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Endangered sustainable innovation: Indigenous milk hygiene and preservation techniques by Maasai too valuable to lose

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Key words: Maasai; milk hygiene; pastoralist; plants; smoke

Abstract

The indigenous Parakuyo Maasai communities of Tanzania are traditional pastoralists who depend on fresh cow's milk as a staple food. However, the arid climate and a lack of clean water challenge milk production and conventional milk hygiene practices.

By conducting informational interviews in eight Parakuyo Maasai regions and 13 districts of Tanzania we sought to identify the key indigenous plants preferred and establish their traditional manner of use. A semi-structured questionnaire was designed to: (i) determine the plants used, (ii) the parts used, (iii) methods of preparation and utensil smoking, (iv) therapeutic applications and associated health benefits of these plants, and (v) alternative uses; that may suggest why they are used and preferred.

Twenty plants were identified as being the most valuable, comprising predominantly hard wood trees and shrubs with strong aromas and astringent tastes suggestive of a role played by secondary metabolites. The most frequently mentioned plants, in order of preference, were: *Zanthoxylum chalybeum* (prickly ash; overall preference 26.6 %), *Olea europaea* subsp. *africana* (African wild olive; 11.9 %), *Combretum molle* (velvet bush willow; 11.4 %), *Cordia ovalis/monoica* (satin saucer berry; 9.5 %) and *C. sinensis* (oldoroko; 7.3 %). Many of these plants are also used medicinally by these pastoralists for a variety of infectious diseases, suggesting possible antimicrobial properties. Plant choices also tended to vary by local geography and the purpose to which the calabashes were assigned, e.g. old or new calabashes and milk stored for children or mothers. Nevertheless, the expertise of selecting these plants and their innovative applications is transmitted solely by the oral tradition.

Further, climatic change is adversely affecting herbaceous habitats in these regions and inter-tribal territorial strife and land-grabs necessitate that the pastoralists remain nomadic. Unless we document and attempt to understand this old indigenous and sustainable hygiene know-how, it may be too late.

Introduction

The Maasai are an ethnic group of Nilotic, semi-nomadic people who inhabit southern Kenya and parts of Tanzania. The total Maasai population is 1.6 million, comprising 800,000 in Tanzania and 841,000 in Kenya (Spear and Waller 1993). They stem from Loikop pastoralists who originally migrated from southern Sudan into the East African Rift Valley and developed a specialized form of pastoralism and an age-set social system. The term *Maasai* refers to "one who speaks the Maa language", a member of the East Nilotic branch of the Nilo-Saharan language family (Ehret 1984). Indigenous Tanzanian Maasai communities farm cattle and have adapted to fresh cow's milk as a staple food (Schoder et al. 2013). They intimately relate to their environment and depend directly on nature for basics, such as firewood, construction materials, weapons and water for themselves and their livestock. However, the hot, arid climate and scarcity of clean drinking water challenges milk production and precludes conventional milk hygiene practices. Instead, the Maasai store milk in hollowed-out, naturally occurring calabashes made from *Lagenaria siceraria* (bottle gourd), which they sanitize with smoke from burning plants. Remarkably these practices safeguard their milk, despite high temperatures. The hygiene know-how is transmitted across generations in the oral tradition. However, as more and more of the younger generation is moving to the cities, the expertise is endangered. Further, cross-culture integration, milk commercialization, climate change and political pressure to vacate land and move to other habitats pose serious challenges to the continuity of the skill (Goldman 2013). While it is intriguing that smoke treatment protects milk without the need for clean water, little has been written about the details or the plants employed. As increasing demands are placed upon the pastoralists' habitats and unique way of life, it is important to record the plant species used, which may be endangered, and to discover more about alternative milk hygiene practices in extreme environments. We sought to learn more about this sustainable innovation using local plants by querying the pastoralists themselves.

Methods and Study Site

Study area

Tanzania has a total land area of 945,000 km². Only 100,000 km² (9.5 %) are arable, of which 51,000 km² (4.8 % of total land area) are cultivated. The residual area is almost exclusively used for livestock grazing under extensive pastoral and agro-pastoral systems (The Tanzania Government Portal 2013). The study area falls within the Maasai homeland, with latitudes from 01°00' to 08°15'S and longitudes from 34°45' to 38°15'E. It comprises the following eight regions and 13 districts: Arusha region (Monduli and Ngorongoro districts), Iringa region (Iringa rural district); Kilimanjaro region (same district); Manyara region (Kiteto and Simanjiro districts); Morogoro region (Kilosa and Mvomero districts); Mbeya region (Mbarali district); Pwani region (Bagamoyo district) and Tanga region (Handeni, Kilindi and Lushoto districts). A total of 24 Maasai villages were visited. The study area covers 13,486 km², of which 8,141 km² (60.3 %) are plains. The major mountainous territories include the Eastern Arc Mountains, namely the East and West Usambara and the Nguu Mountains (Tanga region); the North and South Pare Mountains (Kilimanjaro region); the Nguru, Uluguru, Ukaguru, Udzungwa, Malundwe, Mahenge and Rubeho Mountains (Morogoro region); and the Udzungwa Mountains (Iringa region), covering a total area of approximately 5,350 km², or about 39 % of the total land in the study area (UNESCO 2016). The altitude of the study area (excluding mountain peaks) ranges from 267.3 m in Lugoba village (Pwani region) to 2,184 m in Enguserosambu village (Ngorongoro district, Arusha region; DAFT LOGIC 2016). The climate varies greatly within Tanzania. According to metrological data, the distribution of rainfall in the project area is both unimodal (central parts of the study area comprising the Manyara region) and bimodal (northern parts and coastal areas, comprising the Arusha, Kilimanjaro, Tanga and Pwani regions). In the areas of unimodal rainfall, the rainy season extends from December to April with peak rainfall during March and April (188.5 mm), whereas the bimodal areas are characterized by long rains (known as *Masika* in Swahili) lasting from March to May and ranging from 140 to 255 mm, with peak rainfall in April, and short rains (known as *Vuli* in Swahili) from October to December, peaking at 125 mm in November. The maximum mean temperatures range from 23 °C to 31 °C, peaking in February, and the minimum mean temperatures range from 10 °C to 23 °C, the lowest in July (Sarwatt and Mollel 2006).

Data collection methods

Information was collected by conducting semi-structured interviews, focus group discussions, direct observations and field-walk photography. Participants were local inhabitants, of whom thirty key informants (knowledgeable elders and traditional leaders) were systematically sought on the recommendations of community members. Most of the respondents were known to the interviewer through past projects and social networks, had shown interest in this project and were open to technical advice and support. Interviews and discussions were undertaken using a checklist consisting of 20 questions prepared in English and translated into Maa and Swahili. The questionnaire was designed to (i) elicit information on the local names of the plants used for smoke-treating milk calabashes, (ii) determine the parts of the plants used, (iii) establish the methods of plant preparation and smoking, (iv) verify additional applications and associated health benefits of the plants and (v) determine any other uses in Maasai households. All interviews and discussions were performed by the first author. Responses to the questions were recorded on paper. Focus group discussions were held in each village following interviews. Participants in the group discussions (eight to twelve per group) were selected in consultation with pastoral associations and local authorities. The focus groups presented the opportunity for members to point out or describe the plants they use, to show where they grow and to demonstrate which parts are collected and exactly how they are employed. Focus discussions lasted between 45 and 90 minutes. Plant preference was determined by ranking the proportion of respondents who mentioned the plant as first, second, third or fourth preference. Field observations were performed in the presence of key informants and traditional healers. The collection of plant parts usually took one hour. In some cases where plants were not easily found, a second visit was made. If necessary, field visits to communities were repeated to secure the information over the course of the study period (Laffa et al. 2017).

Specimen collection and identification

Preliminary botanical identification was performed on-site during field walks. Investigators photographed the plants, recorded their organoleptic characteristics and collected fresh specimens, including inflorescences, leaves, bark and stems from each study area (Laffa et al. 2017). Plants were formally identified with reference to taxonomic keys of the CRC World Dictionary of Medicinal and Poisonous Plants (Quattrocchi 2012) and ethnobotanical literature (Kokwaro 1993; Hurskainen 1994; Maundu et al. 1999, 2001; Minja 1999) and with the help of personnel from the Olmotonyi Forest Training Institutes. Plant species were grouped into families together with local, English and scientific names.

Results

Plants preferred by respondents for calabash smoke treatment

A total of 120 Maasai pastoralists (68 women and 52 men) were interviewed using a semi-structured questionnaire. The informants were aged between 25 and 80 years, with a median age of 40. Twenty principal plants were identified that are used by Maasai pastoralists for smoke-treating milk calabashes.

Respondents generally claimed that plant smoke improves the keeping qualities of their milk, that milk stored in this way keeps fresh for longer and that the smoke contributes to its flavour and improves fermentation. The knob tree (*Zanthoxylum chalybeum*), also called prickly ash, ranked as a preferred plant for almost all the pastoralist communities interviewed. It was mentioned by 26.6 % of all respondents, for 58.3 % of whom it was the first choice and for 28.3 % of whom the second choice. The second preferred plant was the African wild olive (*Olea europaea* subsp. *africana*), which was the first choice of 21.7 % of respondents and had an overall preference of 11.9 %. Interestingly, the African wild olive was the first preferred plant by the Loita and Irkisongo Maasai in the Arusha and Manyara regions. The third preferred plant was the velvet bush willow (*Combretum molle*), also known by the Maasai as *Olmaroroi*. At 30.8 %, the velvet bush willow scored high for second preference and had an overall preference of 11.4 %; although it was first choice for only 4.2 % of respondents. The fourth preferred plant was the satin saucer berry (*Cordia ovalis/ Cordia monoica*) with an overall preference of 9.5 % and a first preference of 4.2 %. The fifth preferred plant was *Oldoroko* – greyleaved saucer berry (*Cordia sinensis*), with the same first preference of 4.2 %, a higher second preference of 15 % but an overall preference of only 7.3 %. Whereas some plants are preferred in particular regions, they may be considered mere substitutes in other locations. Some plants are used solely by niche communities, notably *Esitati* (*Grewia bicolor*), which is used for calabashes by the Irkisongo Maasai in Kiteto but is renowned for making herding sticks by all the Maasai communities (Laffa et al. 2017).

Respondents recounted that when they explore new habitats they continuously search for and recruit candidate plants for calabashes, especially when previous favourites are scarce or no longer available. An example is *Olerehaki* (*Monotes africanus*), the name being the Maasai word for “the newly found”. This plant was recently recruited for smoke-treating milk calabashes by the Irkisongo and Parakuyo Maasai pastoralists in the Kiteto district. Respondents also indicated that different plants can be used to treat new and used calabashes, or calabashes intended for specific genders or age groups. For example, milk calabashes for children and nursing/lactating women are commonly treated with African wild olive, in the case of the Loita Maasai, or Knob tree, in the case of the Parakuyo Maasai. Generally, the pastoralists reported that their favoured plants have very hard wood, strong aromas and astringent tastes. Apart from its use for smoking calabashes, the wood is also used for construction, as firewood and medicinally (Laffa et al. 2017).

The plants identified during the study are highly valued for other purposes. The African wild olive (*Olea europaea* ssp. *africana*), for instance, has broad therapeutic applications. The smoke is highly valued and its therapeutic indications include respiratory and gastrointestinal disorders. Smoketreated milk is recommended for pregnant and nursing women, where it is believed to promote milk production and the general health of both mothers and babies. Respondents also reported that it is customary for Maasai women in Enguserosambu village to collect olive firewood for burning in their huts for health reasons during their first postnatal month. The roots are also used as an important constituent of a soup consumed during a male-only ritual cleansing or *Orpuli* ceremony, a meat-feasting ritual lasting several weeks. During these ceremonies, roots of the African wild olive and other plants are boiled with meat and consumed for general body fitness (Laffa et al. 2017).

Discussion [Conclusions/Implications]

Maasai pastoralists use twenty plant species to smoke-treat milk storage calabashes and they claim this procedure enhances milk life and improves its physicochemical properties and sensory appeal. These plants are preferred and when they are not available pastoralists continually search for others. Maasai communities in Tanzania prefer knob wood, African wild olive and velvet bush willow in this order. These and other plants used frequently have other beneficial uses that have been substantiated by ethnobotanists. Applications apart from milk hygiene include treatments for infectious diseases, which make the plants valuable, renewable resources, so their habitats should be protected.

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