‘Teeth as black as a bumble bee’s wings’: The ethnobotany of teeth blackening in Southeast Asia

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Research

Abstract

This study presents a comparative perspective on the ethnobotanical resources utilized in teeth blackening, which was formerly an important life cycle event across Southeast Asia. Based on records from the seventeenth century to the present, we identified over 60 plant species hat were used for this practice in three distinct categories: as masticants, burn products and compound dyes. Different ethnolinguistic groups typically chose not more than a few locally available plant species as teeth blackeners. The mastication of the vine *Epipremnum pinnatum* (L.) Engl. or the fruit and root of *Paederia foetida* L. as well as the application of dry distilled oil of coconut shells were among the methods most widely applied by speakers belonging to different linguistic families. The occasional involvement of non-native plant species, such as *Nicotiana tabacum* L. or *Psidium guajava* L., demonstrates how the practice adapted over time. Betel chewing, though frequently confused with teeth blackening, was a distinct custom, but both intersected in their geographic scopes, use patterns and cultural ascriptions. Assessment of the medicinal qualities of some of the teeth blackeners suggests that the practice might also have had an ethnopharmacological dimension.

Introduction

The purposeful coloring of one’s teeth, typically from around the time of puberty, is a custom of remarkable time depth documented in societies from around the world. Such dyeing of all or just the visible surfaces of the teeth became known as ‘teeth blackening’ (Figures 1 & 2). Together with the extraction, filing and metal decorations of teeth, the process of teeth blackening was considered yet another form of dental ‘mutilation’ (Milner & Larsen 1991, Reid 1988, Romero 1970, Tayles 1996). Compared with other, visually more spectacular adornments of the body, like tattoos or penis decorations, far less information has come to light on teeth blackening. This is surprising since the practice occupied an important place in many cultures, especially across island and mainland Southeast Asia.

The oldest teeth with stains identified in Southeast Asia belong to the skeletal remains of an approximately 4500 year old Neolithic burial in the Duyong Cave on the west coast of Palawan Island, Philippines (Fox 1970), though neither the botanical source nor the cultural context of these colorations has been explained with any certainty. In early written accounts of the colonial period by Europeans confronted with blackened teeth, one typically finds a discourse slanted towards the perceived repulsiveness of the practice. In addition, the custom of betel chewing, which resulted in incidentally stained teeth, was frequently confused with teeth blackening and continues to be so up to this date. An academic debate about the existence of a teeth blackening tradition separate from betel chewing, lasted into the early twentieth century (Holbe 1908, Meyer 1883). These factors stifled the exploration of the methods and motivations underlying the purposeful dyeing of teeth at a time when it was still widely practiced.

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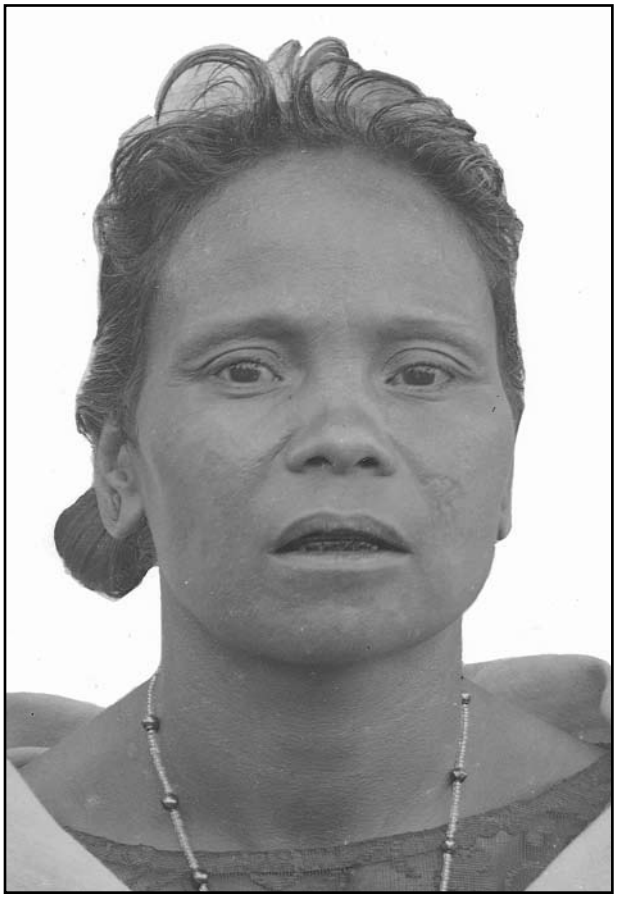

Figure 1. Bukidnon woman with blackened teeth from the mountain province of the same name in Northern Mindanao (Philippines). This staged photograph was taken in 1909 by Dean Worcester, Secretary of the Interior, during the American administration of the Philippines.

Figure 2. Ann woman from near Kengtung (Kyaing Tong), in the eastern corner of Shan State, Myanmar (2008). Among Ann people black teeth are traditionally complemented by dark clothing.

Consequently, the first details to emerge in European journals of how, e.g., the ethnic majority of Viet in Vietnam accomplished the black look of their teeth were fancifully wrong, with one author suggesting a coating of 'bone black' (charred animal bones) in honey (Enjoy 1898).

Outside influences, in particular Christianization and the global propagation of a Western ideal of white teeth, have over time led to the abandonment of the practice in the great majority of indigenous societies as they experienced significant outside contact. While there are still a few communities in which it is possible to acquire first-hand knowledge of the traditional methods of teeth blackening (Zumbroich & Salvador-Amores 2009), historical sources have by now become the primary resource for the study of this custom.

This paper addresses some fundamental issues of teeth blackening by presenting a comparative perspective on the methodologies and, in particular, the ethnobotanical resources deployed in Southeast Asia. This will not only add a facet to the appreciation of how plants were productively incorporated in different cultural practices, but also answer other important questions about the custom. We will explore how the dyeing was accomplished, and whether the methods were specific or, as has been suggested, the wood of 'any' tree (Roux 1924) or that of 'some hundred or more' different kinds of plants could be utilized for teeth blackening (Wray 1893). We will also address the question of the origin of teeth blackening and potential evidence for its diffusion across Southeast Asia as well as its methodological evolution over time. Finally, knowledge of the plant material involved opens up investigations into the pharmacological properties of these plants and their possible role in the practice.

Methods

The geographical scope of this study extends to mainland and island Southeast Asia. Figure 3 indicates the locations for which data are included in this paper. Data were collected from primary sources, such as ethnographic, bo-

Figure 3. Map of Southeast Asia. The geographic scope of this study is indicated by red marks in regions for which ethnographic, botanical and lexicographic data on teeth-blackening were included.

tanical and lexicographic works of the seventeenth century to the present. Based on their descriptions, through cross-referencing or with the help of recent lexicographic publications, a number of previously unidentified plants involved in the practice were identified.

Results

The primary results are listed in Table 1.

Masticants and other simple blackening agents

Chewing a plant product with known coloring potency can be considered the simplest approach to dyeing one's teeth. Undoubtedly the one practice which most commonly contributed to darkened teeth in Asia was chewing a betel quid, typically prepared by wrapping slivers of the seed of the areca palm (*Areca catechu* L.) with slaked lime (calcium hydroxide) in a betel leaf (*Piper betle* L.) (Rooney 1993, Zumbroich 2008). The Nicobarese speaking inhabitants, especially of the Central and Southern Nicobar islands, chewed betel with such great frequency that darkened teeth with encrustations (**yēñ-kanâp**) resulted, which were considered desirable (Hamilton 1790, Man 1894). This constitutes a rare example where areca nut was the primary source of deliberate teeth blackening.

Table 1. Identified species of plants employed for teeth dyeing are listed by plant family, followed by the region of use and, if known, the ethnolinguistic group (in italics) as well as the specific method of utilization. According to the type of use of the plant material the teeth blackening methods are organized into three categories: (1) Chewing a part of the plant or simply squeezing out and applying the sap of a plant to the teeth (yellow overlay); (2) Heating a twig, stem or bark and applying the expelled substance (pink overlay); (3) Compounding a more complex dye mixture of certain plant materials and a metal salt (blue overlay).

Plant Family / Species	Region of use (ethnolinguistic group)	Method of use	Literature source
Anacardiaceae			
Dracontomelon dao Merr. & Rolfe	Laos, Vietnam (Kammu)	Wood tar from shell (endocarp) of nuts.	Tayanin & Bratthall 2006
Rhus chinensis Mill. var. *chinensis* (syn. *R. semialata* Murray)	Vietnam (Viet)	Gall nuts combined with iron sulfate as part of complex protocols.	Huard 1951, Sallet 1928
Semecarpus cuneiformis Blanco	Luzon (Isneg)	Resin from bark and pericarp.	Vanoverbergh 1972
Apocynaceae			
Parameria laevigata (Juss.) Moldenke	Perak (Malay Peninsula)	Wood tar of stem (including latex of bark?).	Burkill 1935, Wray 1893
Parameria polyneura Hook. f.			
Araceae			
Epipremnum pinnatum (L.) Engl.	Bali, Java, Luzon (Agta of Casiguran, Bikol, Tagalog), Mindoro (Hanunóo), Mindanao (Mansaka, Mandaya, Manóbo)	Stems, root, leaf sheaths chewed, sometimes with lime and areca nut.	Cole 1913, Conklin 1958, Fuentes & Cruz 1980, Garvan 1931, Garvan 1964, Headland 1977, Rumphius 1747, Zumbroich & Salvador-Amores 2009
Arecaceae			
Areca catechu L.	Southeast Asia	Seed chewed with lime and leaf of Piper betle L.	Rooney 1993, Zumbroich 2008
	Borneo (Dusun of Tuaran)	Preparation of young seed with copper sulfate.	Evans 1922
	Vietnam (Viet)	Seed enters complex preparations with iron/copper sulfate.	Sallett 1928
Cocos nucifera L.	Borneo (Dyak), Brunei, Java, Malay Peninsula, Mindanao, Sulawesi (Yakan of Basilan), Nias, Sumatra (Acehnese, Minangkabau), Thailand, Vietnam	Empyreumatic oil from dry distillation of coconut shells, sometimes rethickened or diluted.	Adriani & Kruyt 1901, Clifford & Swettenham 1894-, Gomes 1911, Hurgronje 1906, Lubère 1691, Marsden 1784, Sallett 1928, Sherfan 1976, Sokny et al. 2007, Suzuki 1959, Treacher 1889, Veth 1875, Wray 1893, Zwaan 1908

Plant Family / Species	Region of use (ethnolinguistic group)	Method of use	Literature source
Asteraceae			
Carthamus tinctorius L.	Visayas, central Philippines	Red dye from flowers.	Scott 1994
Boraginaceae			
Carmona microphylla (Lam.) G. Don	Java	Wood tar of stem.	Burg 1884-, Filet 1855
Casuarinaceae			
Casuarina equisetifolia L.	Luzon (Agta of Casiguran)	Wood tar of stem.	Vanoverbergh 1937
Clusiaceae			
Cratoxylum cochinchinense (Lour.) Bl.	Perak	Wood tar of stem.	Burkill 1935, Wray 1893
Cratoxylum formosum (Jack) Dyer	Thailand, Laos, Vietnam (Kammu)	Exuded resin of bark, wood tar of stem.	Suddhasthira et al. 2006, Tayanin & Bratthall 2006
Garcinia mangostana L.	Malay Peninsula, Sumatra (Karo Batak)	Wood tar of stem.	Wray 1893, Joustra 1901, 1907
Combretaceae			
Terminalia bellirica (Gaertn.) Roxb.	Java	'Ink' prepared from fresh fruit with iron sulfate.	Clercq 1909
Terminalia catappa L.	Batanes Islands of Philippines	Leaves roasted, mixed with clay and some sulfur.	Madrigal Lorente 1983
	Sulu (Tausug)	Leaf blade chewed, midrib dipped into coconut water in which iron has been submersed for three days (glowing iron into boiling water).	Torre 1978
Euphorbiaceae			
Agrostistachys borneensis Becc.	Borneo (Singhi and other Dyak groups)	Debarked, dried branches burnt against parang knife yields resinous oil, mixed with soot from burning dammar resin.	Beccari 1904, Boyle 1865
Aleurites moluccana (L.) Willd.	Sumba (Kodi)	'Smashed candlenut' (seed husk furnishes dye?).	Hoskins 1990
Antidesma heterophyllum Bl.	Java	Wood tar of peeled branches.	Hasskarl 1845
Antidesma tomentosum Bl.	Mindanao (Manóbo)	Ash (wood tar?) of burned bark.	Reis Altschul 1973
Croton cascarilloides Raeusch.	Laos, Vietnam (Kammu)	Wood tar of stem.	Tayanin & Bratthall 2006
Homonoia riparia Lour.	Java	Sap of leaves.	Clercq 1909
		Liquid from stem section dripped onto iron piece while other end is burned.	Hasskarl 1845
Jatropha curcas L.	Java	Reddish latex exuded from damaged parts of plant.	Filet 1855
	Sulawesi (Alfurese of Poso)	Leaves chewed (after blackening with empyreumatic oil of coconut).	Adriani & Kruyt 1905, Kruyt 1896

Plant Family / Species	Region of use (ethnolinguistic group)	Method of use	Literature source
Fabaceae			
Acacia farnesiana (L.) Willd.	Java	Fruit chewed with coconut water in which iron has been submersed.	Filet 1855, Poensen 1876
Albizia lebbeck (L.) Benth.	Java	Red gum exuding from bark.	Burg 1884-, Clercq 1909
Pithecellobium dulce (Roxb.) Benth.	Luzon (Tingguian of Abra)	Bark mixed with iron sulfate, applied overnight.	Cole 1922
Tamarindus indica L.	Java (Javanese, Sundanese), Malay Peninsula, Mindanao (Bagobo)	Wood tar of bark.	Clercq 1909, Cole 1913, Oosting 1879, Pijnappel 1875
Haloragaceae			
Gunnera macrophylla Bl.	Luzon (Kankanay)	Juice of fruit.	Vanoverbergh 1929, 1933
Icacinaceae			
Gomphandra lanceolata King	Malay Peninsula	Wood tar of stem.	Burkill 1935
Lecythidaceae			
Barringtonia spp., e.g., *Barringtonia racemosa* (L.) Spreng.	Java	Stem bark chewed with coconut water in which piece of iron has been submersed for eight days.	Hasskarl 1845
Loganiaceae			
Fagraea racemosa Jack	Perak	Wood tar of stem.	Burkill 1935, Wray 1893
Malvaceae			
Durio zibethinus Rumph. ex Murray (**nahaq** ethno-variety)	Solor Archipelago (Kédang of east Lembata)	Wood tar of branches.	Barnes 1974
Sida rhombifolia L.	Perak	Wood tar of stem.	Burkill 1935, Wray 1893
Urena lobata L.	Perak	Wood tar of stem.	Wray 1893
Melastomataceae			
Melastoma malabathricum L.	Perak	Wood tar of stem.	Wray 1893
Memecylon scutellatum (Lour.) Hook. & Arn.	Central highlands of Vietnam (Maa, Mnong, Rhade)	Wood tar of stem.	Condominas 1957, Davias-Baudrit 1965, Maurice 1993
Plethiandra beccariana (Cogn.) Merr.	Borneo (Tubao Kayan)	Juice of fleshy leaves.	Beccari 1904, Haddon & Start 1936, Ling Roth 1893
Meliaceae			
Lansium domesticum Corrêa	Perak	Wood tar of branches.	Wray 1893
Moraceae			
Artocarpus heterophylla Lam., *Artocarpus* sp.	Southeast Borneo (Malay), Luzon (Isneg)	Wood tar of stem.	Grabowsky 1884, Vanoverbergh 1972

Plant Family / Species	Region of use (ethnolinguistic group)	Method of use	Literature source
Myrtaceae			
Psidium guajava L.	Luzon (Agta of Casiguran, Bontoc, Gaddang, Kalinga, Ilongot), Mindanao (Bukidnon), Selangor (Malay Peninsula)	Wood tar of stem or bark.	Clapp 1908, Cole 1956, Galang 1941, Skeat 1900, Vanoverberg 1937, Wilson 1947, Zumbroich & Salvador-Amores 2009
	Makassar (Gowa)	Bark, young leaves chewed, teeth rubbed with coconut water in which iron submersed.	Eerdmanns 1897
Rhodamnia cinerea Jack	Perak, Selangor, Sumatra (Minangkabau)	Wood tar of stem.	Hasselt 1882, Skeat 1900, Wray 1893, Zwaan 1908
Rhodomyrtus tomentosa (Aiton) Hassk.	Southeast Borneo (Malay), Malay Peninsula, central Sumatra	Wood tar of stem.	Hasselt 1882, Skeat 1900, Wilken 1888
Olacaceae			
Strombosia philippinensis (Baill.) Rolfe (syn. *S. dubia* S. Vidal)	Luzon (Agta of Casiguran)	Wood tar of stem.	Headland 1977, Vanoverbergh 1937
Pentaphylacaceae			
Eurya acuminata DC.	Luzon (Ifugao)	Reddish resin and wood tar of stem.	Conklin 1967, Lambrecht 1978, Reis Altschul 1973
Phyllanthaceae			
Phyllanthus buxifolius (Bl.) Müll. Arg.	Java (Sundanese)	Sap of stem, leaves.	Hasskarl 1845
Phyllanthus emblica L.	Java (Sundanese)	Wood tar of stem.	Oosting 1879
Poaceae			
Schizostachyum lima (Blanco) Merr.	Mindanao (Bagobo), Mindoro (Hanunóo)	Wood tar of culm.	Cole 1913, Conklin 1958
Punicaceae			
Punica granatum L.	Sulawesi (Makassarese, Buginese), Java (Javanese, Sundanese), Madura	Pericarp of (unripe) fruit chewed while applying coconut water in which iron has been submersed.	Hasskarl 1845, Killian 1904-1905, Matthes 1859, Matthes 1874, Poensen 1876
	Vietnam (Viet)	Pericarp of fruit enters complex formulas including iron sulfate.	Huard 1951, Sallet 1928
Rhizophoraceae			
Rhizophora sp.	Southeast Borneo (Ngaju Dayak)	Wood tar of stem.	Grabowsky 1884, Hardeland 1859, Perelaer 1870, 1881

Plant Family / Species	Region of use (ethnolinguistic group)	Method of use	Literature source
Rubiaceae			
Coffea arabica L.	Luzon (Gaddang)	Wood tar of stem.	Zumbroich & Salvador-Amores 2009
Gardenia tubifera Wall. ex Roxb.	Java (Sundanese)	Wood tar of stem.	Rigg 1862
Paederia foetida L.	Batanes Islands, Mindoro, Vietnam (Tho = Tay, Lolo = Yi)	Crushed fruit.	Bonifacy 1907, Madrigal Lorente 1983, Reis Altschul 1973
	Flores (Ngadha)	Root chewed.	Arndt 1961, Verheijen 1990
Psychotria spp., e.g., Psychotria viridiflora Reinw. ex Bl.	Java (Sundanese)	Pounded bark of stem.	Burg 1884-, Hasskarl 1845
Psychotria rostrata Bl.	Malay Peninsula	Wood tar of stem.	Burkill 1935
Rothmannia macrophylla (Hook. f.) Bremek.	Malacca (Jakun)	Wood tar of stem.	Burkill 1935, Vaughan Stevens 1897, Wilkinson 1950
Rutaceae			
Citrus aurantifolia (Christm.) Swingle, *Citrus* spp.	Malay Peninsula	Soot from burning leaves.	Clifford & Swettenham 1894-, Wray 1893
	Java (Sundanese), Sumatra (Batak)	Wood tar of stem.	Brenner 1894, Guillaume 1903, Hagen 1884, Oosting 1879
Murraya paniculata (L.) Jack	Southeast Borneo	Wood tar of (peeled) stems collected on iron.	Grabowsky 1884
Solanaceae			
Nicotiana tabacum L.	Southeast Asia	Incorporated into betel quid.	Reid 1985
	Mindanao (Mandaya, Manóbo)	Quid of tobacco with juice of Epipremnum pinnatum (and lime, pot black for Manóbo).	Garvan 1931, Valderrrama 1987
	Mindanao (Mandaya, Maranao)	Tobacco soaked in orange or lime juice containing iron pieces.	Cole 1913, Madale 1997, McKaughan & Macaraya 1996, Torre 1978
	Sulawesi (Makassarese, Buginese)	Tobacco dipped in coconut water in which iron piece been submersed (with pomegranate rind).	Matthes 1859, Wilken 1888
Solanum aculeatissimum Jacq.	Java, Perak	Wood tar of stem.	Burg 1884-, Burkill 1935, Hasskarl 1845, Wray 1893
Solanum verbascifolium L.			
Symplocaceae			
Symplocos racemosa Roxb.	Malay Peninsula, Sumatra	Wood tar of stem (bark?) for blackening and shining.	Clercq 1909

Plant Family Species	Region of use (ethnolinguistic group)	Method of use	Literature source
Verbenaceae			
Clerodendrum laevifolium Bl.	Malakka	Wood tar of stem.	Ridley 1902

The first botanically identifiable teeth blackening agent other than areca nut was not described until Marcos de Lisboa's Vocabulario de la Lengua Bicol of 1609. De Lisboa observed that to blacken their teeth the Bikol speaking people of Camarines in central Luzon (Philippines) chewed **amlong**, a root hanging from trees in the forest, which resembled the nascent antlers of a deer, covered in black fur, as well as the tender heart of young **muya**, a vine attaching to the trunks of palms and other trees (Mintz 2004). Not too far away, the Tagalog living around Manila chewed a plant that was called **locmoy** in the Laguna de Bay area and **tibatib** in the mountains (San Buenaventura 1613). It turns out that all these indigenous terms referred to the same species of vine, *Epipremnum pinnatum* (L.) Engl. Later Georg Everhard Rumpf gave a description of its use for teeth blackening in Bali and Java in his seminal Herbarium Amboinense (Rumphius 1747, Figure 4). It is particularly notable that *E. pinnatum* was often chewed in combination with areca nut and lime, again testifying to the connection between betel chewing and other teeth blackening approaches.

The fruit, seeds, bark, leaves or stem of a number of other plant species were also masticated to accomplish blackening of the teeth. An example of a species popular in a number of locales across Southeast Asia, namely the Philippines, the northern highlands of Vietnam and Flores was *Paederia foetida* L. (Arndt 1961, Bonifacy 1907, Lorente 1983, Madrigal, Figure 5). Its fruit imparts a dark purplish stain when crushed and was used for teeth blackening, even though it brought, at least transitorily, a bad smell to the mouth (Latin *paedor* = filth, *foetidus* = stinking).

Figure 5. Fruit of *Paederia foetida* L. at a stage of maturation in which it might be chewed. Subsequently, the fruit dries up completely and eventually has a thin, brown pericarp.

Figure 4. *Epipremnum pinnatum* (L.) Engl. as depicted in Rumphius (1747, vol. 5, plate 183 as "*Adpendix laciniata*") "Others chew the heart [of the vine] with areca nut and lime to make the teeth brown and black, after they have previously polished them, so as to ornament themselves. This they also do with the bark of the long roots that encircle the tree just like long snakes." (Rumphius 1747 5:489; translated by the author)

In the case of *Jatropha curcas* L., the leaves were chewed or the viscous red latex that exuded from damaged portions was collected and applied with the fingers (Filet 1855, Kruyt 1896). The latter approach was also taken in a few other cases, where plants produced a sufficient flow of sap or resin. An unusual example is the black and tarry, but highly irritant sap of *Semecarpus cuneiformis* Blanco that can lead to significant injury on skin contact (Quisumbing 1951), so much so that Ilocano speaking people of Luzon (Philippines) claimed that just the air passing through the tree would poison them (Vanoverbergh 1927). Surprisingly, it was in use for the purpose of teeth blackening amongst

the small proportion of Isneg people of northern Luzon who were reportedly immune to the irritant (Vanoverbergh 1972).

Wood tar and other burn products

The use of fire frequently figured in the production of teeth blackeners, so, e.g., in its simplest form in the case of *Eurya acuminata* DC. among the Ifugao of northern Luzon. Ifugao youths held sticks of the wood into the fire to expel from the stem its reddish resin, which could then be applied to the teeth (Conklin 1967, Lambrecht 1978). In other cases the oily soot rising from the respective wood was condensed on a piece of iron, or the tarry exudate, a mixture of burn products and sap, allowed to drip onto a household iron implement from which it was then smeared on the teeth (Figure 6).

One of the most widely utilized approaches across Southeast Asia to blacken teeth employed the dried shells of coconuts. A piece of shell was set on fire and then rapidly covered up with another coconut shell half that had a hole in it. Oily smoke would escape from the hole to be condensed on a piece of iron. A black liquid, technically called empyreumatic oil of coconut, was thus collected. It was either used directly, or other ingredients like the ash of the leaf of the nipah palm (*Nypa fruticans* Wurmb.) or coconut oil were added to create the right consistency for it to be rubbed onto the teeth with a finger (Wray 1893, Zwaan 1908). The simplicity of this form of dry distillation that required no specific implements potentially speaks to its antiquity. The general abundance of coconut trees in most coastal and lowland areas made this a particularly convenient method.

The wood of a number of other fruit bearing trees was utilized to make wood tar, e.g., that of langsat and mangosteen trees in Perak, the latter also by Karo Batak of Sumatra (Joustra 1901, Wray 1893) or that of a durian variety by Kédang of Lembata, east of Flores (Barnes 1974) and of the guava tree (Galang 1941, Skeat 1900, Wilson 1947, Zumbroich & Salvador-Amores 2009). Assuming that these trees were cultivated close to habitations, ready availability was likely one of the criteria in choosing them. In some locales prepared teeth blackener was for sale, e.g., an Aceh medicine seller hawked **baja kléng**, literally 'foreign blackener'. According to the original meaning of **baja** it should have been based on a burn product, particularly of coconut shells (Hurgronje 1906), but elsewhere

Figure 6. The traditional manner of producing teeth blackener is demonstrated by a Gaddang elder in Ikkalakad, in the Cordillera Central of Luzon, Philippines in 2003. A dried piece of guava wood is lit in the fire and the exuded black tarry liquid, called **tubug**, drips onto a metal shaft, **landuc**, from which it is dabbed onto the teeth.

the dubious content of prepared blackener, which lost its color after a while, was noted (Hasskarl 1845).

Compound dyes

For a distinct group of blackening agents the underlying technology was similar to that employed in certain types of traditional fabric dyeing or ink making. Iron, or less often copper where available in urban settings, was brought into solution to act as a mordant (setting agent). This was accomplished by immersing iron scrapings or pieces of a broken tool or pot in coconut water that was sometimes made to boil and left to stand for days (Torre 1978). The acidity of the coconut water, especially after fermentation, helped to dissolve some of the iron. The solution was then combined with the part of a plant, e.g., the bark of *Pithecellobium dulce* (Roxb.) Benth. by the Tingguian of Abra in Luzon (Cole 1922), to create a dye. Often the botanical agent, such as pomegranate rind, was chewed, while the iron containing solution was rubbed onto the teeth where the dye then developed.

The most sophisticated approaches to teeth blackening were created by Viet people in Vietnam where particularly the practitioners of Hué and their products were held in high esteem. Achieving the desired black appearance of teeth had evolved into a multistage process that could take weeks to complete. After cleaning the teeth followed by acid etching, much like is done in some modern dental procedures, a sequence of dyeing stages was required to create a long-lasting coating. A certain resemblance with Asian lacquer ware led French colonial writers to falsely apply the term 'laquage des dents' (Rey 1888). However, at the core of the blackening process was not Vietnamese lacquer from *Toxicodendrum succedaneum* (L.) Kuntze, but a mixture of iron sulfate with gall nuts from *Rhus chinensis* Mill. var. *chinensis* ('Chinese gall nuts'), pomegranate rind or areca nut that created an intensely black color. A coat of empyreumatic oil of coconut provided the finishing sheen (Crevost 1907, Huard 1951, Sallett 1928). Yet even the most extravagant and complex blackening mixtures used at the royal court in Hué of the nineteenth century, e.g., calling for elephant tusk as an ingredient, retained some of the basic methods of teeth dyeing as practiced by indigenous societies elsewhere.

Discussion

It is evident from our data that in the past the vast majority of people across Southeast Asia strongly favored black over white teeth. Indigenous sources have presented a range of similes to describe esthetically ideal teeth: on the Malay peninsula they were to be 'as black and shining as a bumble-bee's wings', or in Hanoi 'as black as custard apple seeds (*Annona squamosa* L.)' (Andaya 2006, Nguyên Xuân Hiên 2006). The motivation was, as one was frequently told, to assure attractiveness to the opposite sex and thus, ultimately, improve one's chances for finding a suitable partner (e.g., Garvan 1964). The desire for beautification, however, does not fully capture the complexity of notions underlying teeth blackening in different cultures. A recurring theme was that visible, especially canine teeth were associated with animality that could be abolished by making one's 'fangs' disappear visually by blackening or physically by filing teeth around puberty (Forge 1980). This aided in transforming a child into a mature, full member of human society.

Dyeing principle

To accomplish the black coloring of teeth different principles were employed in the three categories distinguished here. Only few of the plant saps and latexes were inherently colored as, e.g., the latex of *J. curcas* used in Java and Sulawesi (Filet 1855, Kruyt 1896). In most cases their black color developed as a consequence of chewing and/or exposure to the air (oxidation). Different secondary metabolites were responsible, likely candidates being polyphenols, that turned a dark color as a result of oxidation, or iridoids reacting with natural proteins to generate a black dye (Jansen & Cardon 2005). What is here summarily termed wood tar, are the complex products of incomplete combustion, often in a matrix of sap that constituted a black oily or tarry substance suitable for dyeing the teeth; though, again, plant metabolites contained in the exuded liquid might also have played a role in developing the color. A number of Euphorbiaceae belong to the first two groups, because many of them are rich in sap that allowed for a coating of the teeth.

Finally, the blackening agents that called for the combination of iron in solution with the part of a plant, relied on the formation of ferric (Fe^{3+}) tannates or other like organometallic complexes. Such pigment dyes were highly effective in conferring a nearly indelible black color to the teeth. Especially in the last group, but also in the others, points of contact can be found between teeth blackening approaches and traditional dyeing technologies of Southeast Asia (e.g., Adriani & Kruyt 1905).

Specificity of methods

Across Southeast Asia plant products formed the basis of teeth blackening materials, e.g., contrasting with Melanesian teeth blackening traditions that used to rely heavily on different kinds of black earth. There was great diversity in the plants and methods used for teeth blackening. However, where our analysis had sufficient spatial resolution (e.g., Sumatra, Luzon), it appeared that locally only one or at the most a few approaches to teeth blackening where practiced. Sometimes these were unique, so, e.g., in the case of the Tubao Kayan who used the juice from the fleshy leaves of *Plethiandra beccariana* (Cogn.) Merr., a plant with a relatively narrow distribution in northern Borneo (Ling Roth 1893). These findings contradict any no-

tion of randomness, since the plants involved in preparing a blackening agent appear to have been carefully selected within the limitations of the local ecology.

On the other hand, there were quite a few instances, in which the methods used by different ethnolinguistic groups at close (or distant, see below) locales matched. Practitioners specializing in teeth blackening have been documented, e.g., the **mantutubog** amongst the Gaddang in Luzon (Zumbroich & Salvador-Amores, 2009) who taught teeth blackening locally, but also traveled within the region, or female practitioners in the lowlands of central Vietnam who provided the service of teeth blackening (Sallett 1928). Such institutions contributed to the diffusion of methods within the regional range of their activities.

Use of non-native species

One of the means to assess whether adaptations in teeth blackening practices occurred over time, is to study the use of non-native species. Indigenous groups across Southeast Asia relied almost exclusively on plant materials from locally grown, native species, but our survey revealed that in a few cases the practice integrated non-native plants and a single, traded non-plant product (lac) into the protocols.

In the case of the pomegranate which was introduced to Southeast Asia by way of India sometime before the middle of the first millennium C.E. (Laufer 1919), the use of its rind for coloring teeth might have been an early innovation in Southeast Asia. Rather unique was the involvement of lac, the red resinous secretion of the scale insect *Kerria lacca* Kerr. on host trees, and strictly speaking not a plant product (hence absent from Table 1). At least as early as the sixteenth century it was traded, presumably from the Southeast Asian mainland, to different parts of the Philippines for the specific purpose of dyeing teeth red, not black (Alcina 1668, Laufer 1919, Mintz 2004, San Buenaventura 1613, Zumbroich & Salvador-Amores 2009). It remains the only material for dyeing teeth that had to be procured through long-distance trade. Much later it was documented as part of **thuoc ruôm rang do**, 'drug to stain teeth red', in Vietnam (Huard 1951, Sallett 1928), but its use in Vietnam for this purpose likely preceded that in the Philippines.

Other plants, like *Psidium guajava* and *P. dulce*, were definitely introduced by European intervention. The guava was originally native to the region between Mexico and Peru and travelled across the Pacific to the Philippines with the Spanish. It quickly became naturalized and spread further westwards towards India (Burkill 1935). There is evidence that the use of guava wood for teeth blackening in Luzon replaced earlier methods and thus, at least in some contexts, reflected an adaptation of traditional methods to the post-contact ecology of the island (Zumbroich & Salvador-Amores 2009).

Tobacco, *Nicotiana tabacum* L., reached the Philippines through Spanish hands in 1575 and Java in 1601. Following the European example, tobacco was initially smoked through long reed pipes, which were eventually supplanted by an indigenous form of cigarette (Reid 1985). Given the precedent of other masticants, it is not surprising that a wad of tobacco was also added to the betel chew from at least the later part of the seventeenth century (García 1937). The custom eventually became common across Southeast Asia and undoubtedly contributed to darkened teeth in some societies (e.g., Hoskins 1990), even though tobacco's primary role was as a stimulant. In separate practices, tobacco preparations were specifically compounded to maximize the blackening of teeth by soaking the tobacco in acidic fruit juice with a piece of iron (Cole 1913). Amongst the Manóbos of Mindanao minced tobacco, lime, the juice of the **mau-mau** vine (most likely *E. pinnatum*) and pot black (scrapings from the bottom of a pot over the fire) made up a marble sized quid kept frequently under the upper lip (Garvan 1931, Figure 7). The addition of the juice of *E. pinnatum* to tobacco by different groups in Mindanao demonstrates how the presumably

Figure 7. Manóbo woman in a photograph taken by Dean Worcester in San Islao, Butuan province, Mindanao (1908). The original caption reads: "Note the tobacco quid held between the lips and the front teeth. Tobacco mixed with an acid vegetable substance is held in this way so as to blacken the teeth, jet black teeth being considered an ornament."

more ancient practice of using the vine eventually had become an accessory to the more recently available tobacco (Valderrama 1987).

Betel chewing and teeth blackening

Ever since the very first description of betel chewing and teeth blackening appeared more than two millenia ago (Maspéro 1918), the relationship between the two practices has confounded observers. This is hardly surprising since both customs intersected in so many ways. In Borneo and Vietnam, areca nuts appeared in specific preparations to dye teeth (Evans 1922, Sallett 1928), and in island Southeast Asia *E. pinnatum* was combined with areca nut to potentiate the coloring of teeth (Rumphius 1747). By itself chewing betel, even with tobacco, would not yield the shiny black color that was usually desired, but rather a darkish brown stain. However, depending on prevailing routines of dental hygiene, frequent chewing of betel quids was often enough to maintain the dark color of teeth previously blackened by other means.

The association of betel chewing and teeth blackening extended beyond the physical process of staining into their symbolic ascriptions. Inspired by the shape of the (male) areca nut enveloped by the (female) betel leaf and the red fluid emanating from the mouth during chewing, a betel quid carried in many cultures distinct sexual connotations, often directly related to initiating courtship or sexual contact (e.g., Hoskins 1990, Stöhr 1981). Similarly, teeth blackening, much like betel chewing, typically began to be practiced from around puberty as a preliminary to marriage, visually marking the transition from child to adult. Offering teeth blackener to a girl could, however, also be a very direct way to indicate sexual interest (Lambrecht 1978). These strong connections between betel chewing and teeth blackening hint at a possible explanation for the origin of teeth blackening. As betel-stained teeth developed into a marker of social boundaries, more effective methods for teeth blackening evolved to amplify the visual effects of betel chewing.

Diffusion and ethnic boundaries

Some cultural practices have been associated with specific linguistic families, e.g., tattooing with Austronesian speakers, as a means of defining their cultural repertoire and, in turn, providing arguments for the diffusion of these practices (Bellwood 2004, Blench 2008). But teeth blackening was so widely represented among speakers of different linguistic families across Southeast Asia that its geographic distribution is of limited help in elucidating historical trajectories of migrations. Even with a more refined analysis that considers the specific approaches to teeth blackening, one finds that the use of identical plants and methods cut across the boundaries of linguistic families. For example, empyreumatic oil of coconut is attested as a blackener for Austronesian speakers in island Southeast Asia, for Mon-Khmer speakers in Vietnam and for Daic speakers in Thailand, potentially indicating the diffusion of this approach over a wide area.

Although there were some ethnolinguistic groups that did not blacken their teeth, such as the Negritos of the Malay Peninsula or the Cham of central Vietnam, there are no indications that the custom played a significant role in articulating ethnic boundaries within Southeast Asia. However, to some people outside the region blackened teeth were one of the markers resorted to in the construction of 'otherness'. Chinese descriptions from as early as the Qin dynasty (221 to 207 B.C.E.) remarked on the blackened teeth of the inhabitants of the Red River Delta (Maspéro 1918). In 1695 the Chinese monk Shilian Dashan travelled along the coast line of central Vietnam and noted that the inhabitants of the small island Cù Lao Chàm 'speak a pigmy tongue and blacken their teeth' (Wheeler 2006) - both epithets understood to be specific to non-Sinicized people of Southeast Asia.

The ethnopharmacology of teeth blackening

Indigenous reports have long claimed that teeth blackening strengthened the gums as well as teeth and and acted as a preventative measure against the action of the 'tooth worm', thought to be responsible for cavities (e.g., Zumbroich & Salvador-Amores 2009). In fact, some of the teeth blackeners doubled as dental remedies in the indigenous pharmacopoeia; for example, empyreumatic oil of coconut was also topically applied as a treatment for toothache caused by caries in the Philippines and Cambodia (Quisumbing 1951, Sokny *et al*. 2007). Similarly, the leaves of citrus plants had diverse medicinal uses in the Indo-Malaysian archipelago that included the treatment of toothaches and oral disorders (Perry 1980, Roosita *et al*. 2008).

It is intriguing that the actual dyeing of teeth often relied on the presence of secondary metabolites which likely had different pharmacological effects. Polyphenols that were frequently involved in the coloring action are also known to play a role in maintaining oral health (Petti & Scully 2009). Indeed, some specific investigations have confirmed that teeth blackening reduced the incidence of dental caries and contributes to dental and periodontal health (Bailit 1968, Flynn 1977). *In vitro* experiments demonstrating the antimicrobial activity of teeth blackening materials from certain plants, such as *Cratoxylum formosum* (Jack) Dyer or *P. guajava*, against cariogenic bacteria, highlight one of the potential mechanism of protection (Suddhastira *et al*. 2006, Tayanin & Bratthall 2006, Zumbroich & Salvador-Amores 2009).

Inevitably some of the blackening material was ingested and absorbed and one must consider that the impact of the practice went beyond the oral cavity. For example, some of the plants which yielded masticants, like *A. catechu*, *E.*

pinnatum, *J. curcas* or *P. foetida* had documented uses as anthelmintics (Burkill 1935, Heyne 1950, Perry 1980, Quisumbing 1951), and their regular usage could have had the effect of reducing helminth infections. One may hypothesize that, if application of these or other blackening agents conveyed health benefits, this could have been a factor favoring the wide-spread adoption of the practice. Expanded understanding of the methods of teeth blackening will allow us to further pursue these preliminary observations on the medicinal qualities of teeth blackeners and their pharmacological basis.

Conclusions

Betel chewing with its associated discoloration of teeth might lie at the root of the teeth blackening practice in Southeast Asia. Other masticants were eventually added to areca nut in order to amplify the visual effect that had taken on different cultural ascriptions related to sexual maturation and becoming a full member of society. Striving to accomplish evenly black teeth led to the adoption of plant-based methods for teeth blackening that were increasingly sophisticated and culminated in week-long processes requiring a dozen ingredients. The evolution of the custom over time is also evidenced by the incorporation of non-native plant species, such as *P. guajava* and *N. tabacum*, into the recipes. Indigenous experience, validated by some experimental evidence, indicates that teeth blackening contributed to oral health. This may in part provide an explanation why certain plants were chosen over others for the process. Whether teeth blackening can be broadly viewed as an expression of indigenous ethnopharmacological knowledge, will require further study.

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