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Commentary

Black teeth: beauty or caries prevention? Practice and beliefs of the Kammu people

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Abstract – *Background:* To be beautiful and caries-free, Kammu women in Laos and Vietnam habitually paint their teeth black. Although this practice existed for many generations, it is now known only among the elderly. *Objectives:* To describe how the tooth-blackening procedure is performed and to test the black stain for possible antimicrobial effects in laboratory experiments. *Methods:* Information on how to blacken teeth was obtained by interviewing groups of elderly Kammu people living in different villages in Laos and Vietnam. Water extracts of the stain were placed in wells in agar plates and the plates incubated with *Streptococcus mutans* or *S. sobrinus*. The stain was also let such that it covered half of the strip test-side of the Dentocult SM® Strip Mutans test kit and incubated with saliva from five persons known to carry mutans streptococci in their saliva. *Results:* Interviews revealed that three plants were commonly used: *Dracontomelon dao* nuts (DD nuts), *Cratoxylum formosum* (CF) wood or *Croton cascarilloides* (CC) wood. The parts (nut, wood) were burned and soot collected on metal plates. The fresh soot, which had a viscous consistency, was applied to teeth with the index finger. Extracts of soot of the DD nuts had no effect on the streptococci on agar plates but inhibited the growth of salivary mutans streptococci on strips. Controls using soot from birch tree (*Betula pendula*) had no effect. *Conclusions:* The procedure was simple and resulted in black, beautiful (?) teeth. The soot of DD nuts effectively inhibited growth of salivary mutans streptococci in *in vitro* experiments.

Key words: *Betula pendula*; black teeth; *Cratoxylum formosum*; *Croton cascarilloides*; *Dracontomelon dao*; extract; Kammu; Laos; mutans streptococci; soot; Vietnam

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Travellers in Asian countries, in particular the remote areas of the Southeast, may have observed elderly people with strikingly discoloured teeth. Among the many reasons as to why such colour changes are found in teeth, a common reason is that various stained particles in food products or other chewed substances are released and discolour the teeth. Betel chewing, a mild stimulant and very popular amidst the older generation, can cause tooth discoloration. A piece of areca nut is wrapped in a betel leaf and lime paste smeared onto. Other ingredients such as tobacco or spices can be added, depending on individual taste, forming the 'betel quid'. Chewing results in an abundant flow of brown-red saliva, which over a period of time discolours the teeth. However, in addition to this 'unintentionally' acquired discoloration, several methods to intentionally paint or blacken the tooth surface have been described. The aims of this paper are to discuss some such tooth-blackening procedures, to identify and describe a still-practised procedure among the Kammu people in Laos/Vietnam and to investigate the stain for possible antimicrobial properties *in vitro*.

Materials and methods

The Kammu, also known as Khmu or Khamu are indigenous folks, a Mon-Khmer-speaking minority

Fig. 1. Black teeth of an old Kammu woman living close to the Laos/Vietnam border.

hill tribe people, living in mid-altitude mountain slopes, mainly not only in northern Laos but also in neighbouring parts of Vietnam, Myanmar, Thailand and China. Their total population has been estimated in 1995 to be about 500 000, including small groups living in France and the United States (1).

Information on how and why one blackens teeth, and beliefs associated with blackening of teeth were obtained by interviewing local elderly Kammu people with blackened teeth, living in Luang Namtha province and Ban Huay xay, Bokeo province, situated in north-west of Laos. Additional information was also collected from elderly Kammu women in Ban Vang, east of Dien Bien Phu, Dien Bien province in north-west Vietnam. Black teeth were photo-documented and mouths were observed (Fig. 1).

Kammu women demonstrated the teeth-blackening procedure in detail and pointed out the types of plants used. Samples of such plants were identified and collected and some of them further identified by Dr Lennart Engstrand and Dr Marie Widén, Department of Systematic Botany, Lund University, Sweden.

Experiments

Pilot experiments on a laboratory scale were performed in Sweden, repeating the method outlined by the Kammu to make the black stain. Dried nuts of *Dracontomelon dao* (DD nuts) (local name Rnkia), wood of *Cratoxylum formosum* (CF wood) (local name Crim) and wood of *Croton cascarilloides* (CC wood) (local name Kleng rooy) (2) were cut into small pieces and burned separately. Metal plates were placed over the fire at close distance. Viscous soot was formed on the metal plates. It was immediately wiped off using sterilized Quick Sticks (small plastic brushes) and then directly transferred to plastic strips of the Strip Mutans test kit (Orion Diagnostica, Espoo, Finland). The soot was allowed to cover half of the strip test-side. After a short while, the soot hardened on the strip and the Quick Stick. The test materials were kept in sterilized tubes until use.

In other experiments, the viscous soot was let to harden on the metal surfaces, which happened within minutes. This soot was then scraped off by a knife and kept in sterilized tubes for further experiments in the laboratory.

Tests for possible anti-microbial activity

Stimulated saliva was collected from a person known to have high levels of mutans streptococci. Fifty microlitres of stimulated saliva was added to test strips, partly covered by the DD, CF and CC soot, with two strips for each type of material. Excess saliva was removed using a pipette tip. The test strips were then placed in the selective culture broth and incubated at 37°C for 48 h. Control strips were not covered by soot. Results were compared by the chart supplied by the Strip Mutans test strip manufacturer, where class 0 = none or just a few colonies to class 3 = dense growth of bacteria on the strip.

Tests for possible antimicrobial activity were repeated with stimulated saliva from five subjects with high counts of mutans streptococci and soot from DD nuts. As an extra control, soot from Swedish *Betula pendula* (BP) wood (local name silver birch) was chosen. BP wood pieces were collected and kept dry, cut into small pieces, and burnt covered with a metal plate. The soot of the BP woods (viscous, but not as viscous as soot of DD nuts) on the metal plate was collected and smeared onto a half of the test side of the strip, as explained above.

Test of extracts on agar plate

Extracts from soot of DD nuts were prepared in two ways: viscous soot that was removed from the metal plates by Quick Stick, was placed in sterilized tubes and mixed with distilled water to give a final concentration of 0.2 mg/ml. The procedure was repeated with hardened soot scraped from the metal plates.

Streptococcus mutans strain KPSK2 (serotype c, OD (optical density) = 0.8) and *S. sobrinus* strain B13 (serotype d, OD = 1.0) were selected and cultivated in Todd Hewitt broth; 100 μl of each was spread on an MSA-agar plate using glass beads. Wells in the agar plate were filled with 50 μl of each soot preparation. Wells with 50 μl of distilled

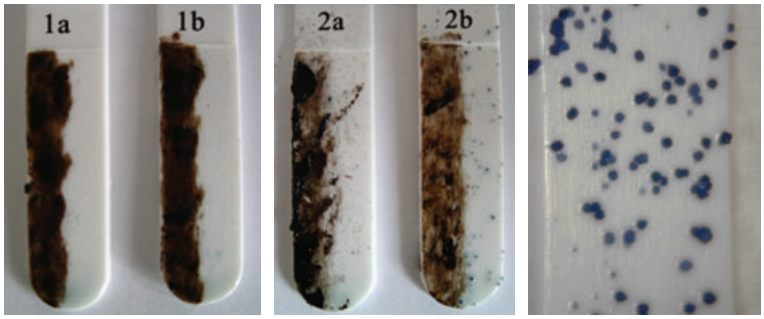

Fig. 2. Strips partly covered by soot after incubation with saliva: (1a and 1b) covered with DD (*Dracontomelon dao*) nuts soot; (2a and 2b) covered with CF (*Cratoxylum formosum*) woods. The picture to the right shows mutans streptococci colonies on untreated strips (control) after incubation.

water or Hexident (a mouth wash containing chlorhexidinegluconate 1 mg per 1 ml; Ipex, Solna, Sweden) were used as negative and positive controls respectively. The plates were incubated anaerobically at 37°C for 48 h.

Test for possible effect on pH value

Soot of DD nuts was collected from the metal plate and 0.06 g placed in a test tube. Two millilitres of tap water was added for measuring pH. Control tube contained 2 ml tap water only. The pH values in these tubes were measured at different time intervals: 0, 30, 60, 90, 120, 150 and 300 min, using pH meter (Metrohm AG, Herisau, Switzerland).

Test for fluoride concentration in the soot water

Fluoride concentration was analysed in tap water containing 0.06 g soot of DD nuts. The analysis was made 5 days after mixing by using an ion-specific electrode and a Benchtop pH/ISE Meter (Model 290A; Orion, Boston/Beverly, MA, USA). As a positive control, the same amount of two common fluoridated toothpastes were added to water.

Results

Kammu women used three different plants for blackening their teeth: CF (wood), CC (wood) and DD (nuts). These trees grow in the forests around the villages and were used according to availability. Each time the women needed to blacken their teeth, they burned the wood and made soot. The wood of CF and CC are also used as building materials and firewood (D. Tayanin, pers. comm.)[1].

In the winter (November–December), the DD fruits ripen and fall to the ground. In a few weeks, the fleshy parts of the fruits rot with the hard nuts remaining. Kammus collect the nuts, store them and prepare food from the nut's seeds – the nuts are heated and the seeds are dug out and mixed with pepper. Women use the empty shells for making soot for painting their teeth black (D. Tayanin, pers. comm.).

The tooth-blackening procedure is as follows: the woods (CF or CC) or nuts (DD) are burnt and the fire covered with cast iron for about 10–15 min. The viscous soot from the woods or nuts attach to the cast iron. This warm viscous soot is rubbed off immediately using the index finger and then smeared on all buccal surfaces of the teeth. Some women also use this sticky smear for occlusal surfaces. Women used to blacken their teeth after dinner every week, usually twice a week. According to them, they were more attractive with blackened teeth. They also believe that the teeth will be strong and the black soot will protect their teeth from pain and decay.

Results of experiments

Tests for possible antimicrobial activity

The control strip showed strip class 2, indicating a fairly high number of mutans colony forming units (CFU) in the person's saliva. The two strips with DD nut soot demonstrated an apparent inhibition of mutans streptococcal growth on both the soot-covered part as well as on the noncovered area. Strips with soot of CF wood showed growth of mutans streptococci in class 0–1 on the empty areas of both test strips. For strips with CC wood soot, one of the strips had no growth of mutans streptococci, whereas the other showed some bacterial growth. For this reason, the DD nuts were chosen for further experiments (Fig. 2).

Table 1 and Fig. 3 show the results when saliva of five persons were incubated on strips covered either by DD soot, BP wood soot (control) or uncovered strips (control). The results showed that DD nut soot markedly inhibited the growth of mutans streptococci both on the smeared and

[1]Dr D. Tayanin (Department of Linguistics and Phonetics, Lund University, Sweden) a Kammu and used to be a shaman and traditional medical man. He himself has been using these plants for blackening of teeth

Table 1. Growth of mutans streptococci on strips after incubation with salivas from five individuals

	Strip Mutans class of stimulated saliva		
Person ($n = 5$)	No soot, control	DD nut soot	BP soot
1	2	0	2
2	1–2	0	1
3	2	0	2
4	2	0	2
5	3	0	3

Test strips covered by soot of *Dracontomelon dao* (DD) or *Betula pendula* (BP).

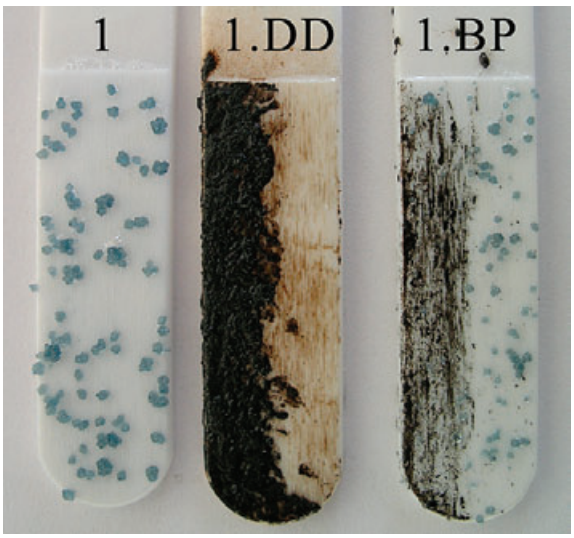

Fig. 3. Example of mutans streptococci growth on strips after incubation with saliva. Left: non-treated strip (control). Centre: strip partly covered by soot of DD nuts. Right: strip partly covered by soot of BP woods.

nonsmeared sides, while BP soot had very limited effect, if any.

Test of extracts on agar plate

Neither hardened nor viscous soot of DD nuts demonstrated any inhibition zone of growth of mutans streptococci on the agar plates. Hexident (positive control) had a significant inhibiting effect.

Test for possible effect on pH value

The pH of the tap water used was 8.2. In tubes with DD nut soot plus water, pH immediately dropped to 8.02. After 30 min, pH value was found to be 7.67 and remained so until the experiment was stopped at 300 min.

Test for fluoride concentration in the soot water

The tap water contained 0.224 ppm fluoride. Water with DD nut soot showed a fluoride concentration of 0.234 ppm. Water with same amount of toothpastes as for soot showed 27.8–40.9 ppm.

Discussion

Blackening of teeth seems to have been a widespread Asian tradition. According to Nguyen (3), applying a black varnish to the teeth was a habit in Vietnam already in the Bronze Age. Around 3000 BC, individuals, regardless of gender, seemed to have varnished their teeth. The habit spread and was maintained for many centuries, apparently recognized as a symbol of elegance and good taste. Nguyen refers to observations of a few Frenchmen visiting Vietnam about 100 years ago – persons with white teeth were the object of jokes and humiliation. Similar customs were observed in other countries in this region, e.g. Laos, Cambodia, Thailand and Myanmar.

The techniques and the materials used varied in different countries and populations and depending on the procedure – the teeth remained stained for a few months up to several years. As an example from Vietnam, Nguyen mentions a procedure in several steps: the teeth were first cleaned using toothpicks and then with pieces of dried areca nut. After that, teeth were etched with slices of lemon, with the lemon pieces changed several times a day. In the next step, shellac was boiled with lemon juice and rice vodka to obtain a gluey substance. This substance was applied to banana leaf or paper, which then covered the teeth overnight. Such applications were repeated four to five times. In the final step, another gluey substance, obtained by boiling a mixture of alcohol and powder containing, among others, iron sulphate, dried pomegranate skin, cinnamon and cloves, was applied for many times a day. Nut oil or lard was then smeared onto the teeth.

A somewhat similar technique to blacken the teeth, used in Vietnam, was described by Flynn (4). At first, the teeth were etched using pieces of lemon for 2 days and nights. The teeth were then covered with small pieces of paper, on which a mixture of black paint, ginger and mango had been applied. The teeth turned black after 12 h. In about 350 blackened teeth extracted for periodontal causes, no signs of caries were reported.

Pindborg (5) described a method of blackening teeth in Japan originally published by Nakahara et al. (6) – a book showing pictures of women blackening their teeth. In the procedure, kanemizu and fushi powder were used. Kanemizu was

prepared using melted iron in a bowl, to which water, strong tea, rice wine, vinegar and rice jelly were added. The mixture was allowed to ferment, and then the supernatant was heated. A brush was dipped into the bowl, which contained iron acetate and covered with fushi powder (containing tannic acid). A kind of pigment was obtained. This procedure was repeated every third day. According to this description, the blackened teeth was a symbol of a married woman. It was said that if the black colour never changed, the relationship between husband and wife never changed.

Furthermore, Balfour (7) described a technique of blackening teeth in Japan found in Mitford's Tales of Old Japan. Red hot iron was placed in half a cup of rice wine with three pints of warm water for 5–6 days. The scum was removed and warmed afterwards. Pounded gall nuts that contained larvae (from sumac tree) and further iron filing were then added. The mixture was reheated and then painted on the teeth. The more the iron filings and gall nuts, the darker were the shades obtained. To maintain discoloration, reapplications were required. According to Balfour, a reason for this procedure was to keep the teeth 'clean and sound'. The Emperor outlawed the practice in 1870, according to the source.

In Philippines, Salvador (8,9) studied traditional tooth blackening in Cordillera, North Luzon, Philippines. This practice, termed 'tubug', had begun during the pre-Spanish period. The procedure of how to blacken teeth was not mentioned in detail; the indigenous folk apparently used black resinous substance from burned guava, coffee branch or other plant dyes to stain their teeth. The idea of blackened teeth was to differentiate humans from animals, and as an ethnic symbol and aesthetics. It was also believed to have dental preservative effect. According to Salvador, archaeological findings supported the later idea. This practice was preformed since youth. Nowadays, some old people in that area still keep blackening their teeth.

A conclusion from this short review is that several different procedures to blacken teeth have been used in Asian countries, and some methods are apparently still used locally. The Kammu procedure described in the present paper seems somewhat primitive compared with the others. The teeth were not pretreated with etching substances and the painted surfaces were carrying a rather thick layer of soot. Is it beautiful? Well, it is not up to the authors to answer that question. Is it tooth-preserving? Does it protect against dental caries? Our study cannot answer that question, although no apparent cavities were observed visually. The observation by Flynn (6) that none of 350 blackened teeth had caries is of course striking, but there was no control group. Furthermore, if teeth are not subject to cariogenic factors, there should be no cavities anyway – and we do not know anything about sugar consumption or plaque or other risk factors in that study. Nevertheless, the results of our laboratory experiments are indicative of a possible antimicrobial effect, although also somewhat contradictory. No effects of the soot when tested for inhibition of bacterial growth on agar plates were found, but the soot of DD nuts effectively prevented colony formation on the strips. In their study, Khan and Omoloso (10) actually found antibacterial and antifungal effects of *Dracontomelon dao* extracts. However, they used methanol extracts of the leaves, stem and root barks while in our study, only water extracts of the nuts were used. In addition, it should be observed that the agar plate method and the strip method have a difference in the fact that if bacteria cannot adhere to the strips, or are prevented by a substance from doing it, there will be no colonies. Several more studies are needed to clarify if the observed antibacterial effect seen in the strips has any clinical significance.

Plants and plant extracts contain numerous substances having adverse effects on bacteria. For example, it has been shown that methanolic extracts of *Morus alba* root bark inhibited the growth of *S. mutans*, *S. sobrinus*, *S. sanguis* and *Porphyromonas gingivalis* (11). Extracts of *Mikania laevigata* and *M. glomerata* were found to have an effect on mutans streptococci growth and adherence of cells to a glass surface (12). Monomeric polyphenol components in Oolong tea extract showed antibacterial effect on *S. mutans* (13). Compounds found in the natural product propolis were found to have effects on *S. mutans* growth and on glucosyltransferase activity (14). Finding plants with anticariogenic properties can open up new possibilities for preventive or curative strategies. We do not believe that (so many) persons would blacken their teeth if an antimicrobial effect really was shown. However, the effect does not necessarily need to be connected with the black pigments.

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