022 Feb; 11(2): 277.
21. Sabrina Ganzinelli, Charles Byaruhanga, María E Primo, Zinathi Lukanji, Kgomotso Sibeko, Tshepo Matjila, Luis Neves, Daniel Benitez, Batmagnai Enkhbaatar, Arifin Budiman Nugraha, Ikuo Igarashi, Monica Florin-Christensen, Leonhard Schnittger, International interlaboratory validation of a nested PCR for molecular detection of *Babesia bovis* and *Babesia bigemina*, causative agents of bovine babesiosis. *Veterinary Parasitology*. 2022 Mar; 304: 109686.
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23. Ragab M Fereig, Yoshifumi Nishikawa, Genetic disruption of *Toxoplasma gondii* peroxiredoxin (TgPrx) 1 and 3 reveals the essential role of TgPrx3 in protecting Mice from fatal consequences of toxoplasmosis. *International Journal of Molecular Sciences*. 2022 Mar; 23(6): 3076.
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b) International conferences:

5

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2. Umemiya-Shirafuji, R., Kuniyori, M., Sato, N., Suzuki, H. The roles of oogenesis-related molecules in Babesia-infected Haemaphysalis longicornis. *The 15th International Congress of Parasitology (ICOPA), Copenhagen, Denmark, August 21 – 26, 2022.*
3. Taniguchi, T., Miyauchi, E., Kawabata-Iwakawa, R., Nishiyama, M., Umemiya-Shirafuji, R., Hisaeda, H., Ohno, H., Tomita, H., Suzuki, H. Altered gut microbiota by antibiotics administration ameliorates experimental cerebral malaria in C57BL/6N mice. *The 15th International Congress of Parasitology (ICOPA), Copenhagen, Denmark, August 21 – 26, 2022.*
4. Wanlop A., Angeles JMA., Kirinoki M., Dang TMA., Yajima A., Kawazu S. Expression and evaluation of recombinant antigen thioredoxin peroxidase-1 (TPx-1) from Schistosoma mekongi for schistosomiasis diagnosis. *The 20th International Congress for Tropical Medicine and Malaria, Bangkok, Thailand, October 25, 2022.*
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c) National conferences:

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1. Sukanuma, K., Amma, H., Yamauchi, T., Kawazu, S., Inoue, N. Seasonal variation of blood-sucking horsefly on a farm in Tokachi, Hokkaido. 74th Annual Meeting of the Japanese Society of Health Zoology, Kyoto, Japan, April 8 – 10, 2022.
2. Umemiya-Shirafuji, R. Development of Tick Biobank and New Development of Vector Biology. The 91st Annual Meeting of the Japanese Society for Parasitology, Obihiro, Japan, May 28 – 29, 2022.
3. Taniguchi, I., Miyauchi, E., Kawabata, R., Nishiyama, M., Umemiya-Shirafuji, R., Hisaeda, H., Ohno, H., Tomita, H., Suzuki, H. Antibiotic-altered gut microbiota attenuates experimental cerebral malaria in C57BL/6N mice. The 91st Annual Meeting of the Japanese Society for Parasitology, Obihiro, Japan, May 28 – 29, 2022.
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5. Sukanuma, K., Hong, Y., Obari, Y., Kayano, M., Nakazaki, K., Fukumoto, S., Kawazu, S., Inoue, N. epidemiological study of *Trypanosoma* parasites in Yezo deer. The 91st Annual Meeting of the Japanese Society for Parasitology, Obihiro, Japan, May 28 – 29, 2022.
6. Wanlop, A., Angeles, J.M.A., Kirinoki, M., Dang, T.M.A., Yajima, A., Kawazu, S. Diagnostic potential of *Schistosoma japonicum* recombinant antigens with ELISA in detecting *S. mekongi* human infection in Laos. The 91st Annual Meeting of the Japanese Society for Parasitology, Obihiro, Japan, May 28 – 29, 2022.
7. Arpron, L., Nihei, K., Kondo, D., Nishikawa, Y. A New Drug Against *Toxoplasma* Infection: Polyetherionophore Quizimycin. The 91st Annual Meeting of the Japanese Society for Parasitology, Obihiro, Japan, May 28 – 29, 2022.
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11. Ahmed, A., Nishikawa, Y. Protective effect of NcGRA7-deficient strain as a live-attenuated vaccine against *Neospora* infection. The 91st Annual Meeting of the Japanese Society for Parasitology, Obihiro, Japan, May 28 – 29, 2022.
12. Umeda, G., Goto, Y., Watanabe, K., Ushio, N., Ragab F.M., Inohara, F., Tanaka, S., Suzuki, M., Nishikawa, Y. Effect and analysis of chemokine receptor CXCR3 deficiency in mouse brain during *Toxoplasma* infection. The 91st Annual Meeting of the Japanese Society for Parasitology, Obihiro, Japan, May 28 – 29, 2022.
13. Nanang, A., Baldorj, P., Hatano, K., Ikeda, N., Isshiki, K., Igarashi, M., Nihei, K., Nishikawa, Y. Fevastin, an aminopeptidase N inhibitor, has antimalarial activity. The 91st Annual Meeting of the Japanese Society for Parasitology, Obihiro, Japan, May 28 – 29, 2022.
14. Ushio, N., Fujiwara, R., Watanabe, K., Furubayashi, Y., Nishikawa, Y. Brain distribution of protozoa and protozoan-derived proteins in cattle infected with *Neospora*. The 91st Annual Meeting of the Japanese Society for Parasitology, Obihiro, Japan, May 28 – 29, 2022.
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16. Nishikawa, Y. From drug discovery research against *Toxoplasma* to constructing a comprehensive drug discovery research base utilizing the livestock protozoan disease analysis matrix. 28th Molecular Parasitology Workshop / 18th Joint Conference of Molecular Parasitology and Malaria Research Forum, Nagasaki, Japan, August 3 – 5, 2022.
17. Nakamura, H., Nishida, A., Nishikawa, Y. Elucidation of the mechanism of action of *Toxoplasma*-derived apoptosis-promoting factor TgPDCD5 and its application to cancer treatment. 28th Molecular Parasitology Workshop / 18th Joint Conference of Molecular Parasitology and Malaria Research Forum, Nagasaki, Japan, August 3 – 5, 2022.
18. Ushio, N., Fujiwara, R., Watanabe, K., Furubayashi, Y., Nishikawa, Y. Brain distribution of protozoan-derived proteins in *Neospora* infection. The 165th Annual Meeting of the Japanese Society of Veterinary Medicine, Azabu (online), Japan, September 5 – 7, 2022.
19. Nanang, A., Aboshi, T., Miyazaki, N., Sasaki, Y., Nishikawa, Y. Ainu medicinal plants-associated fungi are potent sources of anti-*Toxoplasma* Agents. The 165th Annual Meeting of the Japanese Society of Veterinary Medicine, Azabu (online), Japan, September 5 – 7, 2022.
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23. Sato, S., Suzuki, H., Umemiya-Shirafuji, R. Expression analysis of the *Vg-1* gene in *Babesia ovata*-infected *Haemophilus pines*. The 31st Annual Meeting of the Japanese Tick Society, Kyoto, Japan, September 17 – 18, 2022.
24. Takeda, N., Arai, Y., Suzuki, K., Kataoka, K., Yura, T., Umemiya-Shirafuji, R., Ghazy, N.A., Mori, K., Gyobu, M., Suzuki, T. Whole genome sequence of phytoseiid mite and multi-omics analysis of starvation response factor. The 31st Annual Meeting of the Japanese Tick Society, Kyoto, Japan, September 17 – 18, 2022.
25. Fereig Ragab, Yoshifumi Nishikawa. Pathogenic involvement of protozoan-derived peroxiredoxin in *Toxoplasma* infection. The 68th Joint Conference of the Japanese Society of Parasitology and the Japanese Society of Medical Zoology Northern Japan Branch, Sapporo, Japan, October 15, 2022.
26. Kumar, M.U., Umemiya-Shirafuji, R., Xuan, X. Molecular detection of ticks and piroplasma of livestock in Bangladesh. The 68th Joint Conference of the Japanese Society of Parasitology and the Japanese Society of Medical Zoology Northern Japan Branch, Sapporo, Japan, October 15, 2022.
27. Sato, S., Suzuki, H., Umemiya-Shirafuji, R. *Vg-1* gene expression analysis in *Babesia ovata*-infected troglodytes ticks. The 68th Joint Conference of the Japanese Society of Parasitology and the Japanese Society of Medical Zoology Northern Japan Branch, Sapporo, Japan, October 15, 2022.
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29. Yamazaki, A., Kawazu, S., Inoue, N., Kita, K., Tanaka, Y., Watanabe, K., Suganuma, K. Oral treatment test using ascofuranone and glycerol in mice infected with *Trypanosoma congolense*. The 68th Joint Conference of the Japanese Society of Parasitology and the Japanese Society of Medical Zoology Northern Japan Branch, Sapporo, Japan, October 15, 2022.
30. Ahedor, B., Sivakumar, T., Valinotti, M.F.R., Otgonsuren, D., Yokoyama, N., Acosta, T.J. PCR detection of *Theileria equi* and *Babesia caballi* from apparently healthy horses in Paraguay. The 68th Joint Conference of the Japanese Society of Parasitology and the Japanese Society of Medical Zoology Northern Japan Branch, Sapporo, Japan, October 15, 2022.
31. Mori, N., Sivakumar, T., Mizutani, Y., Matsui, S., Takahiro, K., Shirafuji, R., Inokuma, H., Yokoyama, N. There are two types of large bovine piroplasma (bovine *Babesia*) in Japan. Cattle clinical parasite research group Hokkaido research meeting, Japan, October 28, 2022.
32. Davaasuren, B., Amgalanbaatar, T., Tsogtgerel, M., Suganuma, K., Tsuda, Y., Tanaka, T., Kinoshita, H., Kawazu, S., Nanpo, Y. Evaluation of the effect of oral administration of 5-aminolevulinic acid on improvement of aerobic exercise efficiency in Mongolian horses. The 35th Annual Meeting of the Japanese Society of Equine Science, Tokyo, Japan, November 28 – 29, 2022.

d) Other (Provide website address or link to appropriate information):

1

<https://www.obihiro.ac.jp/facility/protozoa/en/oie>

11. What have you done in the past year to advance your area of focus, e.g. updated technology?

We created dedicated websites for the WOA reference laboratories located within our collaborating centre. We prepared global epidemiological maps and posted them in these websites. We named a novel *Babesia* species capable of causing clinical bovine babesiosis to facilitate the smooth biological communication. We expanded our international collaboration network to accelerate research, as well as to improve the human resources for the control of animal protozoan diseases.

12. Additional comments regarding your report:

None