Chapter 8

Conclusion

ICP-AES is found to be an acceptable and reliable technique for the analysis of elemental concentration in teeth. The concentration of each element could be determined accurately. However, some error may occur during the system measurement, one of them is the waiting period for ICP analysis, which causes the elements to be lost when deposited on the glassware surfaces of the test tube. Therefore, the fresher the sample, the more accurate the measurement. Shaking the test tube before measurement is a way to reduce this error.

The analysis of teeth for Pb can be a useful guide to observe the cumulative Pb exposure to a person (Steenhout and Pourtois, 1981; T Al-Naimi et al, 1980; L.T.Chew et al, 2000). The Pb concentration for these groups from Klang Valley vary from 1.412 ± 0.835 μg (g of tooth mass)$^{-1}$ to 53.802 ± 6.483 μg (g of tooth mass)$^{-1}$, while the Malaccan samples range from 0.713 ± 0.039 μg (g of tooth mass)$^{-1}$ to 55.512 ± 8.945 μg (g of tooth mass)$^{-1}$. The samples from Klang Valley which reflected a significant enhancement are the samples from donors who are working in the factory environment (welding metal, wire, automobile, refrigerator, aluminium) and as taxi driver, where their concentration of Pb is higher than the median level of 7.801 ± 1.973 μg (g tooth mass)$^{-1}$ for Klang Valley. Their average Pb concentration is at the level of 18.617 ± 3.980 μg (g tooth mass)$^{-1}$. However, most of the donors from Malacca are not involved in factory activities as in the case of donors from

Klang Valley. They are mostly retired workers and housewives. Their background history is hard to trace for this study purpose since they are mobile from one place to another. Thus, the likely reasons, that contributes to the higher concentration of Pb could not be ascertained.

The difference in living environment may cause the Malaccan samples to have higher concentration of Zn and Cu, if compared with the samples from Klang Valley. However, more information is needed for detailed assessment. The mean tooth-Zn level for Klang Valley and Malacca are 103.645 ± 0.929 μg (g of tooth mass)$^{-1}$ and 120.667 ± 1.252 μg (g of tooth mass)$^{-1}$ respectively. While the Cu concentration ranges from 0.346 ± 0.121 μg (g of tooth mass)$^{-1}$ to 37.945 ± 1.207 μg (g of tooth mass)$^{-1}$ and 0.613 ± 0.391μg (g of tooth mass)$^{-1}$ to 54.754 ± 1.537 μg (g of tooth mass)$^{-1}$ for the samples of Klang Valley and Malacca respectively. The concentration of Zn and Cu are quite constant over the donors' age, which show no sign of accumulation of these two elements in the teeth of more mature donors.

The concentration of Cd is found to be low. The Klang Valley samples show the concentration of Cd to range from 0.0181 ± 0.002 μg (g of tooth mass)$^{-1}$ to 3.910 ± 0.072 μg (g of tooth mass)$^{-1}$, while the samples from Malacca show the concentration to be in between 0.039 ± 0.019 μg (g of tooth mass)$^{-1}$ and 3.511 ± 0.039 μg (g of tooth mass)$^{-1}$. These results illustrate the concentration level of Cd in human teeth is very low, if compared to some other parts in the body such as the kidney cortex, blood and urine (Lars Ahlgren and Soren Mattson, 1981). The Cd contamination comes mainly from the exposure to industrial waste, food intake and inhaling cigarette smoke as suggested by Ellis et al. (1979). However, for smokers,

information such as the length of time since they started smoking and whether the family members and closely associated friends around are smokers also are not available. Therefore the lack of these information greatly restrict for further analysis on the relationship of these parameters.

No significant difference on the concentration of Ca and Mg for the samples between that from the Klang Valley and Malacca is found. Both concentrations seem not to be age dependent.

The significant relationships of Zn with Cd, and Ca with Mg have been noticed whereby the correlation coefficients are 0.416 and 0.251 for Zn-Cd, and Ca-Mg respectively. The relationship between Ca and Mg is constituted by the theory that Mg is an important element to regulate the calcium level in the body. Thus, both have a close relationship in terms of concentration in human teeth. Cd, on the other hand, is toxic by nature, while Zn is an important element in cellular processes in human body, especially in the proper calcification of bone and teeth. Thus, logically we can't find any relationship between these elements. Therefore, the analysis could be concluded with the idea that this relationship might be due to the food intake, which is contaminated by Cd. Otherwise, this coefficient might not necessarily have any implied meaning to it. Therefore, further study is needed to make the confirmation.

XRF technique in this study failed to detect Pb concentration lowers than 800 ppm. The spectrum of Pb K-lines does not appear clearly. High error in calculation of average mean of difference failed to form the standard calibration to detect the Pb in tooth (the concentration of Pb in tooth << 100 ppm). Therefore, base

on the results obtained, this XRF system is just suitable to detect only higher level of concentration (>> 800 ppm) of Pb for industry wastes.

Future work must be directed towards analysing donors' background information such as smoking habit, and detail of working and living environment in order to obtain a reliable correlation between these factors and concentration absolute of heavy elements in specific regions of the teeth. XRF method, could be further improved by replacing the radiation source of Cd-108 instead of Tc-99m in order to detect the Pb concentration at level lower than 100 ppm.

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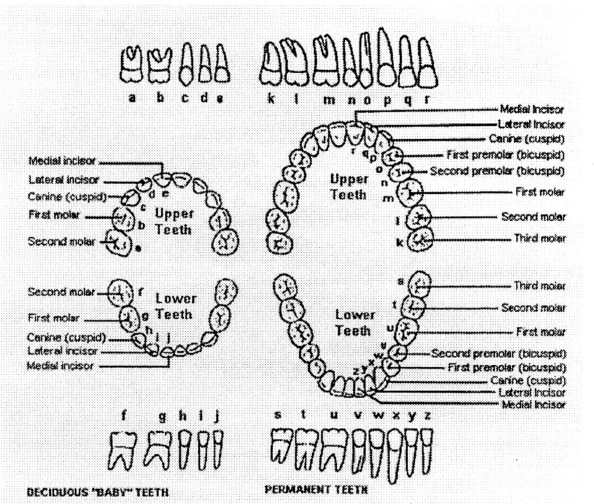
Structure and Composition of a Tooth



Deciduous and permanent teeth in the upper and lower jaw

List of Publications

1. Chea-Beng. Lee, Y.M.Amin, Mohd Jamil Maah and David Bradley, **2000**, *"The Determination of Pb Concentration with Tc-99m As Excitation Source"*, Nuclear Science Journal of Malaysia, vol. 18 no. 2, pg.136-142.

2. Chea-Beng Lee, D.A.Bradley, Ithnin Abdul Jalil, Y.M.Amin, Mohd Jamil Maah and Khairul Zaman M.Dahlan, **2001**, *"New Measurements Concerning a Non-Resonant Photo-Activation Cross-Section for ^{111}Cd"*, Radiation Physics and Chemistry 61, 367-369.

3. Chea-Beng Lee, Mohd Jamil Maah and Y.M.Amin, 2000, *"Study the Lead Concentration in Human Teeth by Induced Coupled Argon Plasma Atomic Emission Spectroscopy (ICP-AES)"*, **In press**, Seminar on Radiation, Medical Physics and Radiotherapy, University of Science Malaysia, Oct. 2000.

4. Chea-Beng Lee, Y.M.Amin, Mohd Jamil Maah and Rosli Mahat, 2000, *"Comparison Of The Concentration Of Toxic Element (Lead) In Human Teeth Taken From The Areas Of Kuala Lumpur and Malacca"*, **in press**, Borneo Science.

5. Chea-Beng Lee, Y.M.Amin, Rosli Mahat and Mohd Jamil Maah, *"Evaluate of XRF Analysis of Lead"*, Proceedings of The First iTRS International Symposium on Radiation Safety and Detection Technology, **July 18-19, 2001**, Seoul, Korea, pg. 243-247.

6. Mohd Jamil Maah, Chea-Beng Lee, Y.M.Amin, *"Study on the Concentrations and Correlation Coefficient of Cadmium and Zinc in Human Teeth by ICP-AES"*, ASIANALYSIS VI, The Sixth Asian Conference on Analytical Sciences, **in press, August 7-10, 2001**, Tokyo, Japan.

7. Chea-Beng Lee, Mohd Jamil Maah, Y.M.Amin, *"Determination of Cadmium Concentration in Human Teeth by ICP-AES"*, The First Asia Oceania Congress of Medical Physics (1st AOCMP), **November 14-16, 2001**, Bangkok THAILAND, 161-165.

8. Mohd Jamil Maah, Chea-Beng Lee and Mohd Yusof Amin, *"Study on Trace Metals Contents in Human Teeth Collected from some Residents in Klang Valley and Malacca"*, Regional Analytical Science Symposium (RASS 2001), **11-13 September 2001**,

9. H.J.Woo, C.S.Wong, C.B.Lee, Y.A.Abdulla and Y.M.Amin, *"Transient Hollow Cathode Discharge As Pulsed X-ray Source"*, Persidangan Fizik Kebangsaan 2001, **15-16 September 2001,** Kuala Lumpur.

10. Chea-Beng Lee, Y.M.Amin and Mohd Jamil Maah, "*The Concentration of Heavy Metals in Different Type of Human Teeth*", in-press, Journal of Science Malaysia.

11. Chea-Beng Lee, Y.M.Amin and Mohd Jamil Maah, "*Study the Lead Concentration in Human Teeth by Induced Coupled Argon Plasma Atomic Emission Spectroscopy (ICP-AES)*, Journal of Science Malaysia.