



Phytochemical Considerations for Use of Local, Traditional Plants for Integrated Management of Malaria in the Farming Village of Sanambele, Mali

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Bourema Coulibaly (right) examines "river" harboring mosquito larvae in shady areas during the dry season. Below, Hawa Coulibaly (left) and Florence Dunkel (right) review integrated malaria prevention strategies



Results and Discussion

When a child is suddenly struck with malaria symptoms (fever, chills, sweating, shaking, enlarged liver) they should immediately go under a bednet, and village health worker asked to take blood sample for diagnosis. Child should immediately begin drinking a salty onion, basil, and clove soup. Oxidants from these vegetables will be quickly absorbed into the bloodstream, where they can prevent newly emerged parasites from infecting healthy red blood cells. Medication with oxidizing foods should continue for first 36 hours after fever subsides, to encourage infected red blood cells to lyse early, releasing immature, noninfectious parasites for destruction by immune system. Oxidants can also be given as tea made from Joun (ethanol or fermented mango extract) mixed with cinnamon, sugar, a pinch of nutmeg. After 36 hours, Bari roots / stems extracted with fermented mangos or water-ethanol mixture (ethanol can be evaporated after extraction by setting it in sun) should be given until next fever cycle begins. Treatment should be repeated starting with bednet. If commercial medicines are available, this regimen will complement, rather than interfere, with normal use of ACT, amodiaquin, and chloroquin.

For infant / child at onset of diarrhea, a small tea could be made from Kosafinè (leaves or extract), a sprinkle of nutmeg, and a zinc supplement or other high-zinc food. Zinc supplements can decrease the duration and severity of diarrhea (Winch, et al. 2008) For dehydration caused by diarrhea, a tea should be made with Joun and Kosafinè (to ensure water is clean of *E.coli.*), sugar plus salt, the combination used for Oral Rehydration Therapy. To assist with cleaning soiled skin, a soft soap can be made by mixing liquid potash with a boiled fat such as shea butter or neem mixed in dried, crushed leaves of Joun and/or Kosafinè; a hard soap can be made by adding salt before cooling.

Many Mali soils are severely zinc-deficient. If a plant is grown in zinc-deficient soil, it will not take up zinc or iron properly. Cloves, onions, and basil, hibiscus grown in women's small garden could be supplemented with zinc-enriched fertilizers, outer casings of zinc-carbon batteries, or even littered American pennies (97.5% zinc; treat with sulfuric acid for highly soluble zinc sulfate). Zinc is a critical nutrient for the immune system. Many studies demonstrated positive effects of zinc supplementation against diarrhea, malaria, tuberculosis, and even the parasites that cause African Sleeping Sickness (Winch, et al. 2008; Shankar, et al. 2000; Brazão, et al. 2008). High zinc medicinal plants should be grown in the village in ceramic pots or woven baskets for sustainability, and also to prevent night visits to the river.

P. falciparum has 48 hour "latency" between fever cycles. **Bari** (below, behind Bourema) root /stem extracts should be taken 6-12 hours before fever cycle onset (Benoit-Vical, et al. 1998). Bari harvested just after rainy season (September) is twice as active against malaria as Bari harvested in January. Store away from cowpeas (Yawovi & Gumedzoe 1993).



Kosafinè (left) extracts can be prepared in advance of illness and stored for over a year.

Use for diarrhea, bacteria, wounds.

Use is better when prepared and stored in jars or bottles (Stafford, et al. 2005).

Joun leaves (below), are good for malaria only when dissolved in water-ethanol or mixed with fermented mangos (Ojokoh, 2007). As tea, Joun is good for cleaning clothes and skin soiled by diarrhea.



Sinjan (right) leaves, flowers, and bark are toxic. Eating leaves kills sheep in 24 hours. Signs of poisoning are drooping eyes, loss of appetite, vomiting & liver congestion.



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Dicliptera verticillata



Leaf stalk compounds applied to paper strips changed from pale-rose to violet in seconds when malaria was present in infants. Method is 95% accurate compared to traditional methods. Plant (left) grows in West Africa (Sawadogo, 2005)



Onions
Oignons



Sanambele woman with her onions for sauce for dinner (left). Village elders accept microscope to present to school (above).

Light Microscopy

A proper blood smear can detect tuberculosis, each of the four human malaria protozoa, trypanosomes, and pathogens of infected wounds, as well as indicate the stage and infection severity. Malaria detection depends on availability of Giemsa stain dissolved in 100% methanol. Pathogens in water can be identified and treatments devised.



Oxidizing Foods

Antimalarials like ACT (artemesinin combination therapy) work by promoting the oxidation of red blood cells and release of immature parasites. Laws (PMI) require malaria diagnosis before ACT or amodiaquin are free to infants and pregnant women. Without diagnosis, oxidants found in onions, basil, cinnamon, nutmeg, and cloves can be used for malaria.

Rapid Diagnostic Tests (RDTs) are

limited cost, specificity to malaria strains, temperature-sensitive storage, and availability. Doctors Without Borders (MSF) may assist rural Malians with RDTs.

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Introduction

At the core of this research is a holistic, village-based approach to malaria management. Our focus is long-term sustainability by sharing biotechnical knowledge and building NGO resource networks. People of Sanambele, Mali are rural, subsistence farmers who for centuries have relied on local, traditional medicines almost exclusively to treat illness, including malaria. Villagers make teas from leaves of four small trees which grow along a tributary of the Niger River, Joun (*Mitragyna inermis*), Kosafinè (*Vernonia colorata*), Bari (*Nauclea latifolia*), and Sinjan (*Cassia sieberiana*). However, there are no standard methods for diagnosing illness, combining plants, creating extracts, combining extracts with modern medicines, dosing for small children, or combining medication with other anti-malarial activities. Villagers requested information on effectiveness of their traditional medicines, and indicated they want enhanced methods demonstrated side-by-side with them. Chloroquin-resistant malaria strains, particularly *Plasmodium falciparum*, are suspected to be the leading cause of child mortality; the next leading cause of death is severe diarrhea. Both malaria and diarrhea are more likely to be fatal because of poor childhood nutrition. Fortunately, however, once a child survives their first bout with malaria (CDC, 2004), he/she will usually be able to defeat the disease later in life. First priority against malaria is therefore prevention of young deaths.

Hypothesis: Medicinal plants used by women of Sanambele for malaria can be used more effectively with information from peer-refereed literature.

Methods

Information on chemical constituents and widespread use of traditional plants used by Sanambele women was discovered in peer-refereed journals, especially the *Journal of Ethnopharmacology*. In assisting villagers in approaching their holistic goal, we considered their own accounts of the quality of life they seek, their current difficulties, and the base of resources available to them, now and in the future. We suggest the following treatment methods based on pharmacologic and toxicologic literature.