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Decontaminating Sacred Objects of the Haudenosaunee

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Abstract

Six sacred objects (masks) of the Haudenosaunee were found to have high levels of arsenic and mercury contamination. Treatment with a surface-active displacement solution reduced the contamination in all of the objects, but only four reached the agreed-upon mitigation goal (nanograms). A chelating compound, dimercaptosuccinic acid (DMSA), was identified as a possible second treatment to further reduce the level of contamination. DMSA was subsequently applied to all painted and unpainted surfaces of all of the objects. Removal efficiencies for mercury ranged from 4 to 85%, with an average decrease of 48.5%. Arsenic residue removal efficiencies ranged from 2 to 33%, with an average of 15%. Although mercury and arsenic levels generally decreased, sacred objects 2 and 5 still did not meet the mitigation goal.

Titre et Résumé

Décontamination d'objets sacrés du peuple haudenosaunee

Six objets sacrés (des masques) du peuple haudenosaunee présentaient un niveau élevé de contamination à l'arsenic et au mercure. Un traitement avec une solution de déplacement tensio-active a permis de réduire la contamination de tous les objets, mais seuls quatre d'entre eux ont atteint l'objectif d'atténuation fixé au départ (en nanogrammes). Nous avons déterminé que l'acide dimercaptosuccinique (DMSA), un agent chélateur, constitue un deuxième traitement possible pour réduire le niveau de contamination. Nous avons donc appliqué du DMSA sur toutes les surfaces (peintes et non peintes) des objets. L'efficacité d'élimination du mercure a varié entre 4 et 85 % et, en moyenne, le niveau de mercure a connu une baisse de 48,5 %. Quant à l'efficacité d'élimination des résidus d'arsenic, elle a varié entre 2 et 33 % et en moyenne, le niveau d'arsenic a connu une baisse de 15 %. Si, de manière générale, les niveaux de mercure et d'arsenic ont diminué, les objets n^os^ 2 et 5 n'ont pas atteint l'objectif d'atténuation fixé.

Introduction

When a group of six sacred objects (masks) were repatriated to the Haudenosaunee under the *Native American Graves Protection and Repatriation Act* (NAGPRA), they were screened for arsenic and mercury contamination prior to their transition back to the tribal community (Reuben 2006). Sampling was performed under the supervision of the Saint Regis Mohawk Tribe's (SRMT) Tribal Historic Preservation Office (THPO), which facilitates the transition of repatriated objects back to their community and currently stores these masks. The results revealed that arsenic and mercury were present in milligram amounts.

A strategy was then developed to reduce the level of contamination to the order of nanograms. This mitigation goal was determined through consultation with a toxicologist, and was based on factors such as age, gender, contact time, and route of entry. It was agreed upon by tribal representatives.

The first step was to remove certain potentially contaminated items that could be replaced, such as headgear and horsehair. This was done with the approval of the tribal representatives, and all removed items were returned to the SRMT for proper disposal. The remaining painted and unpainted surfaces were then treated with a surface-active displacement solution (SADS) as part of a recently developed strategy to remove the surface contamination. This treatment resulted in a significant decrease in dislodgeable arsenic and mercury surface residues as determined by surface wipe samples analysed by atomic absorption spectroscopy. It reduced the scale of the contamination from milligrams to micrograms and nanograms, but two of the six objects still did not meet the mitigation goal.

The objective was now to further reduce the levels of arsenic and mercury contamination to nanograms of residue per surface wipe sample (i.e. $<1.0\ \mu g$).

Mitigating the contamination to this level is imperative, as these sacred objects will come into contact with the traditional practitioner's hands and face when they are worn and with their families when they are stored.

To meet this goal, a chelating compound, dimercaptosuccinic acid (DMSA), was selected to treat the painted and unpainted surfaces following the SADS treatment. It has long been known that sulfhydryl-containing compounds have the ability to chelate metals (Aposhian 1983). DMSA was chosen because it is a sulfhydryl-containing, water-soluble, non-toxic, orally administered metal chelator that has been in use as an antidote to heavy metal toxicity since the 1950s (Aposhian 1983).

Description of the Masks

Although the surfaces in this investigation have been classified simply as painted or unpainted, each is unique. The six sacred masks had paint only on the front sides. The colour, age, and number of layers of the paint; size; use of metal; and contours were also unique to each. Red and black were the most common colours, with other colours such as white on facial features. To date, analysis has not been performed to determine if the paint contains and contributes to the arsenic and mercury issues. The age of the masks ranged from the late 1800s to the mid 1900s. The presence of ornate carved features on the painted sides furthered their individual nature. The unpainted sides were also as distinct as the painted sides. These unpainted sides make direct contact with the facial skin of the traditional practitioner when the mask is worn, and the process of fitting the mask to the face adds to the complex surface contours. Skin oil, sweat residue from normal use, and natural oil residue from traditional cleaning methods can be present on the unpainted surfaces of masks such as these. Those that have been a part of a collection can also be heavily soiled from dust due to improper storage and neglect. Cracks can range from minor surface cracks to deep cracks with separation.

Experimental Procedure

Chelating solution treatment

A 10% chelating solution was prepared using reagent-grade DMSA and commercial-grade distilled water. Cotton cloths were saturated with this chelating solution and used to wipe down the entire painted and unpainted surfaces of the masks, using light pressure in a serpentine motion. Separate cloths were used for each surface. Following this treatment, the surfaces were wiped down with a separate cotton cloth saturated with distilled water to minimize residues from the chelating solution. The surfaces were then allowed to slowly air-dry prior to obtaining surface wipe samples to determine removal efficiencies. The results from the previous study (SADS treatment, Reuben 2006) were used as the control for this study.

Detection and analysis

Twenty-four surface wipe samples were taken from the six objects using Palintest premoistened dust wipes following a modified Brookhaven National Laboratory procedure (Brookhaven 2002). The sample area was increased to half the surface area of the painted or unpainted surfaces (approximately 1000 cm^2) to account for possible uneven distribution of contaminants. Samples were analysed at Severn Trent Laboratory (STL Buffalo, New York State certification #10026) using SW8463 Analytical Method 6010 (total arsenic) for Atomic Absorption Spectroscopy (AAS) and SW8463 Analytical Method 7471 (total mercury) for Cold Vapor Atomic Absorption Spectroscopy (CVAAS). Twelve of the 24 samples were analysed for arsenic and the remaining 12 were analysed for mercury.

Results and Discussion

Arsenic results

The results from the analysis of the wipe samples for arsenic are shown in Table 1. Nine of the 12 samples showed only a slight decrease or no significant change in arsenic levels. Removal efficiencies ranged from 3 to 33%, with an average of 15%. The arsenic levels could not be determined for sacred objects 1 and 2 as they were below the minimum detection limit (MDL) for the AAS (0.50 μg per wipe). One unpainted and two painted surfaces showed an increase in arsenic levels after treatment. We speculate that this is due to additional contaminants being loosened during the mitigation treatment and mechanically removed by the surface wipe.

Mercury results

The results from the analysis of surface wipe samples for mercury are shown in Table 2. Eleven samples showed a decrease in mercury levels, with removal efficiencies ranging from 4 to 85% and averaging 48%. The other sample, the unpainted side of sacred object number 5, showed an increase of 14%. As with the increases in arsenic residues, this increase in mercury was probably due to the loosening of contaminants during the mitigation procedure.

Table 1. Results from the analysis of surface wipe samples for arsenic residues on Haudenosaunee sacred objects

Object number	Surface	Arsenic residue levels (µg per wipe) on sacred objects*			
		Before treatment	After chelating treatment	Removal efficiency (%)	Paint colours
1	Painted	0.53	ND	5	Red & black
	Unpainted	0.56	ND	10	
2	Painted	0.52	ND	3	Black
	Unpainted	0.50	ND	0	
3	Painted	0.65	1.24	0	Red
	Unpainted	0.72	0.51	29	
4	Painted	0.78	0.66	15	Black
	Unpainted	0.92	0.62	33	
5	Painted	ND	0.55	0	Black
	Unpainted	0.65	1.08	0	
6	Painted	ND	1.15	0	Black & grey
	Unpainted	0.65	0.73	0	

* Minimum detection limit (MDL) for arsenic = 0.5 µg per wipe.

Table 2. Results from the analysis of surface wipe samples for mercury residues on Haudenosaunee sacred objects

Object number	Surface	Mercury residue levels (µg per wipe) on sacred objects*		
		Before treatment	After chelating treatment	Removal efficiency (%)
1	Painted	0.334	0.05	85
	Unpainted	0.174	0.04	77
2	Painted	1.71	1.30	24
	Unpainted	2.99	1.68	44
3	Painted	0.188	0.15	20
	Unpainted	0.186	0.04	78
4	Painted	0.886	0.85	4
	Unpainted	0.176	0.11	38
5	Painted	4.76	3.07	36
	Unpainted	10.12	11.75	0
6	Painted	0.246	0.11	55
	Unpainted	0.226	0.06	73

* Minimum detection limit (MDL) for mercury is 0.012 µg per wipe.

Advantages and limitations of the treatment technique

The procedure used for the DMSA treatment differed from the technique used in the SADS treatment in the previous mitigation step (Reuben 2006). The SADS formulation was applied directly to the surface being cleaned, whereas the DMSA solution was applied to a cotton cloth and the saturated cloth used to clean the surface. This method was chosen to minimize the contact between the aqueous DMSA solution and the porous unpainted surface, thereby limiting swelling, warping, and cracking. Although this procedure has the advantage of limiting the water absorbed by the wood surface, it also limits the amount of DMSA that contacts the surface to chelate arsenic and mercury residues. This could be overcome in future experiments by increasing the concentration of DMSA to greater than 10%. Future experiments will also consider the possibility of direct application of the DMSA solution to the surface of the mask, as in the SADS treatment.

Conclusion

The discovery of mercury and arsenic contamination on six sacred objects of the Haudenosaunee complicated their repatriation (Jemison 2001). This study focussed on reducing this contamination to acceptable (nanogram) levels. Success means that the sacred objects can safely be returned home for their intended use, i.e. they can be handled and worn on the face of the traditional practitioner during ceremonies, and stored in homes where they could contact family members when not in ceremonial use. Although it is not likely that all of the contamination will ever be removed, lowering the contamination to the level where it is not harmful to human health gives the Haudenosaunee the opportunity to use these objects again.

Prior to the DMSA treatment described in this paper, two of the sacred objects (numbers 2 and 5) did not meet the mitigation goal of nanograms of arsenic and mercury. Post-treatment samples indicated that sacred object number 2 had met the goal for arsenic and was only marginally above it for mercury. However, sacred object number 5 was still marginally above the mitigation goal for arsenic on the unpainted surface and clearly above it for mercury on both the painted and unpainted surfaces. The other sacred objects, which had already met the mitigation goal by means of the SADS treatment (Reuben 2006), showed a further decrease in arsenic and mercury contamination following DMSA treatment. Future testing on simulated objects will be needed to determine the optimum conditions for DMSA use — to maximize its effectiveness in the removal of arsenic and mercury residues and its potential as an additive to future SADS formulations.

The next step for these six sacred objects will be determined by tribal representatives. Among their options is the use of alternative detection methods such as direct measurement of the surface by X-ray fluorescence techniques. This could replace or supplement the indirect analysis of the surface by wipe samples during the mitigation process. A second application of a SADS formulation will also be suggested as an option. As a final step, tribal representatives may decide to proceed to traditional cleaning methods (Reuben 2006).

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Materials

Palintest premoistened dust wipes:
Palintest Inc.
http://www.palintest.com

Dimercaptosuccinic acid (DMSA) [304-55-2],
part number D7881:
Sigma Aldrich
http://www.sigmaaldrich.com.

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Biographies

Richard W. Hill Sr. is an artist, writer, educator, and museum consultant. A member of the Haudenosaunee (People of the Longhouse), Mr. Hill is Tuscarora, Beaver Clan. He has worked in many institutions, as well as being a consultant at the Rochester Museum, the Buffalo Historical Society, and the Institute of American Indian Arts in Santa Fe. He currently teaches at McMaster University, Mohawk College, and Six Nations Polytechnic, and has been involved in developing culturally based curricula and training for Seneca language teachers in New York State. He was formerly an Assistant Professor in Native American Studies at the State University of New York (SUNY) at Buffalo, and Assistant Director for Public Programs at the National Museum of the American Indian, Smithsonian Institution in Washington, DC. He is currently the Chairperson of the Haudenosaunee Standing Committee on Burial Rules and Regulations and is involved in the repatriation of human remains, burial objects, sacred objects, and objects of national cultural patrimony. Along with Raymond Skye, he has developed the Six Nations Virtual Archive of Information of Haudenosaunee.

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