X-RAY STUDY OF KOHL STONE USED IN INDIAN TRADITIONAL MEDICINE AND COSMETICS

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ABSTRACT

Kohl or surma is one such material which is widely used as medicine as well as cosmetics in traditional practices both in rural as well as urban India alike. Kohl stone is one of the major ingredients of kohl. Kohl stone used in the traditional practices is subjected to x-ray study to know the composition. X-ray study reveals that the composition of kohl stone is galena. It has been established by several studies that application of kohl does not cause lead poisoning. But recent scientific studies have reported lead poisoning following traditional lead based medication or kohl application. Similarly, Indian traditional medicinal texts advocates about the application of anjana (kohl) for curing eye diseases. But it has been mentioned that the prolonged and persistent use of anjana may cause conjunctivitis and cataract. Hence, the authors are of the opinion that application of kohl may be beneficial to eyes but still there may be a possibility of adverse effects on prolonged use.

KEY WORDS: Kohl stone, Kohl, Surma, Galena, Lead, Anjana

INTRODUCTION

In India, kohl or surma is widely used in traditional practices as cosmetics as well as medicine. Traditionally, only old people apply surma. In recent times even the younger folks are also applying it as cosmetics as it is made of natural material and it enhances the beauty of eyes. In addition, mothers of young infants also apply kohl to their newborn and young children to ward off the evil eye. It has been reported that kohl is worn to ward off the evil eye or as an eye ailment material in other places as well [1][2][3][4][5][6][7]

Generally, kohl is used as cosmetics in many countries including India and popularly known as kohl or ithmid or surma [1]. In India, it is known by various names like sirma or surma in Punjabi and Urdu, kajal in Hindi and Urdu; and in south Indian languages it is known as kaadige in Kannada, kaatuka in Telagu, kanmashi in Malayalam and kanmai in Tamil.

Kohl may be defined as an ultra-fine powder of kohl stone that is used for various eye ailments. In addition to the kohl stone it may also contain herbs, minerals and marine products of therapeutic value [1][2][3][4][5].

In ancient India, natural minerals and metals were used to cure diseases apart from using them as ornaments or cosmetics. For the conversion of minerals to a pharmaceutical recipe, acceptable to the body, metals are converted into oxide form which is known as ‘bhasma’ (ash). Susruta one of the pioneer of Indian traditional medicine has mentioned in his book ‘Susruta samhita’ about the use of tin, lead, copper, silver, iron and gold in the form of oxides as drugs [8][9].
In Indian traditional medicine, the components of antimony, lead and mercury are collectively called as ‘anjanas’. Anjana means collyrium – the material put into eyes as medicine or cosmetics, generally antimony – lead compounds.

In India, use of anjanas as cosmetics for decorating eyes has been mentioned in 150AD Indian text angavijja whereas the traditional application of kohl dates back to Bronze Age: c 3500-1100 in some other countries [1][8][9].

The early 14th century text rasaratna samuchchaya is considered as one of the complete treatise of ayurveda and it classifies the anjanas into five types; sauvarjanana (stibnite), rasanjana (yellow oxide of mercury or herbal plant extract), srotanjana (antimony sulphide), pushpanjana (extract from the nector of plants) and nilanjana (galena) [10].

Galena is the most important and widely distributed mineral of lead. Chiefly occurs in metalliferous veins associated with silver, antimony, arsenic, copper, gold, selenium etc. Compositionally, galena contains 86.6% of lead (Pb) and 13.4% of sulphur (S) [11].

X-RAY STUDY OF KOHL STONE

To know the composition of kohl stone used in traditional practices, two samples of kohl stones or surma are collected. One sample is collected from a gift received from a relative who returned from Hajj stated that it was purchased in Saudi Arabia. The other sample is collected from grandmother’s collection who was a traditional medicinal practitioner. Both the samples are of unknown origin, lumpy and shows silver grey colour. Figure 1 shows the photograph of kohl stone sample purchased in Saudi Arabia.

The samples of kohl stone are ground to fine powder and subjected to X-ray studies employing Rigaku-MiniFlex table-top x-ray diffractometer (CuKα), Japan under standard conditions. The resulting patterns are compared with the JCPDS-ASTM data bank to identify the phases.

RESULTS OF X-RAY STUDY

Figure 2 shows the resulting x-ray powder pattern of both the samples. The resulting patterns of x-ray powder diffractometer for both the samples are matched with the JCPDS-ASTM data that matches well with the pattern of galena (XPDF: 5-592). This confirms that compositionally the kohl stone is galena or lead sulphide (PbS). It has been reported by some studies that the major elemental composition of kohl too is lead [2][3][5][11].

Figure 2: X-ray powder patterns of kohl stone used in traditional practices. a, X-ray powder pattern of kohl stone collected from traditional medicine practitioner comparable to galena (XPDF: 5-592). b, X-ray powder pattern of kohl stone received as gift brought “from Saudi Arabia” comparable to galena (XPDF: 5-592).”

The x-ray powder pattern of both the samples is almost identical. It is observed that the two theta values of both the samples are almost identical with minor changes. The x-ray powder pattern of both the samples can be compared to the reported Saudi Arabian sample of Ullah et al. (2010) [5]. It is assumed that the present sample is similar to the reported sample of Ullah et al. (2010) assuming that all the kohl stones sold in Saudi Arabia may originate from one place [5]. From this assumption we may guess that the chemical composition of galena of the present study may be approximately 85.5% of lead, 11.5% of sulphur with traces of other elements as reported by them and corroborated with the composition given in the text book of mineralogy [5][11].

DISCUSSION

In rural India people try traditional medicine before consulting a modern medicinal practitioner may be either due to lack of modern medical facilities or tradition. In urban areas, people are becoming more health conscious and preferring natural materials and adapting to Indian
traditional and/or home medicine and cosmetics in order to minimise the consumption of chemicals. Kohl or surma is one such material which is widely used as cosmetics both in rural as well as urban India alike. Habitually, kohl is extensively used cosmetics in almost every civilization to keep eyes cool and clean [1][12].

The x-ray powder diffraction study confirms that compositionally the kohl stone is galena or lead sulphide (PbS). It has been mentioned in the Indian traditional medicine books that lead is used for curing several diseases. Lead is one of the metals mentioned in the earliest text the athavda veda in which lead powder was reported to have medicinal value that used in curing tuberculosis [8][9]. Another book rasaratna samuchaya mentions the use of lead bhasma to cure urinary tract diseases and diabetes [10]. But the general application of kohl is for eye ailment to cure diseases such as, blepharitis, trachoma, chalazion, pterygium, cataract, conjunctivitis, ectropion, as well as for the prevention of recurrence of trichiasis [1][5][12]. Similarly, in Indian traditional medicine the most common application of lead and antimony minerals is for the ailments of eye diseases as evident in some of the ancient medicinal books. One such book Rasaratna samuchchaya mentions that the application of nilanjan or surma or kohl is beneficial to eyes [10]. It has been stated in the astanga samgraha that the anjanas will be helpful to clean the eyes, removes excess redness, greasiness, dust and other foreign particles [13]. A recent traditional medicinal book swadeshi chikista ke chamatkar advocates that surma is beneficial to eyes and it enhance the shine of eyes [14]. Another book Aasaan Gharelu tibbi Ilaj states that application of kohl stone enhances the eyesight [15].

Some of the recent scientific reports also nearly corroborate with the above mentioned traditional medicinal claims either directly or indirectly. These reports have concluded that the application of kohl is safe and it does not cause lead poisoning. It has been established by some of the studies that lead does not transport through transcorneal route [16]. To reason out the observed elevated blood lead levels in the kohl applying people, the authors opined that the observed high blood lead levels in kohl applying people might have occurred through ingestion [16]. Ingestion might have occurred in the following way. Kohl is an irritant and produces a slight burning and tearing in eyes when applied on the conjunctival surfaces. Generally, it is observed that when kohl or surma is applied in the eyes of children, they wipe or rub their eyes. Then the lead may reach stomach orally through fingers as finger licking is common among children. This may be the cause of observed elevated blood lead levels among children [1]. Further, the authors have concluded that the observed lead poisoning or increased blood lead level on application of kohl (surma) is likely to be more theoretical rather than a practical health hazard [1]. In addition, many recent scientific studies support the view that the black and shiny particles of galena or lead are useful in protection of eyes from the glare of the sun and harmful effect of UV rays as well[1][5][17].

Contrary to this, it is evident from the recent scientific studies that the lead is purely toxic and causes lead poisoning. No threshold level has been found below which any exposure to lead can be considered safe. It is a known fact now that children are more vulnerable to lead poisoning than adults. It is reported in the literature that the chronic exposure to low level of lead decreases the intelligence quotient (IQ), produces mental deterioration, learning disabilities, behavioural abnormalities, slow growth and impaired hearing among children whereas high concentration may cause acute encephalopathy, memory loss and death [2][3][4][18][19][20].

A recent study in Morocco conducted on 150 children who use kohl regularly revealed lead intoxication in 19 children and impregnation of lead in 111 children. The authors opine that the lead contamination might have occurred from the kohl what they use as it consists of up to 98% lead [4]. Now, it is commonly accepted worldwide that lead concentration higher than 10μg/dL in blood is considered as toxic and it may cause lead poisoning [2]. In one of the study, an elevated blood lead levels between 30-92 μg/dL was recorded among few children in Delhi who used surma [21]. In another study, following the treatment with lead based traditional medicines, an elevated blood lead levels were noticed in Omani children indicating subclinical lead intoxication [3,22]. Elevated blood lead levels due to the use of kohls have also been reported in adults as well [23].

Lead poisoning also affects the nervous system and may cause anaemia as well [21]. A recent study conducted on children reports an elevated mean blood lead concentration of 29.6 ± 10.2 μg/100 ml among those who use kohl regularly revealed lead intoxication in 19 children and impregnation of lead in 111 children. The authors opined that the lead contamination might have occurred from the kohl what they use as it consists of up to 98% lead [4]. Now, it is commonly accepted worldwide that lead concentration higher than 10μg/dL in blood is considered as toxic and it may cause lead poisoning [2]. In one of the study, an elevated blood lead levels between 30-92 μg/dL was recorded among few children in Delhi who used surma [21]. In another study, following the treatment with lead based traditional medicines, an elevated blood lead levels were noticed in Omani children indicating subclinical lead intoxication [3,22]. Elevated blood lead levels due to the use of kohls have also been reported in adults as well [23].

There are reports of encephalopathy among neonates and young children following the use of lead bearing traditional medicine [23][25]. A recent study reported an acute encephalopathy even at lower concentrations of blood lead levels of only 56.9 mg/dl whereas the proposed threshold level for encephalopathy is 70 mg/dl [26]. It has been demonstrated through a study conducted in Kuwait that in neonates lead affects the synaptic inhibitor gamma amino butyric acid (G.A.B.A.) [27].

Traditionally at homes surma is prepared from kohl stone by grinding either using a mortar and pestle or by rubbing on a flat surface of clay tiles, stones etc. This produces a very fine powder. Due to some constraints we could not measure its particle size; but according to one of the study the estimated average size of the particles of similar material is 69μ on grinding[2]. Since, there is no information of grinding method adopted by Hardy et al (2004)[2], we presume that rubbing on a flat surface may produce even finer particles. It has been reported that the smaller sized particles of galena are having higher dissolution in gastric fluids and the dissolution of lead is doubled when the mean particle size is 30μ compared to the mean particle size of 100μ[2][28]. Hence, the authors are of the opinion that the surma prepared by rubbing on a flat surface may have a higher dissolution rate and could be easily absorbed by the body on ingestion thereby elevating the blood lead levels.
It is evident from the literature that the application of kohl causes lead poisoning or not is unclear and still is a debatable topic. On one hand, most recent scientific studies have confirmed that kohl causes lead poisoning. Numerous substantiating studies conducted in different countries have reported lead intoxication and elevated blood lead levels in children following the treatment with lead-based traditional medicine or application of kohl. On the other hand, several workers have shown that application of kohl or surma does not cause lead poisoning rather it enters the human body through ingestion thereby increases the blood lead levels. Even the traditional medicinal texts endorse the use of kohl or surma or anjana for curing eye diseases. But it has been observed by the authors that there are few instances where, even the traditional medicinal practitioners have warned about the adverse effects of anjanas on prolonged use. One of the Indian traditional medicinal book astanga samgraham mentions that on continued application of anjanas if the redness and inflammation increases on application may leads to conjunctivitis and cataract. This can be corroborated with a recent report from France where lead poisoning was observed in a woman caused by prolonged use of kohl. If we analyse the above mentioned scientific findings and the traditional medicinal facts, it is still ambiguous to accept kohl as totally safe material. Hence, the authors are of the opinion that kohl or surma may be beneficial to eyes but still there is a scope for further study to confirm with authenticity that even on prolonged use it will not cause any harm. But there is no doubt that through ingestion kohl causes lead poisoning.

CONCLUSION

The x-ray powder diffraction study showed that the composition of kohl stone or surma used in the traditional medicine and cosmetics is nothing but galena or lead sulphide (PbS). Lead is a toxic material and it causes lead poisoning. The authors are of the opinion that the traditional method of kohl preparation at homes produces finer particles and on ingestion it may have a higher possibility of biological absorption and thereby elevating blood lead levels. Hence, there is an urgent need to educate people about practice of personal hygiene thereby avoiding lead poisoning. Finally, the authors are of the opinion that application of kohl may be beneficial to eyes but still there may be a possibility of adverse effects on prolonged use.

REFERENCES


