

ENERGY DISPERSIVE X-RAY ANALYSIS OF HUMAN HAIR

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Abstract: This paper reports data on elements presents in male human hair of different age 0.6year, 5 year, 30 year and 50 year respectively. For this purpose, Energy dispersive X- ray spectrometer is employed which gives percentage of elements suggests in homogeneity in molecular composition (both inorganic and organic) of these hairs.

Keywords: EDXA, Elements, Calcium Phosphate.

1-Introduction

Energy dispersive X-ray spectroscopy (E D X) is an analytical technique used for the elemental analysis of a sample. As a type of spectroscopy, it relies on the investigation of a sample through interactions between electromagnetic radiation and matter, analyzing x-rays emitted by the matter in response to being hit with charged particles. Its characterization capabilities are due in large part to the fundamental principle that each element has a unique atomic structure allowing x-rays that are characteristic of an element's atomic structure to be identified uniquely from each other. To stimulate the emission of characteristic X-rays from a specimen, a high energy beam of charged particles such as electrons or a beam of X-rays, is focused into the sample being studied. At rest, an atom within the sample contains ground state (or unexcited) electrons in discrete energy levels or electron shells bound to the nucleus. The incident beam may excite an electron in an inner shell, ejecting it from the shell while creating an electron hole where the electron was. An electron from an outer, higher-energy shell then fills the hole, and the difference in energy between the higher-energy shell and the lower energy shell may be released in the form of an X-ray. The number and energy of the X-rays emitted from a specimen can be measured by an energy dispersive spectrometer. As the energy of the X-rays are characteristic of the difference in energy between the two shells, and of the atomic structure of the element from which they were emitted, this allows the elemental composition of the specimen to be measured. Giround et al (1934) [1]observed that the process of keratinisation produces many varieties of structures which can be classified,

physically and chemically, as the medually or schizo – keratins and the herd or sclero – keratins.

Marshall (1983)[3] worked on characterization of proteins of human hair and nail by electrophoresis. The heavy metals in biological samples like nails, teeth, and hair were examined by Barbara Nowak (1996). Investigations of biological samples (hair 249 samples, teeth 145, nail 80 samples) were provided for inhabitants of selected towns in Beskid Slaski. The towns are small mountain towns in southern Poland Wista, Szczyrk, Istebna, Koniaków, and Jaworzynka. Analysis of ANOVA and MANOVA variances were used for biological samples in the context of age, sex, and type of samples for 12 elements (Pb, Cd, Cr, Zn, Fe, Cu, Mn, Ni, Co, Ca, Na, and K). The matrix correlation and cluster analysis were applied to explain the behavior of metals in human hair, teeth, and nails. Takagi et. al (1988)[4] presented with references that the evaluation of trace metals in human tissues as hair. Fraster et. al (2006)[5] study the isotopic composition of hair.

3. Materials & Methods

Four Scalp hairs from each of 4 individuals (4males) were collected. These four hairs were taken from 4different persons of minimum and maximum age of 0.6year, 5 year, 30 year and 50 year respectively. For experimental analysis hair were properly cleaned to remove dust oil and greasy material. The sample is cut in to very small pieces suitable for EDX instruments. Specimens were mounted on aluminium stubs using double adhesive tape, coated with gold in vacuum evaporated Hitachi HUS- 5GB and EDX studies were carried out on OXFORD LINK- ISIS EDX fitted to Hitachi S-520 scanning electron microscope.

The spot mode operation was used for elements suspected to be concentrated in very small regions. For this purpose, spots were selected. Figs. 1.1-1.4 show scanning electron micrographs (SEM) and Figs. 2.1- 2.4 shows spectra of hair of different age groups. The area in which measurements of elements was made can be seen in Figs. 1.1.-1.4.

Table1. reports data on 18 different elements present in hair under study. The concentration of the elements is in weight percentage.

3. Results & Discussion

In the study of energy dispersive X-ray analysis of the human hair, of different age males, 18 elements are found. Table 1.1. reports the data on Eighteen different elements present in male human hair of different age determined by employing energy dispersive x-ray analysis. Of all elements analyzed C and O in general, are found to be more in quantity while Na is less. The percentage of carbon is more i.e., 38% to 48% when compared to other elements. The

interesting feature is that, in children, the quantity of carbon is less, when compared with adults and it goes on 48 increases with increase in age. The carbon isotopes of human hairs hold dietary information related to both food sources and dietary practices in a region. The carbon content in all the age group is not different, but increases with aging. The increasing carbon content with ongoing age could be explained by loss of inorganic material from the hair, followed by a subsequent increase of organic materials. Oxygen is the second highest quantity present in human hair, when compared with the other elements

The element Si is present in almost all in hairs specimens and it ranges from 0.13% to 1% in adults, but in children its value is more. Silicon was suggested to have an important function in the formation and maintenance of connective tissue. Sulphur is the third dominating element in human hairs and it is ranging from 3.83% to 8.14%. The occupation of a human being and the expose to harmful substances will decreases the level of sulphur by the diminution of sulphur proteins in the hairs. This is due to the damage of bonds by acids and alkaline groups leading to structural abnormalities in the hair. The interesting feature is that 50year hair sample has more sulphur than children. The element Cl is ranging from 0.07 to 1.5% human finger hair, of adult males. The quantity is more in children. The element Cl is ranging from 0.07 to 1.5% human finger hair, of adult males. The quantity is more in children. The Ca is a close range of 0.09 to 0.92%. But the amount of calcium is more in adults. It is known that calcium is an important element in the biological systems and plays vital role as structural material. It is in abundant quantity, in hard tissue such as bone, horn, hoof, hair, molluscan shells etc.

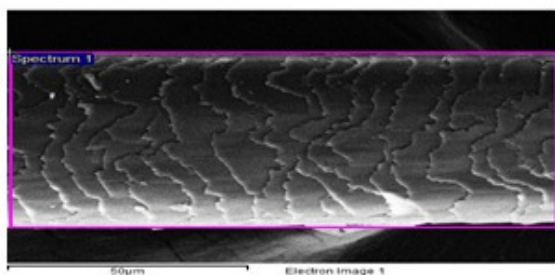


Fig.1.1 SEM Micrograph of hair of age 0.5 years Male Hair of age 0.5 yr

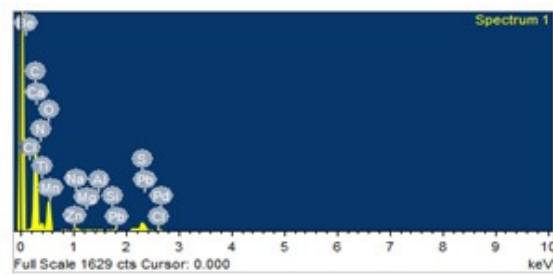
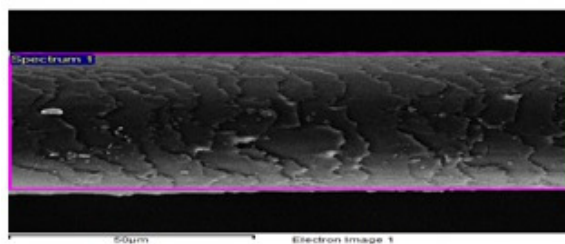


Fig:2.1 EDXA Spectrum of



**Fig.1.2 SEM Micrograph of hair of age 5 years
Spectrum of Male Hair of age 5 yrs**

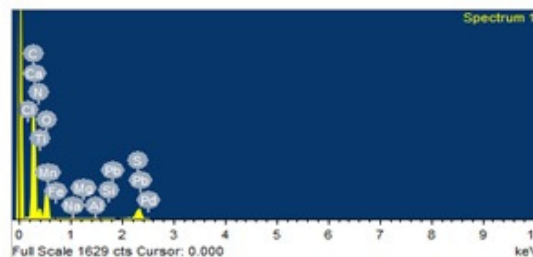
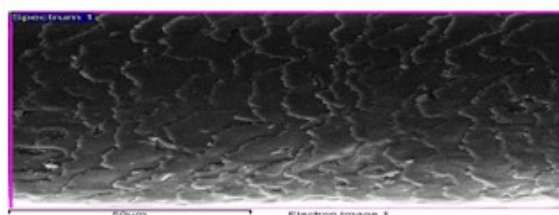


Fig:2.2 EDXA



**Fig.1.3 SEM Micrograph of hair of age 30 years
Male Hair of age 30 yrs**

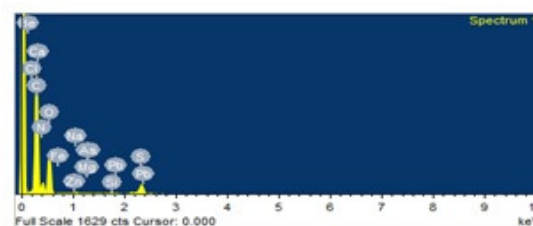
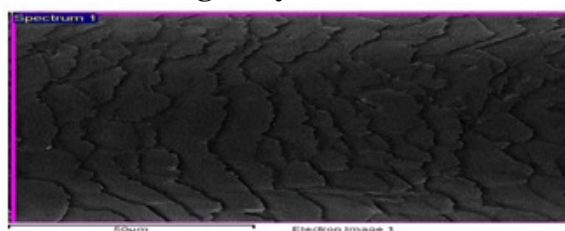


Fig:2.2 EDXA Spectrum of



**Fig.1.4 SEM Micrograph of hair of age 50 years
Male Hair of age 50 yrs**

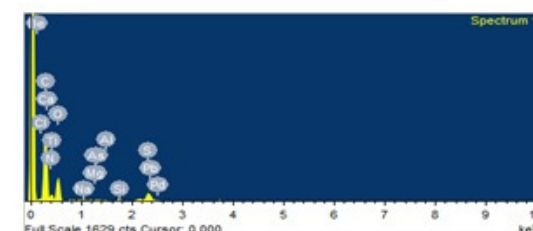


Fig:2.4 EDXA Spectrum of

Table 1-Data on elements of hair in weight percentage

Element	Weight(%)			
	6Months	5year	30 year	50 year
C	46.70	37.50	48.31	41.20
N	20.80	15.03	19.85	14.11
O	22.84	31.58	26.27	34.00
Na	0.05	0.62	0.16	0.03
Mg	0.05	0.26	0.04	0.8
Al	0.02	0.19	-----	00.03
Si	0.09	0.16	0.03	0.06
S	4.32	6.04	3.83	8.14

Cl	0.24	1.50	0.07	0.49
Ca	0.09	0.24	0.32	0.56
Ti	-----	0.15	-----	0.42
Mn	1.72	4.63	-----	-----
Fe	1.54	1.83	0.37	-----
Zn	0.22	0.05	0.11	-----
Pd	-----	0.25	-----	0.36
Pb	1.24	0.02	0.57	0.11
As	0.09	-----	0.07	0.08
Cd				0.04

References

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