

Coffee, its roasted form, and their residues cause birth failure and shorten lifespan in dengue vectors

Hamady Dieng¹ · Salbiah Binti Ellias² · Tomomitsu Satho³ · Abu Hassan Ahmad² · Fatimah Abang⁴ · Idris Abd Ghani⁵ · Sabina Noor⁴ · Hamdan Ahmad² · Wan Fatma Zuharah² · Ronald E. Morales Vargas⁶ · Noppawan P. Morales⁷ · Cirilo N. Hipolito⁴ · Siriluck Attrapadung⁶ · Gabriel Tonga Noweg¹

Received: 11 October 2016 / Accepted: 28 February 2017
© Springer-Verlag Berlin Heidelberg 2017

Abstract In dengue mosquitoes, successful embryonic development and long lifespan are key determinants for the persistence of both virus and vector. Therefore, targeting the egg stage and vector lifespan would be expected to have greater impacts than larvicides or adulticides, both strategies that have lost effectiveness due to the development of resistance. Therefore, there is now a pressing need to find novel chemical means of vector control. Coffee contains many chemicals, and its waste, which has become a growing environmental concern, is as rich in toxicants as the green coffee beans; these chemicals do not have a history of resistance in insects, but some are lost in the roasting process. We examined whether exposure to coffee during embryonic development could alter larval eclosion and lifespan of dengue vectors. A series of bioassays with different coffee forms and their residues

indicated that larval eclosion responses of *Aedes albopictus* and *Ae. aegypti* were appreciably lower when embryonic maturation occurred in environments containing coffee, especially roasted coffee crude extract (RCC). In addition, the lifespan of adults derived from eggs that hatched successfully in a coffee milieu was reduced, but this effect was less pronounced with roasted and green coffee extracts (RCU and GCU, respectively). Taken together, these findings suggested that coffee and its residues have embryocidal activities with impacts that are carried over onto the adult lifespan of dengue vectors. These effects may significantly reduce the vectorial capacity of these insects. Reutilizing coffee waste in vector control may also represent a realistic solution to the issues associated with its pollution.

Responsible editor: Philippe Garrigues

✉ Hamady Dieng
hamachan1@yahoo.com

Keywords Coffee · Coffee waste · Dengue vector · Embryonic development · Adult lifespan

Introduction

With over 40% of the world's population at risk (WHO 2012a), 100 million cases annually, and 1 in 2000 cases resulting in death (CDC 2015), dengue has become the most common arboviral disease. Management of this disease has been attempted using a variety of methods, mostly targeting vector populations with chemical insecticides (WHO 2012a). Some such programs have worked well (Ooi et al. 2006), but the two main vectors, *Aedes aegypti* (Dia et al. 2012) and *Ae. albopictus* (Vontas 2012), have acquired resistance to the four classes of insecticides registered for vector control. With the absence of licensed vaccines and treatments (Laughlin et al. 2012), the ongoing reductions in availability of effective insecticides due to resistance, and increased anti-pesticide

- ¹ Institute of Biodiversity and Environmental Conservation (IBEC), Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, Kota Samarahan, Malaysia
- ² School of Biological Sciences, Universiti Sains Malaysia, Penang, Malaysia
- ³ Faculty of Pharmaceutical Sciences, Fukuoka University, Fukuoka, Japan
- ⁴ Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, Kota Samarahan, Malaysia
- ⁵ Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Bangi, Malaysia
- ⁶ Faculty of Tropical Medicine, Mahidol University, Bangkok, Thailand
- ⁷ Faculty of Science, Mahidol University, Bangkok, Thailand