



Exploration of Traditional Anti-malarial Medicinal Plants of Mali: Effectiveness in Experimental (*in vitro*) Trials

Eva J. Mends¹, Florence V. Dunkel¹, Michael White³, Maria Jerome³, Robyn A. Klein¹

Department of Plant Sciences and Plant Pathology, 119 Plant BioScience Building, Montana State University, Bozeman, MT 59717-3150, United States

³Department of Veterinary and Molecular Biology, Technology Park Center, Montana State University, Bozeman, MT 59717

(Eva Mends was a 2007 and 2008 Mali Extern in the Montana State University program)



INTRODUCTION

- Malaria occurs in most equatorial, tropical, and semi-tropical areas of the world. Malaria kills between 100 million and 300 million people worldwide annually, with over half of those deaths in young children. The estimated economic impact is enormous, with over twelve billion dollars a year spent on malaria in Africa alone (Roche 2004).
- Malaria is caused by a one-celled parasite, a protozoan, *Plasmodium* spp. Although there are over 170 species of *Plasmodium*, only four infect humans: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae*, and *Plasmodium ovale*. The parasite is transmitted through the bite of the female anopheline mosquito. These parasitic cells (sporozoites) then travel to the liver of the infected person and incubate for a period from days to weeks. When the cells have matured, they burst out of the liver and invade red blood cells. In 48 to 72 hours the sporozoites burst out of the red blood cells and cause the high fever and acute reaction in humans. Sporozoites mature into trophozoites, the stage capable of infecting mosquitoes and being transmitted (after a maturation process in the mosquito) to another person.
- In Mali, many medicines used to treat malaria are natural plant extracts because of a lack of other available medicines and prohibitive costs of Western treatments. Participatory assessment by MSU-Bozeman externs in 2005 (Kante et al. in review) in 2 Mali communes (11 villages) indicated malaria was the number one concern.
- The purpose of this research project is to assist initiatives of the Mali Agribusiness Network and the National Institutes of Health (NIH).

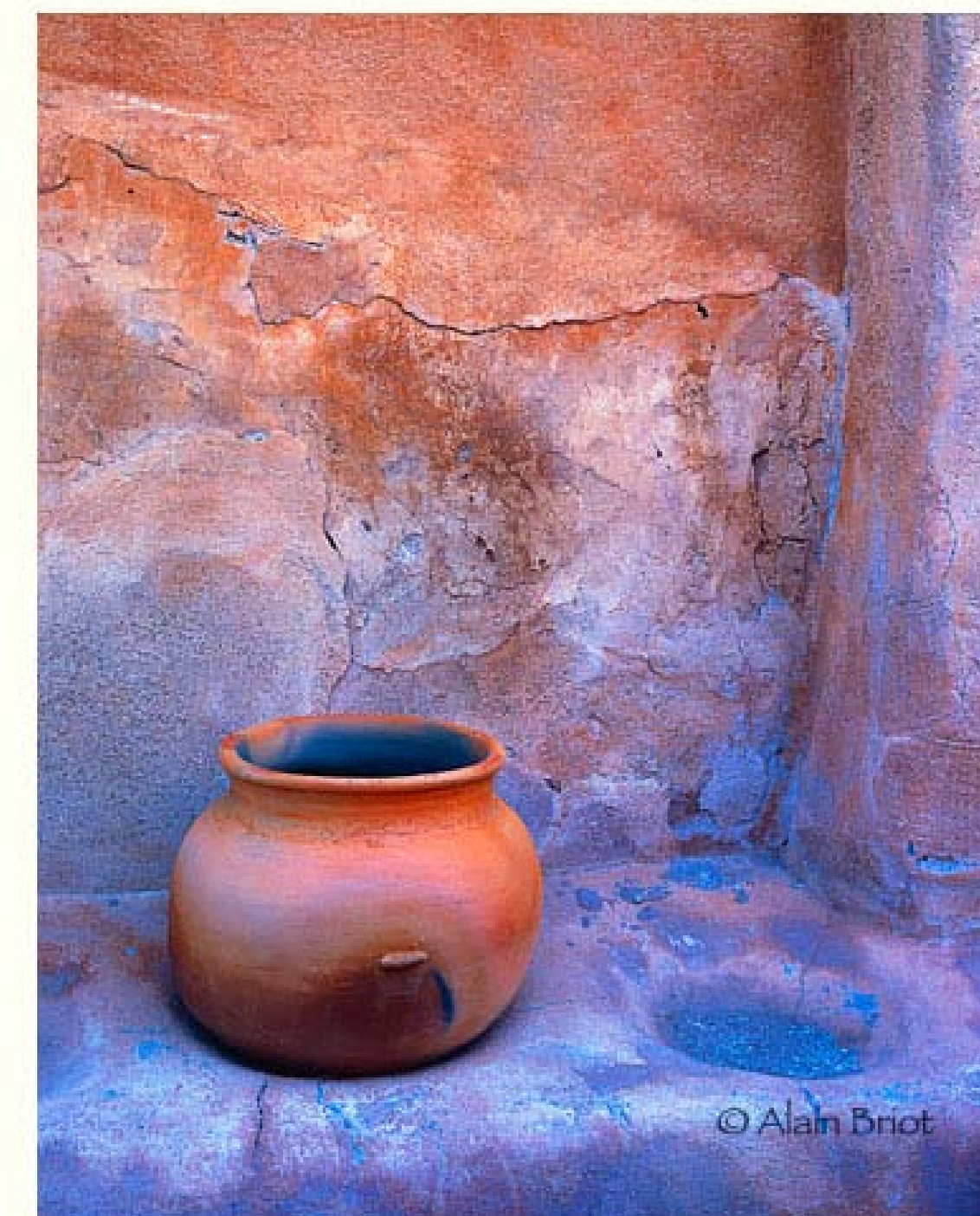


Hypothesis: All Malian plant species collected with documented efficacy against malarial symptoms will have a measurable effect on the *in vitro* parasitic protozoan model *Toxoplasma gondii*.

MATERIALS AND METHODS

- We choose a holistic, participatory approach (Chambers et al.1989, Savory and Butterfield 1999). Active involvement of Malians, including villagers, is imperative to sustainably help Mali combat malaria. Input and critique by Malians was incorporated at each step in this project.
- We selected one village from 11 surveyed by MSU Undergraduate Scholars in 2005, the Bambara farming village of Sanambele (Commune Dialakoroba) to conduct holistic discussions that included malaria issues.
- Separate survey instruments were developed for in-depth interviews with individual villagers in Sanambele and the city population in Mali. In Mali, data were gathered with these instruments to evaluate knowledge of causes and symptoms of malaria as well as natural remedies preferred. Mends conducted many surveys in a wide range of economic levels and ages in Bamako and in village of Sanambélé. These surveys gave general knowledge of the types of methods used for malaria treatments as well as treatments available.

- Mends also conducted in-depth interviews (with Malians of both genders in diverse ages, socioeconomic groups) to determine specific ways to prepare ethanol and water extracts to test these samples for activity against *Toxoplasma gondii*, a parasite in tissue culture at MSU-Bozeman (Dr. White's lab).
- In the *Toxoplasma* lab, Mends practiced tissue culture procedures. Mends, Jerome, and White developed methods to use the culture to test the Malian extracts. Tissue cultures are human foreskin fibroblasts in tissue culture sample containers. *Toxoplasma* strains include both normal and variant strains created by Dr. White's lab.
- Robyn Klein provided detailed advice on collection, storage, and preservation techniques including alcohol tinctures and water extract methods.
- Plants were obtained with help of Sanambélé village midwife, Awa Diarra, who also explained extraction methods and dosage.
- Extracts were made with water using a 1:2 ratio of plant to water, while a 40:60 ratio of alcohol to water was used for the tincture process in a 1:5 ratio with the plants.
- Mends visited the University of Medicine and Pharmacology in Bamako to discuss the advent of a malaria vaccine and isolation of resistance factors with scientists associated with the World Health Organization (WHO) and the National Institutes of Health (NIH).



Marmite (cauldron) used for preparing water extracts. Extracts are prepared by boiling water and plant material in marmite and drinking cooled mixture three times a day.

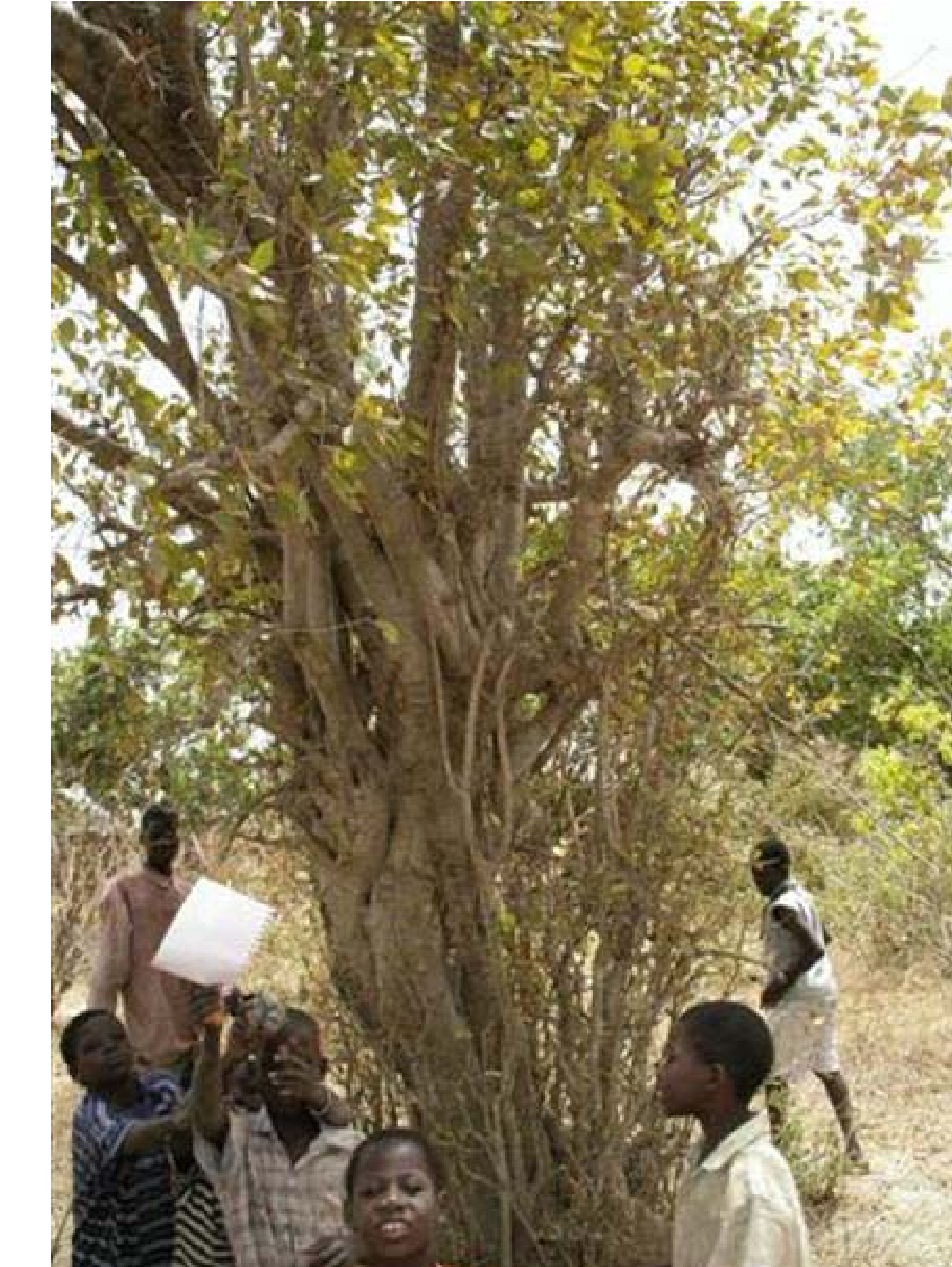
Photo by Alan Briot.

RESULTS

- Four medicinal plants are commonly used in the village of Sanambélé were called, in the native language of Bambara: joun, kosafine, sinjan, and bari.
- Scientific names for the plant samples are:
 - *Nauclea latifolia* Sm. Syn. *Sarcocephalus latifolius* (Sm.) Bruce (Rubiaceae) (Bambara: bari)
 - *Cassia Siberiana* (Fabaceae)(Bambara: sinjan)
 - *Vernonia colorata* (Willd.) Drake (Asteraceae)(Bambara: kosafine)
 - *Mitrogyna inermis* (Bambara: joun)
- A commercial, medicinal tea was obtained as a control in the *Toxoplasma* bioassay. This tea contains three plant species sanctioned by the National Institute of Therapeutic Medicine in Bamako, Mali who clinically tested each species for effectiveness against human malaria *Plasmodium* spp.
- Collection of these 4 plant species were made by Dunkel for herbarium voucher specimens and verified by Saidou Ouattara, Dr. Drissa Diallo, and Sori Ibrahima Traoré



Joun growing in the garden area of Sanambele, Mali



Bari collection with Sanambele villagers



Sinjan at edge of village of Sanambele, Mali. Photos by Eva Mends

- Mends visited the Mali Institute of Medicine's Vaccine Development Program to obtain understanding of need for local solutions to malaria infections until a vaccine becomes available.

DISCUSSION

- This research will point the way to local plants Malians use effectively against the malaria parasite itself and not only to treat symptoms.
- Eight Malian plants were documented by peer refereed journals to have anti-malarial activity (Lehman et al. 2007), only 2 (*N. latifolia*, *V. colorata*) of the 4 collected in the village were among these.
- Results gathered to date are solely qualitative, not quantitative. Testing plant samples will begin immediately.
- From the bioassay results we will predict effectiveness of these medicinal plants against the *Plasmodium* spp. causing the 4 forms of human malaria.

CONCLUSIONS

- Natural medicines are widely used in Mali and there is much common knowledge about how to use them.
- The general population does not have means and in large part, access to synthetic medical treatments for malaria. Tradition also dictates the use of medicinal plants instead of Western preparations.
- Traditional healers, midwives and pharmacists provide the best health information in the village areas we surveyed in this study.

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