**Evaluation of Trace Elements in Human Biological Tissue –Permanent Teeth for the determination of Biometrics**

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**Abstract**

**The original aspect of this analysis and study was to identify various trace elements present in the biological tissue teeth of the human being and to measure the quantity of varied trace elements and their concentration .Therefore the concentration of each and every trace elements present in human teeth and their variation has been studied to seek their possibility to prove the usage of them for biometric Authentication. The 38 healthy women aged between 15 to 55 years was investigated for the element, K, Cl, Mg, Na, P, Mg, S,Ca and Sr in the intact roots of human permanent teeth. And also Fifty-six human tooth samples were collected from male and female subjects of 46 different age groups, all of whose age is (0 to 18, 19 to 30,31 to 45, 45+) and the data obtained were analysed for Biometrics. Additionally, the variation of concentration of trace elements like Fe, Ba, K, Sr, Na, P, Al ,Mg, Si, Cl, Ca ,F ,Zn and S in the human Tooth were analysed.. The composition of elements and their concentration in human teeth varies from one person to a different person and this study is helpful in identifying an individual and this technique is applied for recognizing a person or in the area of Biometrics. This is the new area of research in the field of Biometrics. The findings and results of this study would be applied for creating a knowledge base and database for bio monitoring, disease analysis and also Identify nutritional status of human body. This study and findings is not yet been performed at this biometrics area of research**

**Key Words : Teeth, Trace Element, concentration**

**1.Introduction**

The Biological tissue Human Teeth contains various elements and trace elements. Trace element are found in two forms namely unstable (radioactive) forms and stable form in nature. These two kinds of elements enter into the human body through food intake, air and water. These are transferred to various parts of the human body via the respiratory system, digestive system or dermal absorption [1]. The variation of element concentration depends upon many factors such as environmental conditions and mineral intake within the individual's diet [2]. Once they enter in human body these elements, accumulated in various ral parts of the physical body and they are consistent with their chemical properties. As an examples the element iodine is accumulated within the thyroid; the elements thorium, radium and potassium is accumulated within the bones; plutonium is accumulated in both the bones and liver. The various stable elements plays an vital and inevitable role in human organ ,tissue’s function. The intake of some excessive amounts of certain stable elements or absorbing some elements that carry toxic characteristics can cause damage to the human beings. For example the dificiency or excess of sodium can bring heart disease and the element Magnisium can cause damage to vessels and intestines of the human body. So it is vital to observe the presence and excess of certain stable and unstable elements in certain tissues such as Nail and hair and in biological fluids such as plasma,urine,whole blood,serum,breast milk,sweat and saliva. The Trace elements in biological tissue, teeth are often measured in the fields such as forensic identification, paleoecology, scientific archaeology and other area of research [3]. The Element analysis methods helps us to figure out the geographical origin of human beings. The Element analysis assist in identifying what are the elements are very important for the function of the human body and also important for growth function of the human body, development, metabolism and endocrine function [4]. The elemental composition and concentration of human teeth varies to each and every individual person. There has been wide scope among researchers to select the proper biological entity to study the Biomonitoring .it is also important to use the human body fluids urine ,blood and tissue such as bone, teeth, nails, hair and saliva to the assessment of environmental pollution through detection of toxic heavy metals .These biological entities are considered for soft Biometrics[5] . it is also helpful in identifying murder victims and ancient human remains.

**2. Soft Biometrics**

Soft biometrics is the sub area of biometric identification field which use physical or behavioural traits which can be naturally used to describe or recognize or identify humans. Soft biometrics identification uses the descriptions such as height, weight, Scars, Tattos and eye color to identify a person with the primary biometric information such as finger print or face recognition. We can also use the elements or trace elements present in the teeth of the human being for soft biometrics as the composition and concentration varies to each and every individual of human being.

**3. Biological Tissue -TEETH**

Humans beings have 20 primary teeth (which is “baby” or “deciduous” teeth ) and 32 permanent (adult) teeth. The biological tissue Teeth in the human body are classified as canines , incisors, premolars and molars. The timeline for each different tooth is extremely different . Each and every tooth has different time line for their development .The age of initial calcification, crown completion and root completion for the third molar is from 7 -10 years old, 12 -6 years old and 18 -25 years old for the respectively.

The elemental compositions and concentration of human bones and teeth often provide information on the human health and diet of a n individual and thus the exposure to chemicals of the human beings is applied in the field of research .it is helpful in forensic medicine and environment study.

The concentration of elements in Deciduous teeth are applied mainly in environmental studies because the information on metals or chemicals exposure to the elements obtained from the environment during childhood are often provided by deciduous teeth. Deciduous and permanent teeth are similar in morphology so permanent teeth can be used to assess and analyse the environmental exposure of humans to metals .It is also noted that teeth enamel is consistently in direct contact with the environment of the human mouth. The various factors such as pathological and physiological factors that affect the human mouth (the utilization of drugs , consumption of food, can affect the essential concentration and compositions of the surface of the human teeth[4] .

**4. Trace Elements in TEETH**

The content and composition of trace elements are different in sound deciduous and permanent teeth .It depends upon the type of tooth. The distribution of chemical elements during a development of tooth isn't homogenous. So The study has to be performed on the tooth regarding the age and gender related changes. The study has also to be performed on the type of tooth ,the tooth part (root and crown)and thus the tooth tissue (cementum, dentin, pulp and enamel,).It is also noted that among different ethnic groups, there are many variations within the concentration of trace elements in teeth enamel. this is because of differences within foods and food choices, which are often influenced by cultural and social practices.

The differences in elemental content may be nutritional elemental intake from the food, air and water we take and our environmental surrounding. Environmental pollution with heavy metals (e.g. Cd, Pb) can also affect the composition of human teeth. The mineral composition of human teeth can also be affected by the applied fillings in permanent and primary teeth. The time of their presence within the mouth may reflect changes in mineral composition of teeth.

The difficiency of a particular essential chemical element or elemental overload could also be life threatening or debilitating to the human beings[5].

**4. Data Set creation**

We used the open dataset from pubmed and mendeley that is available in J Radioanal Nucl Chem, DOI 10.1007/s10967-016-4803-8.

**5. Previous Work**

In my previous work the body Fluids like serum, Blood and urine was analysed for Transient Biometrics. the weather and chemical element or minerals exposure in Human blood, urine, Serum was studied. The Exposure of chemical element within the physical body or the concentration of element or trace elements in body fluids or tissues are constant for a specific period of your time and then it changes. The blood Concentration is stable surely period (Several days), The Concentration in urine for several Weeks[4]. in order that they are Determined for Transient biometrics. The element exposure within the body tissues like Toe nail and finger nail have shown longer exposure (several months) than the physical body Fluids like Blood, Serum, urine. Compared to other body fluids Human nail are often collected easily and nail samples are often obtained Non-Invasive way.

**6. Proposed Approach**

The physical body fluids like Urine and blood provide current or recent body status compared to other quite body tissue like nail. The Nail has various uses and even has advantage over body fluids like sweat, blood and Urine or other accessible tissues. Many Characteristics or advantages of nail is painless removal, Easy to handle, Easy to gather , easy to move , high stability over temperature and comparatively higher elemental concentration than other body fluids and tissues.

**7. Methods**

**7.1 Samples**

The non carious permanent teeth of human were collected for the assessment of trace elements within the teeth . The trace elements such as K, Cl ,Mg, Ca, Na, , Mn , Sr and P in the intact roots of permanent teeth of 38 healthy women aged between 15 to 55 years was determined and analysed by neutron activation analysis .And also elements from 56 tooth samples were collected from male and female subjects of four different age group is (0 to18, 19to 30, 31 to 45, 45+)observed.

**7.2 Data Analysis**

A total of 8 trace elements Ca, , K, Cl ,Mg, P, Na ,Sr and Mn were investigated in most of the human tooth dentine samples that were analyzed and determined by neutron activation analysis.

**8. Results and Discussion**

The results of the data analysis of trace elements such as Mg ,Ca, K, , Na, P, Cl ,Sr and Mn that are present in the human biological tissue ,teeth of 38 female (**Table 2**) and 46 male (**Table 4**) have shown that the concentrations of Trace elements in the teeth varies from one person to a different person then it's proved that it identify a person and considered for biometrics. This also provide ancillary information to the primary biometrics and also it can be often used with the primary biometrics like iris, face and finger recognition. Two sets of data analysis showed that concentrations of Ca, K, Mg, Sr .Na , P, Cl and Mn remain stable within the age group of 16 to 58 years. The analyses of, primary and permanent teeth, elements in hair and nails are attractive in the research fields of environmental exposure and helpful in biomonitoring of elements in various age groups and are those are given much attention as non-invasive methods allowing to find the health status of human beings.

The results of this can be trained using Aritificial techniques to automatically identify a person.

**Table 1 statistical parameters of Mg .Cl ,Mn,k, Na, Sr,P and Ca**

**Mass fractions (g kg-1, dry mass basis) in the intact roots of female permanent teeth**

**Element Mean STD Mini Maxi Medi**

Cl 0.793 0.415 0.220 2.12 0.614

Ca 286 41.1 209 356 2830

Mn 0.0010 .0006 0.0002 0.0032 0.0010

Mg 8.32 1.89 4.08 12.3 8.24

K 0.893 0.307 0.075 1.34 0.943

P 152 23.2 89.9 227 148

Na 7.35 2.33 4.85 13.9 6.69

Sr 0.425 0.204 0.149 0.911 0.348

El element Mean arithmetic mean, STD standard deviation, Mini minimum value,

Maxi maximum value, Medi median,l,

**Table 2 Mean values (Mean ± SEM) of chemical element mass fractions in the intact roots of female**

**permanent teeth for different age groups (g kg-1, dry mass basis)** SEM standard error of mean,

Age

(years)

n Ca Cl K Mg Mn Na P Sr

51–55 5 264 ± 12 0.62 ± 0.08 0.87 ± 0.15 8.21 ± 0.62 0.00107 ± 0.00020 7.35 ± 1.57 147 ± 7 0.587 ± 0.084

46–50 6 303 ± 18 0.62 ± 0.10 0.87 ± 0.18 6.70 ± 0.74 0.00070 ± 0.00018 8.12 ± 0.64 146 ± 6 0.380 ± 0.118

41–45 5 254 ± 5 1.13 ± 0.16 0.73 ± 0.18 7.73 ± 0.59 0.00094 ± 0.00006 6.12 ± 0.37 133 ± 11 0.433 ± 0.096

36–40 4 285 ± 23 0.50 ± 0.15 0.90 ± 0.08 8.27 ± 1.17 0.00119 ± 0.00067 8.17 ± 1.64 154 ± 9 0.531 ± 0.090

31–35 5 336 ± 18 0.88 ± 0.13 1.11 ± 0.21 9.97 ± 0.7 20.00081 ± 0.00019 6.96 ± 0.24 171 ± 12 0.276 ± 0.030

26–30 4 291 ± 25 1.28 ± 0.49 1.00 ± 0.10 8.54 ± 0.67 0.00103 ± 0.00047 6.61 ± 0.71 151 ± 10 0.383 ± 0.064

21–25 4 291 ± 42 0.52 ± 0.06 0.80 ± 0.12 9.11 ± 1.72 0.00104 ± 0.00051 9.27 ± 2.38 177 ± 27 0.424 ± .116

15–20 5 280 ± 15 0.95 ± 0.23 1.00 ± 0.06 10.16 ± 0.64 0.00096 ± 0.00004 6.02 ± 0.61 153 ± 3 0.281 ± 0.045

**Table 3** *Basic statistical parameters of, Cl, Ca K, Mg, Mn, P, Sr and Na mass fraction (g/kg, dry*

*mass basis) in the intact roots of male permanent teeth.*

**Cl K Ca Mn Na P Sr Mg**

***M 2888 742 348 3.64 6184 177 259 5255***

***STD 1159 514 31.9 2.91 1288 29.7 236 2035***

***SEM 178 83 4.9 0.45 198 4.6 36 314***

***Mini 942 147 295 0.193 2548 110 29 2063***

***Maxi 5352 2767 436 11.2 11116 247 985 10908***

***Medi 3022 681 344 2.66 6034 176 164 5214***

*M: Arithmetic Mean; STD: Standard Deviation; ; Mini: Minimum Value;*

*Maxi: Maximum Value; Medi: Median*

**Table 4 Mean values (M ± SEM) of chemical element mass fractions in the intact roots of male**

**permanent teeth for different age ranges (g kg-1, dry mass basis)** SEM standard error of mean,

Age

(years)

n Ca Cl K Mg Mn Na P Sr

*51–55 6 348 ± 11 2433 ± 440 539 ± 130 6490 ± 1013 3.21 ± 1.34 6200 ± 612 167 ± 8 151 ± 35*

*46–50 5 341 ± 4 3153 ± 423 538 ± 83 5600 ± 686 5.19 ± 1.79 5952 ± 298 166 ± 10 241 ± 150*

*41–45 8 334 ± 9 2630 ± 318 586 ± 41 5785 ± 543 3.95 ± 0.97 6152 ± 855 166 ± 5 142 ± 23*

*36–40 5 346 ± 10 2490 ± 500 709 ± 333 4489 ± 813 2.76 ± 1.20 6221 ± 310 180 ± 3 376 ± 154*

*31–35 7 355 ± 19 3827 ± 600 974 ± 476 4880 ± 810 3.53 ± 1.42 6108 ± 388 195 ± 15 245 ± 97*

*26–30 5 370 ± 15 3528 ± 575 926 ± 110 5941 ± 1240 3.85 ± 1.48 6585 ± 279 200 ± 11 432 ± 107*

*21–25 5 361 ± 20 265 ± 470 991 ± 100 3403 ± 581 3.68 ± 0.87 6242 ± 495 184 ± 22 369 ± 164*

*15-20 5 326± 19 1793 ± 7 5 831 ± 168 4523 ± 1750 1.78 ± 0.81 5839 ± 252 148 ± 38 224 ± 6*

**Conclusion**

Accurate measurement and determination of trace element in human teeth is very important for identifying toxic and sub–toxic effects in the human body. This study identified a total of 8 trace elements in almost all tooth dentine samples. The findings and results of this study would be helpful for creating a biometric knowledgebase and also it will be useful in future biometrics if any new device will be found with the calculation capability of trace elements concentration in a human teeth of a alive person’s teeth. This area of research is at the intersection of several applied science and current fundamental and to solve many inquiries such as biochemistry ,metabolomics, medicine toxicology, environmental exposure , health physics, environmental and food science Very few studies have been reported for the elemental analysis of Tooth samples and hence it remains helpful for the further area of researches. It is also useful to analyse various diseases in human beings.

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**Ethical Statement**

This manuscript does not contain samples that were obtained from clinical studies and no personally identifiable patient data is included.

**Conflict of Interest**

The authors declare that they have no conflict of interest.

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