

Centers of Advanced Medicine

Center for Medical Entomology

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General Summary

Arthropod vectors are organisms that play a role in the transmission of a pathogen between humans or from animals to humans. Vectors tend to be blood-sucking insects that ingest the disease-causing organism with the blood from an infected host and then inject it into a new host at the time of their next blood-meal. New strategy to control the vector should absolutely be developed and involved in integrated vector management, because it is one of the most effective means of dealing with the problem while waiting for a vaccine or other effective dengue-control strategy. In this center, based on collaboration with institutions in endemic countries, such as Burkina Faso, Nigeria, and Taiwan, entomological studies promoting multilateral approaches have been performed to gather knowledge of diagnosis, ethology, immunity, and epidemiology of vector species for effective vector control.

Research Activities

Evidence of vertical transmission of severe fever with thrombocytopenia syndrome virus in field-collected ticks

Tick-borne diseases represent major public health issues worldwide. Severe fever with thrombocytopenia syndrome virus (SFTSV) is a newly identified *Phlebovirus* in the *Bunyaviridae* family causing acute hemorrhagic fever in East Asia, China, Korea, and Japan. Cases of SFTSV have been detected and isolated from diverse species of tick in the endemic areas. We collected ticks from 15 localities (over an area of 10 km²) on Kyushu Island, Japan, in April and October 2013. In addition, the localities are known to have an abundance of ticks and a recent history of human cases of Japanese spotted fever. A total of 1,168 questing ticks were collected with flagging vegetation (using a white flannel cloth of 170 × 70 cm). The SFTSV-specific RNA was detected with the reverse-transcription polymerase chain reaction in complementary DNA generated from the RNA of individual ticks. The SFTSV-specific RNA was detected in 4 species: *Haemaphysalis formosensis*, *Haemaphysalis longicornis*, *Haemaphysalis flava*, and *Haemaphysalis hystricis*. The SFTSV RNA was not detected with the reverse-transcription polymerase chain reaction in any field-collected *Amblyomma testudinarium* tick. Most of the ticks collected in April were nymphs (n = 794, SFTSV-positivity = 9.8%), 73 (8.2%) were adults, and only 10 (0%) were larvae. In contrast, in October we collected 8 (0%) nymphs, 38 (0%) adults, and 245 (7.3%) larvae. Interestingly, SFTSV-specific RNA was also detected in larvae. Larvae may become infected with the SFTSV via vertical transmission.

Genetic dissection of intermediate host and tapeworm interaction

Dwarf tapeworm, *Hymenolepis nana*, which belongs to the order Cyclophyllidea, is the most common cestode of humans. Its intermediate host is arthropods, in particular, beetles. Once the intermediate host ingests tapeworm eggs, oncospheres immediately hatch and pass through the insect's gut wall. Cysticercoids develop within the hemocoel, where they survive without loss of infectivity until the intermediate host is ingested by a definitive host. To dissect the interaction between a tapeworm and an intermediate host, we employed a reverse genetic approach with the red flour beetle, *Tribolium castaneum*, in which a robust systemic RNA interference (RNAi) response is observed, as a model system to explore host responses to tapeworm infection. Adult knock-down phenotypes in *T. castaneum* were induced by injection of double-stranded RNA into late instar larvae. We performed RNAi screening targeting several gene transcripts of Toll and immune deficiency pathways, which are 2 major signaling pathways of the humoral immune response in insects. Reduction of Toll pathway function, which was induced by RNAi-mediated silencing of *MyD88*, *Dif1*, and *Dif2*, in addition to Janus kinase/signal transducer and activator of transcription and c-Jun N-terminal kinase components, increased the burden of cysticercoids. On the other hand, RNAi-mediated knock-down of the immune deficiency pathway components *dredd* and *imd* had no significant difference on cysticercoid load. Our findings suggest a pivotal role of specific pathways, such as Toll signaling, in regulating the resistance to tapeworm infection.

Publications

Badolo A¹, Bando H², Traoré A¹, Ko-Ketsu M², Guelbeogo WM¹, Kanuka H, Ranson H³, Sagnon N¹, Fukumoto S² (¹Univ Tokyo, ²Obihiro Univ Agr Vet Med, ³Liverpool Sch Trop Med). Detection of G119S ace-1 (R) mutation in

field-collected *Anopheles gambiae* mosquitoes using allele-specific loop-mediated isothermal amplification (AS-LAMP) method. *Malaria J.* 2015; **14**: 477.