

The rise to prominence of *Artemisia annua* L. – the transformation of a Chinese plant to a global pharmaceutical

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Abstract

This paper focuses on the transformation of a recently promoted medicinal plant named Artemisia annua L. For over 2000 years, the Chinese have used A. annua as a herbal tea preparation against malaria. Pharmacological studies led to the isolation of artemisinin as the principal anti-malarial compound. Since 2001, the World Health Organisation (WHO) has recommended artemisinin-based combined therapies (ACTs) for the treatment of malaria – Novartis is the leading actor to extract the compound in tablet form. In the 1990s, A. annua was introduced to Tanzania. Beside the local plant-based promotion of Artemisia-tea as an efficient, inexpensive natural practice to treat malaria, Tanzania hosts influential actors who seek to commercialise the plant. By following the biography of the Chinese medicinal plant, its global transfer, production, marketing, distribution, consumption, and its transformation to a highly demanded commodity, the paper critically reveals the dialectics and reciprocities between different actors and their relation to existing powerful reference systems (such as WHO, Pharmaceutical Industry).

Keywords: *Artemisia annua* L., artemisinin, Tanzania, ACT, effectiveness, social life of medicines

“Artemisia (*Artemisia annua*) is a seemingly simple, though versatile, medicinal plant suddenly at the heart of international attention. It was long a traditional remedy for a variety of ills. But by virtue of the extraordinary qualities of a purified extract, artemisinin, it is now a key player in global efforts to help control malaria, particularly in Africa where it is a particular scourge. In doing so, it is following in the legendary footsteps of quinine, also a plant derivative (...), and has become - at least for the present - one of the most important medicinal plants in the world.”

(Dalrymple, 2008: 57)

Introduction

Malaria is the most important parasitic disease of mankind. Each year, malaria causes disease in approximately 515 million people and kills between one and three million people, the majority of whom are children in sub-Saharan Africa (Snow et al., 2005). In Tanzania, we see 14 to 18 million new malaria cases and up to 125 000 malaria-related deaths every year.¹ Researchers have pointed out that the most plausible single factor contributing to this staggering number is the resistance to widely available, low-cost antimalarials. During the past few years, traditional single drug treatments (known as monotherapies such as chloroquine) have lost appreciable effectiveness and are currently replaced by a new generation of antimalarials: artemisinin-containing combination therapies, 'ACTs' (White, 2004; Arrow et al., 2004; Namdeo et al., 2006).

ACTs derive from the Chinese medicinal plant *Artemisia annua* (its ancient Chinese name is *qinghao*, blue-green, fragrant herb), a species which is known worldwide for its antimalarial properties (Wright, 2002; Hsu, 2006a+b).² For over 2000 years, the Chinese have used what is commonly called *Sweet wormwood* as a herbal tea preparation for treating periodical fevers (indicative of the paroxysms of malaria) and other 'heat syndromes' (Guo Qiao et al., 1994; Valecha and Tripathi, 1997; Mueller et al., 2000).³ The fresh juice soaked by the entire plant was found to be most effective in relieving chills and fever when used in large dosage. *Artemisia's* historical usage to 'clear damp heat' associated with malaria has then been confirmed with modern pharmacology (Chen and Chen, 2004; Hsu, 2006a: 667). The clinical utility of a component and extract from the Chinese plant – artemisinin (*qinghaosu*) – has globally stimulated interest in traditional plants as potential sources of new antimalarial drugs. Artemisinin and its derivatives have a very rapid onset of action against the most virulent form of malaria, *P. falciparum*, and have been found to be the most rapidly acting of all antimalarial drugs (Haynes, 2006).⁴ As the key-ingredient in the leading treatment for malaria is an extract of an ancient medicinal plant, the (re-)discovery of *A. annua* reveals something that Dalrymple (2008:7) prospects as a "golden triangle" – an interaction between traditional medicine, modern medicine, and science. The fact, that artemisinin-based combination therapies are 'ancient' in its use and 'modern' in its formulation shows the transformation potential of the plant itself: "[...] the medical rationale for dispensing these medications has been shaped by commercial demands in ways that have worked toward transforming the formerly scholarly Chinese medical tradition [...] into a consumer-near and popular 'folk medicine'" (Hsu, 2009: 111).



Pic.1 1 Artemisia annua in Tanzania (Photo by C.M.)

The Chinese plant was transferred to other socio-cultural contexts and now plays an important role in East Africa (Heemskerck et al., 2002). In the early 1990s, *Artemisia* (as an artemisinin- rich genetic variety) was introduced in Tanzania, where experts concluded that the production of the medicine locally was a viable option in combating malaria. Due to continuously developing resistance against widely used malaria drugs in the country, the Tanzanian *Ministry of Health* has been forced to call for a shift in treatments. National health authorities then considered artemisinin-based remedies as a promising approach for addressing the disease at the primary health care level (Kachur et al., 2006; MoH, 2008). The use of *Artemisia*'s semi-synthetic medicines have widened the range of treatment in Tanzania and numerous studies have demonstrated their therapeutically potential (Yeung et al., 2004; Nosten and White, 2008).

Besides this, also the *Artemisia*-leaves become increasingly used in the treatment of malaria. Tanzania hosts a wide spectrum of researchers and stakeholders who are seeking for alternative *Artemisia* - therapies, which are efficient, inexpensive, accessible, and widely available in the country, especially for the rural population. Thus, there is no single usage but a range of treatment possibilities provided by the plant-ingredients.

As has been widely reported, pharmaceutical concerns world-wide are conducting research into this medicinal plant (Bhakuni et al., 2002; Bosman and Mendis, 2007). While there has been overloading information available on *A. annua* and its chemical derivatives, the antimalarial activity of artemisinin, the development of ACTs, agricultural, technical, and economical outcomes of the plant, considerably less has been written on its acceptance, adoption, and most important, cultural effectiveness – especially in regard to its global transfer.⁵

Following its trajectory, meaning and use, the *Artemisia* plant became my main object of research. I traced the plant into multiple sites in Tanzania, where it has been planted,

therapeutically used, and commercially produced. My research draws on ethnographic fieldwork undertaken between 2006 and 2008.⁶ During the research, special attention was given to the potential of *Artemisia* as a self-reliant treatment for malaria including local production practices followed by the possibilities for using herbal infusions from the plant leaves (Hirt 2000, 2001; Hirt et al., 2004; Hirt and Lindsey, 2006a+b; De Ridder et al., 2008: 303).⁷ The feasibility of using the traditional formulation of *Artemisia* were investigated as a more affordable and accessible option for the treatment of malaria in poor and remote areas. Challenges, advantages, and renewal were documented that people face through the introduction of this new remedy; contemporary dynamics and transformations of medical knowledge gained through *Artemisia* were also explored.

Given the fact that several actors are linked with *Artemisia annua*, multiple forms of adoption, consumption and (re-) productions of the plant exist. A number of plant-based products (such as herbal tea infusions, herbal pills or artemisinin-based pharmaceuticals) are found – depending on *who* is interested in influencing the acceptance of *Artemisia*. The classification of the plant itself is subject to change. A variety of – often conflicting – attributes such as ‘natural’, ‘traditional’, ‘modern’ or ‘commercial’ given to the plant had a strong influence on the legitimisation of treating or healing practices with *Artemisia*. Actors such as non-governmental organisations or churches – primarily the international NGO called Action for Natural Medicine (*Anamed*) – who push the application and utilisation of *Artemisia*-tea formulation based on the Chinese pharmacopeia (Willcox et al., 2009: 104) – would classify *Artemisia* as a ‘natural’ plant-based medicine (in the Swahili language *darwa ya asili*), emphasising the fact that it has been extensively studied, scientifically tested, and proven. They endorse it as an alternative to pharmaceuticals and promote it in opposition to the locally available ‘traditional medicine.’ Traditional healers, however, would consider *Artemisia* a ‘traditional’ medicine (*darwa ya kienyeji*) and incorporate it into their *materia medica*. Due to significant similarities between the Chinese variety and the indigenous *Artemisia*-plant (*Artemisia afra*), the new remedy was highly accepted among healers. Likewise, malaria patients embraced the new treatment, especially in those areas where the use of indigenous plants has always played an important role in addressing malaria (Gessler et al., 1995: 131; Maregesi et al., 2007). Other actors in Tanzania who use *Artemisia* in commercial-scale cultivation would classify the plant-based products as a European (*darwa ya kizungu*) or ‘modern’ medicine (*darwa ya kisasa*). As a consequence of different naming and marketing strategies *Artemisia* becomes a very versatile plant and occupies different niches. Several actors are pushing the proliferation of *Artemisia* and its varying products like the *Artemisia*-tea, the efficacy of which is still controversial as Willcox et. Al. (2009) points out:

“[...] There has been much debate as to whether it is appropriate to recommend the use of *A. annua* herbal teas for the treatment of malaria. At one end of the spectrum,

commercial growers of A. annua and manufactures of artemisinin have claimed that it would be 'criminal' to promote the use of A. annua teas because they contain 'sub therapeutic doses' of artemisinin, which in theory could lead to the evolution of parasites resistant to artemisinin. [...] At the other end of the spectrum, Anamed replies that it would be criminal not to provide A. annua to remote communities that do not have any other treatment of malaria. Health care infrastructure is lacking in most of the areas worst affected by malaria, making it impossible to distribute drugs to those who most need them" (Willcox et al., 2009: 107).

The discussions on the usage of *Artemisia* in this form are as divergent as local discourses on the use of an artemisinin-based pharmaceutical in Tanzania, as demonstrated in the following part of the paper.

The drug in question is called Coartem® and was designated by the Tanzanian Ministry of Health and Social Welfare as a first-line therapy nationwide. In 2005, Tanzania began the process of initiating a second treatment policy in change, which culminated in the large scale public sector deployment of artemisinin-based drugs (NMCP, 2007). Due to long-lasting price negotiations among the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFTM) and Tanzania's Ministry of Finance, the Swiss company Novartis completed drug delivery in 2006 (Novartis, 2010). Much of the procurement was subsidised and the drug almost entirely (80%) distributed through the public sector; leading to a significant shortage of artemisinin-based combination therapies in the private sector (Wolf und Derriennic, 2005:11). There is still limited availability of the drug outside the public sector and the phase of equating of supply and demand of Coartem® remains a challenge (Dalrymple, 2008: 32, 45). In 2006, among 14-19 million malaria patients, less than six million patients had access to the new drug (Freyhold, 2008:2f). In Tanzania, 40-60% of people seek treatment for malaria from private vendors, such as pharmacies (duka la dawa baridi), drug shops and general stores (Njau et al., 2008:1). As artemisinin-combination drugs are typically sold at retail prices 20-40 times those of common alternatives (such as monotherapies), restricting their uptake by consumers, particularly in rural areas (Kachur et al., 2006). As a result, most retail sector antimalarial consumers continue to use therapies for which resistance has been proven. It is widely acknowledged that access to quality treatment is insufficient in many settings. At local community level, the affordability or availability of antimalarial drugs is only a few among a number of factors influencing effective treatment. As shown in the following case study, malaria patients also struggle with unpleasant side-effects.

Tunaogopa dawa hii – we fear this medicine!

"All drugs are 'problem' drugs...What makes a drug a problem is not so much its inherent pharmacological risks, but the way in which it is used. It is impossible to talk about the 'safety' of medicines as if it was a laboratory problem. In the wrong hands or at the wrong time, even the most carefully quality-controlled

medicine becomes transformed from a life-saver to a life-threatener.”
Chetley and Gilbert (1986:3)

When I visited Jonasi Daudi⁸ in 2007, he held up, in one hand, a partially fractured packet of *darwa ya mseto*, which means ‘mixed medicine’ in the Swahili language and refers to the new antimalarial combination drug called ‘ALU’, also known as Coartem[®]. In his other hand was a set of pictures that showed remarkable skin irritations on the body of his deceased wife Bahati, a well-known woman in the outskirts of Musoma – a small town in the North-western part of Tanzania. **I got to know her as well when I stayed in the same area. I heard about Bahati’s death through the grapevine and went to find her husband to express my condolences. He shared the tragic circumstances of his wife’s death with me.** According to him, after having been tested positively for malaria, Bahati got a prescription for 24 Coartem[®]-tablets, which she was supposed to take for three days. Shortly after having ingested the first dosage, Bahati’s skin became increasingly itchy.

“My wife started to sweat, she felt miserable and expressed doubts (*mashaka*) on this medicine”, Jonasi recalled. He went on: “she thought her body would need time to get used to the new drug. But after having taken another four tablets, Bahati complained about palpitation, she had chills (*kitapo*) and her skin started to itch strongly (*ngozi yake ilianza kuwasha sana*). My wife’s started to develop blisters (*ngozi yake ilianza kutoa malenge lenge*) and it felt like burning fire (*ngozi yake ilibisi kama ime chomwa na moto*). When she started to scratch her skin, it began to peel off (*ngozi yake ilianza kubabuka*), first on the scalp (*ngozi ya kichwa*) and then on the entire body. Whenever my wife tried to move in her bed, the skin would stick to her *kanga*⁹ and peel off, causing her terrible pain.”

Bahati was moved to the local hospital in Musoma, but her condition got worse. Within a few days, her skin peeled off; she lost consciousness (*hakuwa amezirahi kabisa*), and collapsed. The doctors diagnosed that she developed allergic reactions caused by the tablet ingredients.¹⁰ They tried in vain to stop the skin irritations with cortisone injections and Piriton allergy tablets, but Bahati died aged 41.

In the photographs that documented her illness episode at the hospital, Bahati looked so blemished and deformed; I could hardly recognise the strong and portly woman I used to know. The pictures gave an insight into the extent of her suffering. Her sudden death not only shocked people in her community, but provided a basis for long lasting rumours about the medicine she had been prescribed. Bahati’s widower, family members, friends, and neighbours believed the side-effects (*madhara*) of the new drug to be the cause of her death. Discussions started on Bahati’s usage of a ‘bad medicine’ (*darwa mbaya sana*) and the complications she faced. Candidly expressed statements such as: “this medicine causes allergic reactions” (*madhara ya darwa*) or: “we fear this medicine” (Sw: *tunaogopa darwa hii*) contributed to the doubts in the Musoma community about the drug.

As issue became more public and ‘hot’, Jonasi Daudi was impressed upon by the hospital by the hospital *not* to regard the death of his wife as a consequence of her consumption of Coartem®. When I met Jonasi a few weeks later, he would insist his wife must have been poisoned by one of her family members (“*mtu fulani alikuwa amempa sumu*”) and the link to the drug was never mentioned again. Other family members of Bahati confirmed that her illness episode now was meant to be kept a secret (“*ilipangwa kutunzwa kama siri*”).

I was aware that the identification and evaluation of pharmaco-therapeutic side effects is mediated through social and cultural constructs (Etkin, 1988; Kamat, 2009). Yet, I decided to direct my attention to the dynamics of drug distribution and marketing in order to find out who might benefit or lose out from a negative message being spread about the pharmaceutical product Coartem®. The incidents and reactions of people in my immediate environment gave fuel to my growing concern. An ongoing discourse emerged as numerous other patients expressed their doubts and resistance to Coartem®. Mostly common were local terminologies referring to a “loss of strength” (literary: *nguvu inashuka*), such as “Coartem® tires you” or “causes extreme exhaustion” (ALU *inachokesha sana*). Similar to Bahati’s case, also other patients reported of having had strong physical reactions they believed were caused by the medicine in question. Among them were general skin irritations (*tatizo la ngozi*): “it results in mouth ulcers and rashes on the body” (*inaleta vipole mdomini mapele mwilini*) or “there is itching all over the body” (*kuwasha washa*). Those statements remained harmless in comparison to local perceptions on ALU such as “people lose their lives” (Sw: *watu wanapoteza maisha*) or “it kills” (Sw: *inaua kabisa*), that circulated only a year after the new drug was implemented in Tanzania.

My investigations into the use of Coartem® among medical authorities raised my awareness of the economic interests at play behind the scenes. It became obvious that the questioning of a highly promoted and promising medicine was almost impossible. The medical staff at the hospital in Musoma retracted their earlier statement on ALU side effects; and the Tanzanian *Ministry of Health* as well as representatives of the *National Malaria Control Programme* claimed that no serious side effects ever occurred since the introduction of the drug. A veil of ignorance and silence seemed to have descended on the case of Bahati and other patients, contributing to my understanding of how delicate research about medicines can be. The lack of transparency around the handling and control of Coartem® further supported this perspective. I merely witnessed people’s reactions to taking the drug and how their voices were ignored or silenced.

As I am aware of the subjectively perceived efficacy of medicines, my paper does *not* seek to prove whether this medicine can be harmful or not. My focus is on the question of how policymakers use claims about safety in order to secure their control over the discourse on antimalarial treatment and maintain a monopoly over its production. To do

so – by using its biography – I will briefly describe the processing of the *Artemisia* plant into a pharmaceutical drug in the following section. My discussion here leads to one of the key points in the paper: that medicines are powerful technical devices and cultural symbols, which can acquire ‘a life of their own’ in society. As vehicles of ideology and perceived sources of efficacy, they impact peoples’ thoughts and actions and influence their life (Van der Geest, Whyte, and Hardon, 1996).

The social life of a medicine: the rise to prominence of *Artemisia annua* L.

Van der Geest, Whyte, and Hardon (ibid: 156ff) used a popular anthropological metaphor to capture the social and cultural dimensions of medicines: Appadurai’s concept of “*Social life of Things*” (1986:57). Studies in medical anthropology illustrate pharmaceuticals as social and cultural phenomena by following their ‘life cycle’ from production, marketing, distribution, purchasing, consumption, and finally their efficacy. Each life stage is characterised by a specific context and particular actors; it has a “regime of values” expressed in distinctive sets of ideas about medicines. This concept also applies for the social life of the Chinese medical drug *qinghao* as particular actors are involved in every step of the drug-production chain – from seed planting to the processing of artemisinin, to manufacturing and distribution of the finished pharmaceutical:



Pic.1 2*Artemisia annua* from the Chinese *materia medica* (by Willcox et al., 2004: 103)

Within the production and marketing phase, the primary social actors were Chinese scientists, health authorities, and international pharmaceutical companies. One of the main biographical marking points of the drug was its ‘re-discovery’ in China. The transformation of the plant to a highly demanded commodity was part of a complex

historical process that began with the systematic screening of the Chinese *materia medica* to discover new drugs with antimalarial property. In 1972, the plant constituent artemisinin was isolated and subsequently identified as a sesquiterpene-lactone found to be effective against malarial parasites (Klayman, 1985; Bökemeier, 2006; Hsu, 2006a). Since then, the chemistry of the compound, the pharmacology, and the clinical applications of artemisinin and its synthetic derivatives have been widely explored and analysed (Bilia et al., 2002). In fact, they became the most potent and rapidly acting anti-malarial drugs ever discovered (White, 2008:332; Willcox, 2009:103) – results, that marked a starting point for pharmaceutical industries to hunt, commercialise, and patent the plant-based derivatives.



Pic.1 3 Commercial *Artemisia*-plantation in East Africa (Photo by C.M.)

Another prerequisite to transform the *Artemisia* plant was the development of a genetic variation as it is recognised that artemisinin content is affected by geographic and seasonal variations, growing conditions and plant breeding (Hirt, 2001; Laughin et al., 2002; Liu et al., 2006). For this reason, the science of agricultural cultivation of *Artemisia* to maximise artemisinin yields became well-developed. The company Médiplant Switzerland produced an exceptionally high yield of artemisinin, the hybrid Artemis, one of the best genetic varieties for lower latitudes to successfully achieve commercial exploitation of *Artemisia* in tropical countries such as Tanzania (De Ridder et al., 2008: 305).

Furthermore, pharmacological and clinical evidence was needed to commercialise *Artemisia*-plant based derivatives. The World Health Organisation as a powerful authority provides leadership on global health matters; articulates evidence-based policy options, monitors, and assesses health trends. By 2001, WHO had officially recommended

artemisinin-based combination therapies as the anti-malarial of first choice, preferably the drug Coartem® produced by the Swiss company Novartis, who holds the patent to the drug (Dalrymple, 2008:12). In a unique collaboration WHO and Novartis constructed special claims about the safety and effectiveness of this medicine which are used to justify its registration and marketing. In addition to its efficacy, safety and tolerance profile, Coartem® is expected to “increase the likelihood of patient compliance with the drug regimen” (WHO, 2001: 15, 23).

Although several other *artemisinin*-containing compounds have been registered, in Tanzania no fewer than 31, Coartem® became the leading therapy and a mainstay for malaria treatment worldwide (Kachur et al., 2006: 2; Dalrymple, 2008: 13). The number of developing countries adopting the combination-drug as the first-line treatment for *P. falciparum* has grown significantly, reaching a total of 77 by 2008 (WHO, 2008:16). While a number of firms are known to produce artemisinin-based monotherapies, the ranks of those producing ACTs have been more limited: at the international level, Novartis has been the major source (Dalrymple 2008: 17). As Novartis is the sole pharmaceutical company that manufactures *this* combination drug, and as it has been internationally criticised, it has had a long-time monopoly on its production (MSF, 2004). Through an international partnership, WHO and Novartis claim to achieve cure rates of over 96% and confirm that their products are wholesome and effective. Such established scientific claims boost the production of Coartem® in international competition.

Future demand for Coartem® is anticipated 100 million treatments per annum (Novartis, 2010).¹¹ In order to produce these quantities, immense volumes of raw material extracted from *Artemisia* are required. As the leading global supplier, Novartis has established an industrial partnership with the holding company Advanced Bio-Extracts Ltd (ABE), now Botanical Extracts Ltd (BEEPZ), to significantly increase agricultural cultivation of *Artemisia* and extraction of artemisinin. Together with their subsidiaries East African Botanicals (EAB) in Kenya/ Uganda and African Artemisia Ltd in Tanzania, around 1,700 ha *Artemisia*-plants have been cultivated in 2008 (Cuttler, 2008).¹² Although Novartis claims to improve local economies in East Africa by producing the raw material there, the profit for local actors in Tanzania is relatively poor. Access to technology of artemisinin-extraction methods is highly controlled. As *Artemisinin*-based monotherapies are explicitly discouraged and forbidden, local pharmaceutical companies are no longer involved in manufacturing the medicine in tablet form. Furthermore, (small-scale) farmers – who play an important role in the production chain of Coartem® – experience a strong discrepancy between production volume and their compensation for it. In Tanzania, up to 4,700 farmers are involved in the *Artemisia*-production (TechnoServe, 2005). But due to a high price fluctuation of the commodity artemisinin, the production-marketing chain got affected – sufferers being mainly farm producers of *Artemisia*, who received low prices (see also Dalrymple 2008: 46), or experienced total loss of income as it was the case in 2007.¹³ Moreover, knowledge on

the *Artemisia*-plant is retained, respectively wrongly handed on *Artemisia*-growers. The fact that some farmers were taught to cultivate an insecticide (*dawa ya kuua wadudu*), rather than a medicinal plant, and the fact that they are provided with protection clothes for harvesting process to avoid contamination with what they are told is poison (*-enye sumu*), indicates a powerful control and governance of knowledge on the plant. Those results are leading to a reasonable suspicion that the personal usage of the plant-leaves may be systematically suppressed.



**Pic.1 4 Three month-old *Artemisia*-field, commercial cultivation
(Photo by C.M.)**



Pic.1 5 Small-scale farmer cultivating *A. annua* (Photo by C.M.)



Pic.1 6 *Artemisia*-raw material ready for crude extraction (Photo by C.M.)



Pic.1 7 Coartem® in a Tanzanian health facility (Photo by C.M.)

As briefly described, many steps are needed to transform *A. annua* from a medicinal herb to a registered medication. After a medicine has come into the hands of a consumer, it reaches the final stage of its life-cycle: the pharmaceutical efficacy is its ultimate and decisive life stage. It is one thing to demonstrate the clinical efficacy of antimalarials in controlled environments, and quite another thing to ensure their effectiveness when they are deployed under 'real-life conditions' (Amin et al., 2004; Yeung and White, 2005: 121). As Kamat (2009: 301) rightly states, at a time when the literature on drug resistance and the pharmacological efficacy of antimalarials is growing, the relative lack of attention to social and cultural aspects of their effectiveness is a cause for serious concern.

"If the full benefits of ACT [Artemisinin-Combined-Therapy] are to be realized in Africa, then international donors and African governments must continue to actively tackle the broader political, social, economic, legal, and cultural challenges to successful implementation. Rather than only focusing on efficacy, it is time to emphasize these contextual factors that affect programme effectiveness. Having a better understanding of these influences on malaria treatment policy formulation and implementation, and applying this understanding to improving health service delivery, should facilitate the provision of effective malaria therapy in Africa." Durrheim and Williams (2005: 178)

Ethnographic studies of cultural perceptions of antimalarials provide useful perspectives not only on how people negotiate the identity of a febrile illness, but how to understand and interpret the efficacy of existing antimalarials (Kamat 2009: 293). Numerous studies in medical anthropology have argued that efficacy is embedded in culturally specific expectations of the healing process, and that it has biological *and* behavioural dimensions, both of which are equally important (Nichter 1992; Whyte et al., 2002).¹⁴ Anthropologists look at medicines as social and cultural phenomena. They do not overlook their therapeutic function, but want to draw attention to aspects that usually *are* overlooked: their social, cultural, economic, religious and emotional effects. Medicines are a good example of valuable things that assume a wide variety of meanings, far beyond their material (chemical) properties. In the social lives of medicines, themes such as power and inequality, belief, economic rationality and globalisation merge (Van der Geest and Hardon, 2006: 1, 4).

Conclusions

"Given the fact, that medicines are not mere things but are socially and culturally constituted artefacts anchored in both local and global histories, medicines come to reflect, and also shape, any changes in societies and cultures in which they circulate. They tell not merely reflective stories to be interpreted but are themselves active players in a field

that situates people of particular times and places within wider global trends" (Hsu, 2009: 112).

There have been more clinical trials on artemisinin and its derivatives – as monotherapies and fixed combinations – than with *any other* antimalarial drugs (Yeung and White, 2005: 121). As argued in this paper, the total drug effect of Coartem® – usually documented with observed treatment in randomised controlled trials – is not only formed by medical results, but rather based on different pillars. Discourses surrounding antimalarials remain a dominant framework for the judging and evaluation of their effectiveness on a community level. The perceived effectiveness is often dependent on several aspects, including community awareness, prescribed drug policy, shifts in national policy on (newly) recommended antimalarials, as well as the complex configuration of the local medicine market. Such factors contribute to the acceptance or rejection of medicines. Experiences and rumours about Coartem® side effects, such as the incident described earlier had a particular influence on people's acceptance of the drug. As it was the case with the first fixed combination-therapies (such as sulphadoxine-pyrimethamine), perceptions of Coartem®'s efficacy were reflected in statements about the calls made by policy makers to regularly replace antimalarials, which were negatively interpreted (see Mubyazi et al., 2005; Kamat, 2009: 294). Access and cost (Wolf and Derriennic, 2005) were additional crucial components of the drug's reception. Assumptions about Coartem®'s efficacy was closely tied to the perceived costs of the malaria episode.

In addition are considerable logistical costs (Njau et al., 2008). The high cost of Coartem® has been a fundamental obstacle to implementing changes in malaria protocols as it maintains a dependence on bilateral assistance and multilateral subsidy programs, detracting from more sustainable solutions (Dalrymple 2008: 37, 45). Another set of problems involves the fake and/or sub-standard artemisinin-drugs (Willcox et al., 2004: 3; Dalrymple, 2008: 24). As patients are supposed to ingest four Coartem® tablets twice a day for three days, adherence remains another challenge. Even if the correct regimen is received, there is concern that patients will not adhere to the recommended drug schedule, resulting in treatment failure and encouraging the development of drug resistance (Yeung and White, 2005:121ff). In summary, levels of use were generally low as widespread public-sector deployment of *artemisinin*-containing drugs has been constrained by their relatively high cost and limited global supply, access, as well as some lingering concerns about safety (Mutabingwa 2005: 307; Kachur et al., 2006: 2; Dalrymple, 2008: 7).

As Yeung and White (2005: 133) emphasise, "there has been considerable interest and concern in translating antimalarial efficacy into effectiveness, when drugs are taken unsupervised in 'real-life' settings in malaria-affected communities." The importance of understanding of how those medicines are used in the community, and how their use might be improved, have been conceived and reflected in numerous studies.

Nevertheless, malaria has a serious impact on health and economic welfare in the tropical world.

This paper lends itself to the concerns about questions of safety and efficacy from a biomedical view, and their limitations from an anthropological view. It argues that there is no singular, universal perception of (curative) effectiveness, as efficacy must be viewed as something that is essentially negotiated (Waldram, 2000:603). A lot more is at stake in malaria control than the rolling out of highly subsidised ACTs. Integrating knowledge of practices surrounding consumption of preferred antimalarial treatment possibilities can be immensely valuable in improving the effectiveness of malaria control interventions (see also Kamat and Nyato, 2010:8). By taking a closer look at the production and supply-chain of Coartem[®], and by exploring alternative ways for patients to become independent in malaria treatment (through the whole plant leaves as a first-line home treatment), I have come to deeply question the overall effectiveness of its use and critically reveal the production of evidence as shaped by influential actors. No policymaker can afford to overlook the complexity of medicines or the way in which they impinge on the quality of provision and use. As I tried to show, power is exerted for financial *and* social benefit, as influential actors claim to be philanthropists. Coartem[®] is claimed as the hard core of good health care but in its singular manifestation it has blocked progress for other possibilities of how to consume this helpful remedy.

The aim of any effective malaria management strategy is supposed to provide a simple and inexpensive treatment that can be applied effectively in most settings (De Ridder et al., 2008: 303). A significant proportion of Tanzanians cannot easily access basic health facilities because of geographical or economic barriers, even though they recognise their illness as malaria. The inadequacies of health services – inequitable distribution, high costs, or inaccessibility – and the high burden of malaria in rural communities are among the major reasons for patients' interest in self-treatment. The simple herbal infusion of *A. annua* is an inexpensive, first-line home-treatment in areas with limited medical facilities. It rapidly reduces malarial parasites and symptomatic signs of malaria in areas with multi-drug resistance to orthodox malarial treatments and can therewith reduce the morbidity and mortality associated with severe malaria occurring through delayed treatment. Furthermore, through the suffering of fewer bouts of malaria it will allow communities to be more economically productive as the impact of the *Artemisia* introduction goes beyond medical improvements. As Elisabeth Hsu (2006: 669) argues, *Artemisia's* importance for the future of medicine may not lie so much in its effectiveness as a modern pharmaceutical but in its potential to revolutionise the organisation of antimalarial healthcare in those areas where malaria is endemic and the *Artemisia* plant could be widely accessible.

Notes

Endnotes

- 1 Malaria accounts for 30% of the national disease burden, 43% of under-five outpatient attendance, 35% of under-five hospital admissions and 37% of under-five hospital deaths (NACP 2008).
- 2 The genus *Artemisia* comprises more than 400 species, most of them having an aromatic and bitter taste. Botanically, *Artemisia* is a vigorous weedy annual which is single-stemmed and ranges in height from one to three metres. As a member of the Asteraceae family, the genus is native to China. Now widespread, being found in Vietnam, Russia, Japan, North and South America, and South Africa and cultivated in East Africa for the pharmaceutical industry (Willcox et al., 2004: 43; Dalrymple, 2008:14).
- 3 First documented in “*Prescriptions for Fifty-two ailments*” existing from the Han Dynasty of 168 BC; *A. annua* was described as a treatment of hemorrhoids. Later in 340 AD, Ge Hong, author of the “*Handbook of Prescriptions for Emergency Treatment*” described the herbal infusion as an effective treatment of intermittent fevers. In the 16th century, Li Shizhen, writer of the “*Classified Materia Medica*”, stated that *A. annua* was a remedy for malaria associated with fevers and chills. The Traditional Chinese Medicine recognised *Artemisia* as having cold and cooling properties useful in relieving heat syndromes (fevers) with a detoxicant effect (Yu and Zhong, 2002; Hsu, 2006: 667ff).
- 4 Because artemisinin itself has physical properties such as poor bioavailability that limit its effectiveness, semi-synthetic derivatives of artemisinin have been developed. The primary derivative is dihydroartemisinin. Three others are drawn from it: artesunate, artemether, and arteether (Hien and White, 1993). The new derivative named artemisone was recently developed (Haynes et al., 2006). Due to the very short half-life of artemisinin derivatives, their use as monotherapy requires a multiple dose regimen of seven days duration. It is assumed that the combination with a longer half-life ‘partner’ antimalarial drug allows a reduction in the duration of artemisinin treatment, while at the same time reducing the likelihood of resistance development to the partner drug.

The most common ACT-treatment is Coartem[®] (artemether-lumefantrine, AL); other combinations are artesunate-mefloquine (AS+MQ), artesunate-amodiaquine (AS+AQ), and artesunate-sulphadoxine-pyrimethamine (AL+SP) (WHO, 2001b; Bekanis, 2004). For a comprehensive review of ACT formulations see Nosten and White, 2007 and Dalrymple, 2008: 19).

- 5 Exceptions are the anthropological studies provided by Elisabeth Hsu (1999; 2001; 2002; 2006a+b; 2009).
- 6 Results are based on 14 months of fieldwork. Research methods included participant observation, semi-structured, open-ended interviews, expert interviews, group discussions, as well as my involvement in various community projects that promote the use of *Artemisia* at household-level. I conducted qualitative interviews with *Artemisia*-consumers (41 patients, Malaria and HIV/Aids), staff members of Action for Natural Medicine (*Anamed*) (14), medical (including Chinese) practitioners using *Artemisia*-products (10), traditional healers (9), church leaders (8), local NGOs promoting *Artemisia* (6), national representatives such as WHO, NIMR, COSTECH, ITM, MoH, TFDA, TPI, UDSM (15), artemisinin producers such as BEEPZ, AA Ltd, TechnoServe (4), small-scale and commercial *Artemisia*-farmer (8). Regions involved: Mara, Mwanza, Tanga, Arusha, Iringa, Dar es Salaam, Kenya (Athi River).
- 7 Supporter of the *Artemisia*-tea believe in its synergistic activity as found in the whole plant extracts. *Artemisia* contains different classes of compounds. At least 28 monoterpenes, 30 sesquiterpenes, 12 triterpenoids and steroids, 36 flavonoids, 7 coumarins, 4 aromatic, and 9 aliphatic compounds. Several of these have antimalarial activity; the most active being the sesquiterpene lactone artemisinin. As *Artemisia*'s antimalarial activity is attributable to a complex mixture of constituents, it is believed that the application of the whole-leaf *Artemisia* tea makes the development of the resistance less probable compared to a single agent as found in its chemical derivatives (see Willcox et al., 2004:51; Willcox et al., 2009: 103f).
- 8 All names used in this paper are synonyms.
- 9 Piece of printed cotton fabric.
- 10 Possible side-effects that are listed for Coartem® are signs of an allergic reaction such as: exanthema, hives, difficulty breathing, and swelling of the face, lips, tongue, or throat. Other side-effects are: worsening malaria symptoms, dizziness, fainting, fast or pounding heartbeat, severe or uncontrolled vomiting or diarrhea, stomach pain, dark urine, clay-colored stools, jaundice (yellowing of the skin or eyes), weakness, mild headache, joint or muscle pain, and insomnia. See: [<http://www.zct-berlin.de/neueinfuehrungen/arthemeter.html>]; [<http://www.rxlist.com/coartem-drug-patient.htm#sideeffects>]. Accessed: 15.2.2009.
- 11 Details for demand and supply of ACTs are given by Dalrymple, 2008: 13ff.
- 12 An extraction facility in Kenya (Athi River) carries out both crude extraction and purification of artemisinin. It is designed to process up to 4 000 tons of *Artemisia*-leaves, to purify up to 60 tons of crude artemisinin, and to produce

20 tons of pure artemisinin per year (Haynes et al., 2006; Dalrymple, 2008: 18).

- ¹³ Results are based on personal communication with small-scale and commercial *Artemisia*-farmer in Tanzania's northern plantations.
- ¹⁴ For a more comprehensive (and critical) examination of how 'efficacy' has been conceived in medical anthropology, see for example (Etkin, 1988:300f), (Nichter, 1992:226), and (Waldrum, 2000:603ff).

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