

Hair Analysis Shows No Signs Poisoning

This chapter will document important scientific facts regarding analysis of hair arsenic levels in Srila Prabhupada's hair relics. Nityananda Das has claimed that Prabhupada's hair levels were recorded at 3ppm and that this represents solid evidence that "undoubtedly Srila Prabhupada was maliciously poisoned."

We will show that this assertion is untrue, with reference to various authoritative scientific literatures and experts in the fields of toxicology, medicine and neutron activation analysis.

Scientific facts about arsenic in hair

1. Arsenic is the twentieth most abundant element in the earth's crust.
2. The real figure for the testing of Prabhupada's hair sample was NOT 3ppm arsenic but 2.6ppm.
3. Scientific studies have shown levels of 4.8ppm (Mexico City) and 3ppm (Glasgow) average arsenic content of hair in normal (unexposed) populations.
4. Research proves that persons who are malnourished exhibit a 50% increase in the concentration of trace metals in their hair, due to slowing of hair growth while the rate of metal deposition remains constant.
5. Results of up to 1.4ppm arsenic (Didima Mataji) were found in Mayapur devotees, and up to 3.36 ppm in persons who only occasionally visited the Ganges arsenic affected area.
6. By far the major source of elimination of arsenic is through the kidneys and urine. One would expect elevated levels of these toxins in the blood and hair of a person suffering serious kidney malfunction.
7. Forensic pathologists agree that even high levels of arsenic cannot on their own be accepted as proof of poisoning without specific clinical symptoms of arsenic poisoning.
8. Hair analysis for arsenic is a very unreliable indicator of serum arsenic levels when a specific individual is tested without a range of reference values from a group of the same time and place for comparison.
9. Expert scientists who are presently working in the field of hair analysis and neutron activation agree that any amount up to 10 ppm arsenic can be considered 'normal' levels of arsenic.

Discussion

1. Arsenic is the twentieth most abundant element in the earth's crust, and is found in many pesticides, smelting processes, paints, underground water supplies and traditional oriental (including Indian) remedies.

It is common knowledge that arsenic is a deadly poison, and many people imagine arsenic to be a rare chemical manufactured in some exotic chemical laboratory. Therefore many devotees feel shocked when told that Srila Prabhupada's hair relics contain trace amounts of

arsenic. However, the actual fact is that arsenic is the 20th most common element on this planet and pervades almost everything in our environment, including our own bodies.

2. The real figure for the testing of Prabhupada's hair sample was not 3ppm arsenic but 2.6ppm.

In his book, Nityananda Das reports two different tests done on Srila Prabhupada's hair relics. One is reported as being 1.1 ppm and the other "almost 3.0 ppm." He then goes on to use "3 ppm" as the accepted figure. However, we have recently been provided with the original document from Dr. Steve Morris of the University of Missouri who performed the tests, which states that the actual figure was 2.6 ppm arsenic.

3. Scientific studies have shown results of 4.8ppm (Mexico City) and 3ppm (Glasgow) average arsenic content of hair in normal (unexposed) populations. MIT lists 0.13 - 3.71 ppm as the range of average values for normal (healthy) persons.

In 1997, Dr. Armienta of the Geophysics Institute of the University of Mexico conducted a series of tests on water and hair samples from residents of Zimapan in central Mexico. For some years residents had complained of various ailments, which were caused from arsenic exposure via local well water. The tests showed hair concentrations of arsenic in the affected townspeople to be 9.22 ppm.

Even more interesting was their results for a reference group of unaffected 'normal' people. This group was taken from residents of Mexico City and showed the average concentration was 4.8 ppm arsenic in hair. Remember that these are perfectly healthy individuals with no particular exposure to arsenic. The authors explained that the high value could be explained by the air pollution prevalent in Mexico City, as arsenic binds tightly to the keratin molecules in hair, whether via sweat or from external sources.

Another study performed in the 1970's showed an average of 3 ppm hair arsenic in the population of Glasgow, again presumably due to high pollution levels.

Remember that these figures are an average, which means that some of the "healthy" subjects tested contained levels that were much higher still than 3 or 4.8 ppm. Therefore the fact that Srila Prabhupada's hair contained 2.6 ppm cannot be taken as proof of poisoning. Rather this value falls within the range of average values reported in various studies around the world.

4. Research shows that persons who are malnourished exhibit 50% higher than normal content of metals in their hair, due to the hair growth slowing markedly while the rate of metal deposition into the hair remains constant.

In 1983, the New York Hospital Medical Department conducted experiments into the pitfalls of hair analysis for trace element

concentration. They found a peculiar phenomenon, whereby the concentration of trace metals in hair actually increased when a patient was malnourished. This was due to the fact that the rate of hair growth slowed markedly under conditions of malnourishment, while the rate of deposition of trace elements from the blood and external environment remained constant. This produces an artificially elevated level of trace metal in the hair compared to the actual level in the bloodstream.

For example, if 0.05 mg of metal were deposited in the hair per day, which grew at a rate of 2 mg per day, the concentration would be $0.05 / 2 = 0.025$ metal per hair mass. However, if the hair growth slowed to 1.2 mg per day, the apparent hair concentration would rise to $0.05 / 1.2 = 0.040$ metal per hair weight. Thus a 40% decrease in hair growth corresponds to a 50% increase in trace metal concentrations.

It is well known that Srila Prabhupada ate very little for most of 1977. Bhakti Caru Swami, who cooked for him for most of this time, confirms this:

When His Divine Grace was in Bombay, after the Mayapur festival in 1977, I started to cook for him. Although he was eating something, but it was very little and he even commented that if he could just eat two chapattis that would indicate his good health. However, he could not even eat that much.

When Srila Prabhupada arrived in Vrindavan (May 1977) after giving his arrival darshan to all the devotees there, Srila Prabhupada called me to his room and told me not to cook for him and persuade him to eat. He told me, "What's the use of eating when there is no appetite". From then onwards his food intake was reduced to practically nothing.

Srila Prabhupada's hair growth certainly slowed during 1977, and his personal servants also confirm this. Therefore one would expect that the content of metals in his hair would be higher due to constant exposure to trace levels of heavy metals and marked decrease in hair growth.

5. Results of up to 1.4ppm arsenic (Didima Mataji) were found in Mayapur devotees, and up to 3.36 ppm in persons who only occasionally visited the Ganges arsenic affected area.

Nityananda Das claims that "normally one would expect to find from less than 0.05 ppm arsenic up to perhaps 0.1 to 0.2 ppm, depending on exposure... and that farmers regularly exposed to pesticides MIGHT temporarily attain a level of 1.0ppm, which is probably why so many have cancer."

However, we don't have to look very far to discount this speculative reasoning. Recent testing done on some of the resident devotees of Mayapur have found that they do in fact contain hair arsenic levels above 1 ppm, and are not suffering any ill effects from such levels.

Nityananda Das goes on to make a dramatic embellishment of the 3 ppm figure, saying it is "15 to 60 times over average. The presence of such high amounts of the world's deadliest poison in Srila

Prabhupada's hair confirms: Srila Prabhupada was poisoned with arsenic."

However, using these figures, the levels of arsenic in the hair of Didima Mataji are also 30 times the "average" level. If Nityananda is so sure about these figures, why isn't he also suggesting we launch a full investigation into who is poisoning Didima?

Nityananda Das tries to pass off the West Bengal arsenic crisis by saying, "There was some news a few years back about health problems in Bengal due to arsenic contamination in deep well water. However, Srila Prabhupada left Mayapur, Bengal in March 1977 after a stay of six weeks."

In contrast, a 1995 study done by Jadavpur University described the situation as a crisis, titling their research paper "The Biggest Arsenic Calamity in the World" saying that at least 30 million people in six districts of West Bengal are living with levels of arsenic higher than the level recommended by the WHO. A list of the affected areas extended all along the Ganges delta, with Navadwip being specifically mentioned as one of the seriously affected areas. This study reported hair arsenic concentrations from one affected family in Murshidabad as ranging from 4.78 up to 9.78 ppm.

Of special relevance to this discussion, two additional members of the family who only came home occasionally and just happened to be there on the day of the testing, had hair arsenic levels of 2.35 and 3.36 ppm respectively. Neither displayed any adverse health effects.

It is not clear when was the last time the clippers that contained the hair sample were used. The very last time Prabhupada was shaved was on September 22, 1977. However, Tamal Krishna Maharaja reports that he shaved Prabhupada with a razor blade (as reported in TKG's Diary). Therefore the hair clippers were almost certainly not used after Prabhupada came back from England on September 12. This puts the date of last use back to at least mid-August. Prabhupada's servants confirm that his hair growth had slowed very dramatically throughout 1977. This, together with the possibility that other clippers or razors were used to shave Prabhupada's hair, makes it possible, if not probable, that the hair remnants from the clippers in Vrindavan are from much earlier in the year. In fact, the only confirmed use of the Wahl clippers in 1977 comes from Hari Sauri Das who remembers shaving Prabhupada in March with these very clippers. If the clippers were last used in March, April or May, the hair remnants would contain growth from Prabhupada's six-week stay in Mayapur up to 22 March. This factor, together with Prabhupada's travel through polluted Indian cities and the concentrating effect of slow hair growth, as will be explained below, means that a figure of 2.6 ppm arsenic is by no means an unusual amount.

6. By far the major source of elimination of arsenic is through the kidneys and urine. If someone with serious kidney malfunction was exposed to even small amounts of arsenic via water or medicines, one

would expect elevated levels of these toxins in the sweat and sebaceous secretions (and therefore the hair) due to lack of sufficient kidney function to eliminate the toxins.

It is well known that arsenic and other heavy metals have a debilitating effect on the ability of the kidneys to eliminate toxins. However, just as high blood arsenic levels damage the kidneys, an already malfunctioning kidney will also raise the blood concentration of such toxins due to not properly eliminating them via the urine.

Studies show that at least half the total amount of arsenic from water or environmental sources is eliminated by the kidneys and passed out through the urine. Someone suffering from serious kidney damage would have a dramatically reduced ability to eliminate arsenic from the bloodstream. Therefore whatever trace amounts one would normally expect to be deposited in the hair and other tissues would be elevated under these conditions.

Knowing that Srila Prabhupada had severe kidney damage, we can understand that the figure of 2.6 ppm arsenic concentration in Prabhupada's hair is in no way conclusive of poisoning. Considering the state of his kidneys, if Prabhupada were given any amount of arsenic one would expect a far higher level of arsenic in his hair than this.

7. Arsenic gets into hair via sweat and other secretions and binds strongly onto the keratin molecules in hair. Because of this it is impossible to distinguish between arsenic sweated from the skin and then bound to the hair and arsenic that later binds to hair through contamination from an external source. Therefore forensic pathologists agree that even very high levels of arsenic cannot on their own be accepted as proof of poisoning without specific clinical symptoms of arsenic poisoning.

Scientific studies have shown that arsenic gets into hair via sweat and sebaceous secretions and then firmly adsorbs itself to the keratin proteins in the hair matrix. This was discovered through a number of studies, including the work of Young and Rice who found arsenic in the hair of guinea pigs injected with sodium arsenite beyond the point it could have reached by hair growth alone. Similar studies have confirmed these findings.

Therefore, it is impossible to discern between arsenic that is bound to hair via ingestion, from that which binds itself to hair from an external source, either while the person was alive or while the hair relic was in storage.

For this reason, forensic pathologists are very wary of accepting a diagnosis of arsenic poisoning unless there are clear indications via clinical symptoms (i.e. hyperkeratosis, sensory polyneuropathy, raindrop pigmentation, Mees' lines etc). We have covered the subject of Prabhupada's distinct lack of clinical arsenicosis symptoms in chapters 4 and 7.

Dr. Corso of Yale University Medical School and Dr. Hindmarsh of the Department of Pathology and Biochemistry at Ottawa University explain this point nicely, in their 1996 paper that debunked the spurious theory that Napoleon Bonaparte was poisoned by arsenic.

"As every forensic scientist know, the diagnosis of chronic arsenic poisoning cannot be made upon elevated arsenic concentrations in hair alone because external contamination of the hair by arsenic can produce a sustained increase in hair arsenic that cannot be differentiated from the increases that occur from arsenic ingestion. Thus, before a diagnosis of chronic arsenic poisoning can be made, the characteristic clinical features must be present as well as an appropriately elevated arsenic concentration in hair. In addition, external contamination of the hair by arsenic must be excluded."

Doctors Corso and Hindmarsh further elaborate, listing the most common and constant clinical features of arsenic poisoning, and their noted absence in the symptoms displayed by Napoleon.

The most prominent dermatological feature of chronic arsenic poisoning is also constant: raindrop pigmentation of the skin, particularly around the axillae, groins, temple. Eyes, neck, and nipples, although it may also extend over the shoulders and chest anteriorly and posteriorly. Hyperkeratosis of the palms of the hands and soles of the feet is also often present, frequently associated with arsenical "corns". These features were clearly not present at death, as Henry reports that the skin at autopsy was "white and delicate, as were the hands and arms."

The spurious theory of Napoleon's poisoning and that of Srila prabhupada share many common aspects. It should be noted however, that the figures obtained for Napoleons hair analysis included levels of 16.9, 15.3, and 11.8 ppm arsenic. Still the consensus among toxicologists is that the poisoning theory is not acceptable due to lack of characteristic symptoms, and an inability to rule out environmental contamination.

Certainly a similar theory would be even more unacceptable when the highest hair level recorded was only 2.6 ppm.

8. Hair analysis for arsenic is a very unreliable indicator of serum arsenic levels when a specific individual is tested without a range of reference values from a group of the same time and place for comparison. This unreliability is even more marked when a small amount of hair sample is tested.

Because arsenic can be found in quite high concentrations in some parts of the world and practically doesn't exist in others, the reference range of values for 'normal' unexposed populations is very wide. In some places the average arsenic content of hair is seen to be approx. 0.13 ppm, while in other places, especially industrialized cities with pollution problems, or areas with arsenic in underground water supplies, the average levels can be as high as 3 ppm or even 5 ppm.

Thus while one can say what one would normally 'expect' for arsenic content in a person's hair, there is no hard and fast rule for arsenic levels. Rogers et al. from the Toxicology Department at Cambridge, list the "range of mean values reported in 15 different studies involving normal (healthy) sample donors" to be 0.13 - 3.71 ppm arsenic. Thus many studies over the years have shown that normal, healthy population groups can and do have arsenic levels in their hair in excess of 3 ppm.

The standard reference work 'Comprehensive Review in Toxicology for Emergency Clinicians', explains that arsenic concentration of hair varies with nutritional, environmental and physiological factors. Nityananda Das listed this book as one of his reference materials, and in it he should have read, that the upper limit of NORMAL arsenic concentration with 99% confidence in people NOT exposed to arsenic is 5 ppm.

Nityananda Das gives a characteristically emotion-charged lead up to the "3ppm" figure by saying that only "farmers who are regularly exposed over a long term basis to agricultural herbicides and pesticides containing arsenic compounds MIGHT temporarily attain a level of 1.0 parts per million." As we can see from the above studies this is patently UNTRUE.

In his report on the 2.6 ppm figure (see figure 2), Dr. Morris gives no real interpretation of the results, except to say that this figure is approximately 20 times the figure one would expect to find as a normal average among unexposed individuals living in the United states. However there are obvious difficulties in a blanket application of this figure for all times and places. We need only to look at the proven arsenic levels of Didima Mataji of 1.4 ppm. Using the above interpretation, her hair contains more than ten times the average one would expect for someone living in the United States.

Because of the large range of "normal" values for hair arsenic levels, some authorities actually recommend that these values shouldn't be relied upon at all when applied to an individual, but should only be used where a group of individuals from the same area can be measured and compared to the average of that particular group.

In the standard handbook of clinical toxicology 'Clinical Management of Poisoning and Drug Overdose', Doctors Hall and Robertson make this point very strongly with regard to arsenic hair analysis:

Under no circumstances should any credence be paid to hair analysis of an individual patient, unless perhaps it is conducted as part of an epidemiological investigation of a group of patients. Such results ought to be applied only to the group.

We can see the work of Armienta et al. cited above illustrates this point nicely. Their reference group had an average concentration of 4.8 ppm arsenic, while the affected group showed 9.22 ppm. By analyzing the data in terms of the particular locales, they were able to obtain

meaningful results. However, had they blindly followed the rule of 0.13 ppm as the standard level, the reference (unaffected) group would have showed more than 35 times the average for unexposed persons. This is the kind of reasoning Nityananda Das has used to try and make his case.

Another problem with the analysis performed on the hair relic from Prabhupada's clippers is that it is an extremely small quantity of sample. Generally, forensic toxicologists prefer to have a reasonably large group of hair clippings, taken from various parts of the head. Due to large variations in concentrations of metals among different hair strands, it is important to obtain a reasonably large sample amount for testing, otherwise the results may be misleading. The amount of hair assayed by

Dr. Morris was 0.0013 grams, a very small amount that was caught between the blades of the clippers. It is an extremely tenuous proposition to base a murder case on such a small amount of hair, especially as the amount of arsenic - 2.6 ppm - is in itself nothing like proof of arsenical intoxication.

Doctors Corso and Hindmarsh make the same point when exposing the fallaciousness of the Napoleon poisoning theory.

Even when external contamination can be excluded by other evidence, the relationship between the degree of poisoning and hair arsenic levels is only approximate. Traditional interpretations are based on mean concentrations found in a minimum of 1 gram of hair, usually collected from several sites on the head. Variations from hair to hair, and even along the same strand of hair, are large, making the interpretation of data derived from individual hairs or from specific locations on a single hair less predictive than mean levels from larger samples.

Therefore the results obtained from a meager 0.0015 grams of sample should be viewed with extreme caution, especially if they do not indicate an obviously elevated level of arsenic, i.e. more than 10 ppm.

9. Expert scientists who are presently working in the field of hair analysis and neutron activation agree that levels under 10ppm cannot be considered indicative of arsenic poisoning.

During investigations into the poison issue, we contacted various laboratories across the United States regarding possible testing of a hair sample from Srila Prabhupada. These professionals provided a number of interesting facts that are very relevant to this discussion.

Keep in mind that the information relayed below was given totally unsolicited from persons who have no connection with ISKCON, nor even had any idea about why we were enquiring about testing for arsenic.

Larry Kovar from General Activation Analysis, one of the only labs in the world that does commercial neutron activation outside of a university, had this to say about arsenic levels in hair (you can read his entire message in appendix 2):

For your information, my hair has about 3 ppm Arsenic - the last time I tested it (I'm still alive, I hope) If you send samples to a lab, send some of your own as a control.

This squarely puts the 2.6 ppm reported for Srila Prabhupada, and the poison theory in general as expounded by Nityananda, firmly where it belongs; i.e. the 'circular file'. When I mentioned to Larry in a later correspondence about the 3 ppm reported by Nityananda Das, he had the following to say:

Not sure where the As came from - 3 ppm could be "normal" and not from an external source.

When I asked about retesting the hair that was tested by Dr Morris, Larry had this to say:

A low (less than 10 ppm) value shows the hair is "normal". A high value (greater than 10 ppm) indicates Arsenic exposure. Since the hair has been tested at 3 ppm As, I feel a re-test is not necessary... I have discussed this with Dr Vince Guinn, a well-known researcher in this field, and he agrees.

After Larry found that his facility didn't have the required reactor time to perform the tests, he contacted Dr. Richard Cashwell at the University of Wisconsin about performing the analysis. Dr Cashwell wrote back with the following information regarding his own experience with neutron activation analysis for hair arsenic:

We ran a series of As in hair determinations years ago; the highest "normal" sample we saw was 12 ppm- from a physics graduate student from Scotland. I'd agree with your normal range.

What this means is that trained professional scientists who are working in this very specialized field of neutron activation analysis for hair arsenic content, all confer that any value up to 10 ppm arsenic can be considered to be "normal" levels. Therefore we are left to either believe these experts, and all of the other scientists and doctors quoted above, or Nityananda Das who has no experience or background in this field whatsoever.

In conclusion, based on the documented evidence, there are absolutely NO GROUNDS to claim that the 2.6 ppm arsenic level for Srila Prabhupada's hair is a clear indicator of poisoning. Hair can absorb arsenic from any number of possible external sources, thus raising the apparent concentration of arsenic. Therefore no forensic pathologist will return a finding of poisoning based on hair analysis alone, without specific clinical symptoms of arsenicosis.

Even if external contamination could be ruled out (which it clearly cannot in this case), the figure of 2.6 ppm is not high enough to warrant suspicion. Studies have shown average hair concentrations of up to 4.8 ppm in city populations unexposed to arsenic, and a report of 15 different studies by the Toxicology Dept. at MIT Cambridge gives a range of average values for normal (healthy) individuals as being 0.13 - 3.71 ppm arsenic.

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